PRG 25
CSE (M.Tech)
COURSE STRUCTURE

GEETHANJALI INSTITUTE OF SCIENCE & TECHNOLOGY
(Autonomous)
Unit of USHODAYA EDUCATIONAL SOCIETY
An ISO 9001:2015 certified Institution: Recognized under Sec. 2(f)& 12(B) of UGC Act, 1956
3rd Mile, Bombay Highway, Gangavaram (V), Kovur(M), SPSR Nellore (Dt), Andhra Pradesh, India- 524137
E-Mail: geethanjali@gist.edu.in, Website: www.gist.edu.in

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Vision

To evolve as a leading computer science and engineering centre producing competent technocrats to meet the demands of ever-changing industry and society.

Mission

DM1: Imparting quality education through innovative teaching learning processes.

DM2: Motivating students to upgrade their technical expertise by promoting learner centric activities.

DM3: Inculcating ethical values and interpersonal skills in the learners.

DM4: upgrading knowledge in cutting edge technologies keeping pace with industrial standards.

Program Educational Outcomes

PEO1: Outperform in professional career or higher learning by upgrading skills in Computer Science and Engineering stream

PEO2: Provide computing solutions for complex problems to meet industry demands and societal needs.

PEO3: Offer ethical, socially sensitive solutions as professionals and as entrepreneurs in Computer Science and other engineering disciplines.

PEO4: Leverage new computing technologies by engaging themselves in perpetual learning.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Apply the expertise in adaptive algorithms to develop quality software applications.

PSO2: Get employed or become an entrepreneur through their capabilities in basic and advanced technologies.

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I Year I Semester (Theory-4, Lab-2, MC-2)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PC	25D5801T	Advanced Data Structures & Algorithms	3	0	0	3
2	PC	25D5802T	Distributed Operating Systems	3	0	0	3
3	PE	25D5803Ta 25D5803Tb 25D5803Tc	**Program Elective-I** 1.Advanced Computer Architecture 2. Enterprise Cloud Concepts 3.Applied Machine Learning	3	0	0	3
4	PE	25D5804Ta 25D5804Tb 25D5804Tc	**Program Elective-II** 1.Natural Language Processing 2.Smart Sensor Networks &IoT 3.Computing for Data Analytics	3	0	0	3
5	PC	25D5805P	Advanced Data Structures & Algorithms Lab	0	0	4	2
6	PC	25D5806P	Distributed Operating Systems Lab	0	0	4	2
7	MC	25MMC01	Research Methodology and IPR	2	0	0	2
8	SE	25D5807P	Full stack Development Using MERN	0	1	2	2
9	AC	25MAC01 25MAC02 25MAC03	**Audit Course – I** English for Research Paper Writing Disaster Management Essence of Indian Traditional Knowledge	2	0	0	0
Total				**16**	**1**	**10**	**20**

Category	**Credits**
Professional Core Courses(PC)	10
Professional Elective Courses(PE)	6
Skill Enhancement Course(SE)	2
Mandatory Course(MC)	2
Audit Course (AC)	0
Total	20

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I Year II Semester (Theory-4, Lab-2, MC-1)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PC	25D5808T	Advances in Software Engineering	3	0	0	3
2	PC	25D5809T	Advanced Databases	3	0	0	3
3	PE	25D5810Ta 25D5810Tb 25D5810Tc	**Program Elective – III** 1. Block Chain Technology 2. Advanced Computer Networks 3. Deep Learning and Applications	3	0	0	3
4	PE	25D5811Ta 25D5811Tb 25D5811Tc	**Program Elective – IV** 1. Generative AI 2. Digital Forensics 3. Robotic Process Automation	3	0	0	3
5	PC	25D5812P	Advance in Software Engineering Lab	0	0	4	2
6	PC	25D5813P	Advanced Databases Lab	0	0	4	2
7	MC	25D5814	Quantum Technologies And Applications	2	0	0	2
8	PC	25D5815	Comprehensive Viva Voce	0	0	0	2
9	AC	25MAC04 25MAC05 25MAC06	**Audit Course – II**	2	0	0	0
Total				**16**	**0**	**8**	**20**
****Students have to undergo an Industry Internship after I Year II Semester for a duration of 6 to 8 weeks**							

Category	**Credits**
Professional Core Courses(PC)	12
Professional Elective Courses(PE)	6
Mandatory Course(MC)	2
Audit Course(AC)	0
Total	20

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II Year I Semester (Theory-2, PR-1)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PE	25D5816Ta 25D5816Tb 25D5816Tc	**Program Elective – V** 1.Software Defined Networks 2.Reinforcement Learning 3.Data Science	3	0	0	3
2	OE		**Open Elective - I**	3	0	0	3
3	PR	25D5817	Dissertation Phase – I	0	0	20	10
4		25D5818	Industry Internship	0	0	0	2
5		25D5819	Co-curricular Activities	0	0	0	1
Total				**6**	**0**	**20**	**19**

Category	**Credits**
Professional Elective Courses(PE)	3
Open Elective Courses(OE)	3
Project work (PR)	10
	3
Total	19

II Year II Semester (PR-1)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PR	25D5820	Dissertation Phase – II	-	-	32	16
Total							16

OPEN ELECTIVE OFFERED TO OTHER DEPARTMENS

- **Advanced Data Structures & Algorithms**
- **Cloud Computing**

PRG 25
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COURSE SYLLABUS

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M.Tech I Year I Semester

ADVANCED DATA STRUCTURES AND ALGORITHMS
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5801T	3:0:0:0	3	CIE: 30 SEE:70	3 Hours	PC

Course Objectives:

This course will enable students:

- Introduce fundamental data structures including linked lists, stacks, queues, trees, graphs, dictionaries, and hashing techniques.
- Develop algorithmic skills for designing and analyzing searching, sorting, and traversal methods.
- Teach implementation of priority queues, binary search trees, and balanced trees (AVL, Red-Black, Splay, B-Trees).
- Enable students to select and apply appropriate data structures for solving computational problems efficiently.
- Foster understanding of the performance analysis and comparative evaluation of data structures and algorithms.

Course Outcomes(CO):

On completion of this course, student will be able to:

- **CO1:** Implement and manipulate linear data structures like singly/doubly linked lists, circular lists, stacks, and queues using dynamic memory allocation.
- **CO2:** Apply and analyze searching and sorting algorithms including linear, binary search, bubble, selection, insertion, quick, and merge sort.
- **CO3:** Design and implement dictionaries and hashing techniques to efficiently store and retrieve data.
- **CO4:** Construct and operate on trees and priority queues, performing insertion, deletion, and traversal operations.
- **CO5:** Compare and implement balanced search trees (AVL, Red-Black, Splay, B-Trees) for optimized data access and storage.

Syllabus		Total Hours:48
Unit-I	**Introduction**	**10Hrs**
Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.		
Unit-II	**Searching and Sorting**	**9Hrs**
Linear and Binary, Search Methods, Sorting: -Basic sorting techniques, Radix Sort, Bucket Sort, Shell Sort Trees- Binary trees, Properties, Representation and Traversals, Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals		
Unit-III	**Dictionaries and Hashing**	**10Hrs**
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		
Unit-IV	**Priority queues**	**10Hrs**
Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion .Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion		

Unit-V	Search Trees	9Hrs
AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees		

Text Books:

1. Data Structures: A Pseudo Code Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon and Cengage
2. Data Structures, Algorithms and Applications in java, 2/e, SartajSahni, University Press

Reference Books:

1. Data Structures and Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson.
2. Data Structures and Algorithms, 3/e, Adam Drozdek, Cengage
3. C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co.

M.Tech I Year I Semester

DISTRIBUTED OPERATING SYSTEMS (Common to M.Tech CSE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
25D5802T	**3:0:0:0**	**3**	**CIE: 30 SEE:70**	**3 Hours**	**PC**

Course Objectives:

This course will enable students to:

- Introduce the architectures, principles, and design issues of distributed, database, and multiprocessor operating systems.
- Develop an understanding of communication, synchronization, deadlock handling, and agreement protocols in distributed environments.
- Explain distributed resource management, shared memory, scheduling, and fault tolerance techniques.
- Provide knowledge of security and protection models, and cryptographic methods for secure distributed computing.
- Explore the structure and design issues of multiprocessor and database operating systems with concurrency control mechanisms.

Course Outcomes(CO):

On completion of this course, student will be able to

- **CO1:** Explain the architectures, limitations, and synchronization mechanisms (logical clocks, mutual exclusion) in distributed systems.
- **CO2:** Analyze distributed deadlock detection methods, agreement protocols, and distributed resource management techniques.
- **CO3:** Apply concepts of distributed shared memory, scheduling, and fault-tolerance techniques for reliable system design.
- **CO4:** Evaluate models of protection, access control, and cryptographic algorithms for ensuring data security in distributed systems.
- **CO5:** Compare multiprocessor and database operating systems, and analyze concurrency control algorithms for distributed databases.

Syllabus	**Total Hours:48**
Unit-I	**9Hrs**
Architectures of Distributed Systems, System Architecture types, issues in distributed operatingsystems,communicationnetworks,communicationprimitives.TheoreticalFoundations,inherentlimitations of a distributed system, lamp ports logical clocks, vector clocks, casual ordering of messages, global state, cuts of a distributed computation, termination detection	
Unit-II	**8Hrs**
Distributed Mutual Exclusion: The Classification of Mutual Exclusion Algorithms, Non-Token – Based Algorithms: Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm, Token-Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal'sHeurisric Algorithm, Raymond's Heuristic Algorithm	
Unit-III	**8Hrs**
Distributed Deadlock Detection: Preliminaries, Deadlock Handling Strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control Organizations for Distributed Deadlock Detection, Centralized- Deadlock – Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms	
Unit-IV	**8Hrs**
Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, Basic Multiprocessor System Architectures Multi Processor Operating Systems: Introduction, Structures of Multiprocessor Operating Systems, Operating Design Issues, Threads, Process Synchronization,	

Processor Scheduling. Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues

Unit-V		**9Hrs**

Distributed Scheduling: Issues in Load Distributing, Components of a Load Distributed Algorithm, Stability, Load Distributing Algorithms, Requirements for Load Distributing, Task Migration, Issues in task Migration Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues

Text Books:

1. Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", Mukesh Singhal, Niranjan and G.Shivaratri, TMH, 2001
2. **Andrew S. Tanenbaum, Maarten Van Steen**, *Distributed Systems: Principles and Paradigms*, Pearson Education, 2nd Edition, 2006.

Reference Books:

1. **Andrew S. Tanenbaum, Maarten Van Steen**, *Distributed Systems: Principles and Paradigms*, Pearson Education, 2nd Edition, 2006.
2. **Silberschatz, Galvin, Gagne**, *Operating System Concepts*, Wiley, 9th Edition, 2018.
3. **M. Mitzenmacher, E. Upfal**, *Probability and Computing: Randomized Algorithms and Probabilistic Analysis*, Cambridge University Press, 2005.
4. **Alan Tucker**, *Applied Combinatorics*, John Wiley & Sons, 5th Edition, 2007.
5. **Nancy A. Lynch**, *Distributed Algorithms*, Morgan Kaufmann, 1996.
6. **George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair**, *Distributed Systems: Concepts and Design*, Pearson, 5th Edition, 2011.

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M.Tech I Year I Semester

ADVANCED COMPUTER ARCHITECTURE
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5803Ta	3:0:0:0	3	CIE: 30 SEE:70	3 Hours	PE

Course Objectives:

This course will enable students to:

- To impart the concepts and principles of parallel and advanced computer architectures.
- To develop the design techniques of Scalable and multithreaded Architectures.
- To apply the concepts and techniques of parallel and advanced computer architectures to design modern computer systems

Course Outcomes(CO):

On completion of this course, student will be able to

- Analyze various parallel computer models, program partitioning techniques, and system interconnect architectures to evaluate conditions for parallelism.
- Apply performance metrics and scalability analysis to assess parallel processing applications using advanced processor and memory technologies.
- Design and differentiate linear, non-linear, instruction, and arithmetic pipelines to enhance execution performance in modern processors.
- Examine multiprocessor and multicomputer architectures, cache coherence protocols, and synchronization mechanisms for scalable system design.
- Evaluate vector and SIMD processing principles through case studies like CM-5 to identify their effectiveness in solving computationally intensive applications.

Syllabus		Total Hours:48
Unit-I	**Micro Processors**	**10Hrs**

Theory of Parallelism, Parallel computer models, The State of Computing, Multiprocessors and Multi computers, Multi vector and SIMD Computers, PRAM and VLSI models, Architectural development tracks, Program and network properties, Conditions of parallelism, Program partitioning and Scheduling, Program flow Mechanisms, System interconnect Architectures

Unit-II	**Parallel Processing**	**10Hrs**

Principles of Scalable performance, Performance metrics and measures, Parallel Processing applications, Speed up performance laws, Scalability Analysis and Approaches, Hardware Technologies, Processes and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors

Unit-III	**Pipeline Processors**	**10Hrs**

Shared-Memory Organizations, Sequential and weak consistency models, Pipelining and superscalar techniques, Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, superscalar pipeline design

Unit-IV	**Architecture of Microprocessors**	**09Hrs**

Parallel and Scalable Architectures, Multiprocessors and Multi computers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multi computers, Message-passing Mechanisms, Multi vector and SIMD computers

Unit-V	**Applications**	**9Hrs**

Vector Processing Principles, Multi vector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5.

Text Books:

1. Advanced Computer Architecture, Kai Hwang, 2nd Edition, Tata McGraw Hill Publishers..

Reference Books:

1. Computer Architecture, J.L. Hennessy and D.A. Patterson, 4th Edition, ELSEVIER.
2. Advanced Computer Architectures, S.G.Shiva, Special Indian edition, CRC, Taylor &Francis.
3. Introduction to High Performance Computing for Scientists and Engineers, G. Hager and G.Wellein, CRC Press, Taylor & Francis Group.
4. Advanced Computer Architecture, D. Sima, T. Fountain, P. Kacsuk, Pearson education.
5. Computer Architecture, B. Parhami, Oxford Univ. Press.

M.Tech I Year I Semester

ENTERPRISE CLOUD CONCEPTS (Common to M.Tech CSE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
25D5803Tb	**3:0:0:0**	**3**	**CIE: 30 SEE:70**	**3 Hours**	**PE**

Course Objectives:

This course will enable students to:

- Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes(CO):

After completion of the course, students will be able to

- Understand importance of cloud architecture
- Illustrating the fundamental concepts of cloud security
- Analyze various cloud computing mechanisms
- Understanding the architecture and working of cloud computing.

Syllabus	**Total Hours:48**
Unit-I	**9Hrs**

Understanding Cloud Computing: Origins and influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges. Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

Unit-II	**09Hrs**

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology CLOUD COMPUTING MECHANISMS: Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication

Unit-III	**10Hrs**

Cloud Management Mechanisms: Remote Administration System, Resource Management System, SLA Management System, Billing Management System, Case Study Example

Cloud Computing Architecture
Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture, Case Study Example

Unit-IV	**10Hrs**

Cloud-Enabled Smart Enterprises Introduction, Revisiting the Enterprise Journey, Service-Oriented Enterprises, Cloud Enterprises, Smart Enterprises, The Enabling Mechanisms of Smart Enterprises Cloud-Inspired Enterprise Transformations Introduction, The Cloud Scheme for Enterprise Success, Elucidating the Evolving Cloud Idea, Implications of the Cloud on Enterprise Strategy, Establishing a Cloud-Incorporated Business Strategy

Unit-V	**9Hrs**

Transitioning to Cloud-Centric Enterprises The Tuning Methodology, Contract Management in the Cloud Cloud-Instigated IT Transformations Introduction, Explaining Cloud Infrastructures, A Briefing on Next-Generation Services, Service Infrastructures, Cloud Infrastructures, Cloud Infrastructure Solutions, Clouds for Business Continuity, The Relevance of Private Clouds, The

Emergence of Enterprise Clouds
Text Books: 1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham, Cloud Computing: Concepts, Technology & Architecture 1st Edition, 2. Pethuru Raj, Cloud Enterprise Architecture, CRC Press
Reference Books: 1. James Bond, The Enterprise Cloud, O'Reilly Media, Inc.

APPLIED MACHINE LEARNING
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5803Tc	3:0:0:0	3	CIE: 30 SEE:70	3 Hours	PE

Course Objectives:

This course will enable students to:

- To know the fundamental concepts of Machine Learning.
- To understand linear, distance based, and decision tree based models
- To explore tools and practices for Machine learning in Real world situation.
- To know the Artificial Neural Network and Reinforcement Learning.

Course Outcomes(CO):

After completion of the course, students will be able to

- Understand the fundamental concepts of machine learning
- Apply linear, distance based, and decision tree based models
- Analyze probabilistic, neural network models
- Design a suitable machine learning model for a given scenario

Syllabus	Total Hours:48
Unit-I	**9Hrs**
Introduction to Machine Learning: Introduction. Different types of learning, Examples of Machine Learning Applications Supervised Learning: Learning a Class from Examples, Probably Approximately Correct Learning, Learning multiple classes, Model selection and generalization Regression: Linear regression, Multiple Linear regression, Logistic Regression	
Unit -II	**09Hrs**
The ingredients of machine learning: Tasks, Models, Features Binary classification and related tasks: Classification, Assessing classification performance, Visualizing classification performance Beyond binary classification: Multi-class classification, Regression, Unsupervised and descriptive learning	
Unit -III	**10Hrs**
Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Inductive bias in decision tree, Issues in decision tree learning. Linear models: The least-squares method, Multivariate linear regression, The perceptron, Support vector machines, Soft margin SVM, Going beyond linearity with kernel methods.	
Unit-IV	**10Hrs**
Distance Based Models: Introduction, Neighbours and exemplars, Nearest Neighbours classification, K-Means algorithms, Clustering around medoids Probabilistic Models: Using Naïve Bayes Model for classification, Expectation Maximization, Gaussian Mixture models	
Unit-V	**9Hrs**
Artificial Neural Networks: Introduction, Neural network representation, appropriate problems for neural network learning, Multilayer networks and the back propagation, Advanced topics in Artificial Neural Networks Reinforcement Learning: Introduction, Learning tasks, Q-learning	

Text Books:

1. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education .

Reference Books:

1. AurélienGéron, Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. EthemAlpaydın, Introduction to machine learning, second edition, MIT press.
4. T. Hastie, R. Tibshirani and J. Friedman, "Elements of Statistical Learning", Springer Series, 2nd edition

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M.Tech I Year I Semester

NATURAL LANGUAGE PROCESSING
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5804Ta	3:0:0:0	3	CIE: 30 SEE:70	3 Hours	PE

Course Objectives:

This course will enable students to:

- Introduce the fundamental concepts of human language, linguistic structures, and their computational representation for Natural Language Processing.
- Develop knowledge of grammars, parsing strategies, semantic interpretation, and language modelling techniques for designing NLP systems.
- Explore advanced NLP applications such as machine translation, multilingual information retrieval, and cross-lingual language processing.

Course Outcomes(CO):

After completion of the course, students will be able to

- **Understand linguistic foundations** of English syntax and various levels of language analysis for Natural Language Processing.
- **Apply parsing techniques** such as top-down, bottom-up, ATNs, and feature-based systems for grammatical analysis of natural language.
- **Analyse different grammar formalisms and parsing approaches** to handle language phenomena like movement, ambiguity, and human preferences in parsing.
- **Construct semantic representations** using logical forms, thematic roles, and speech acts, and apply n-gram and statistical models for language modeling.
- **Evaluate and compare machine translation approaches** and demonstrate understanding of systems like Anusaraka for multilingual language processing.
- **Implement and analyze multilingual information retrieval systems**, applying appropriate pre-processing, evaluation metrics, and tools for cross-lingual retrieval

Syllabus	Total Hours:48
Unit-I	**9Hrs**
The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax	
Unit-II	**09Hrs**
Grammars and Parsing- Top-Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayes Rule, Shannon game, Entropy and Cross Entropy.	
Unit-III	**10Hrs**
Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers	

Unit-IV		**10Hrs**
Semantic Interpretation: Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts &embedded sentences, Defining semantics structure model theory. **Language Modelling:** Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modelling Problems, Multilingual and Cross lingual Language Modelling.		
Unit-V		**9Hrs**
Machine Translation Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges. **Multilingual Information Retrieval:** Introduction, Document Pre-processing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software and Resources.		

Text Books:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2. Multilingual Natural Language Processing Applications: From Theory To Practice-Daniel M.Bikel and ImedZitouni, Pearson Publications.
3. Natural Language Processing, Apaninian perspective, AksharBharathi, Vineetchaitanya, Prentice–Hall of India.

Reference Books:

1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky,Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008.
3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

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M.Tech I Year I Semester

SMART SENSOR NETWORKS & IOT
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5804Tb	3:0:0:0	3	CIE: 30 SEE:70	3 Hours	PE

Course Objectives:

This course will enable students to:

- To provide an in-depth understanding of IoT concepts, applications, and research areas in domains such as smart cities, smart health, smart energy, and smart transportation.
- To analyze IoT system architectures, design constraints, physical devices, communication protocols, and middleware for advanced implementation.
- To explore industrial and commercial IoT applications, including automation, sensor networks, and emerging trends like edge computing, cloud of things, and digital twins.

Course Outcomes(CO):

On completion of this course, student will be able to

- Explain the fundamental concepts, applications, and research areas of IoT across various domains.
- Analyze IoT reference architectures, functional and deployment views, and real-world design constraints including hardware, technical, and operational limitations.
- Demonstrate practical knowledge of IoT devices, programming, operating systems, communication protocols, network security, and database management.
- Apply IoT principles to industrial automation and enterprise integration using frameworks such as SOCRADES and IMC-AESOP.
- Evaluate case studies in commercial building automation and emerging IoT trends, including edge/fog computing, predictive maintenance, and digital twin technologies.

Syllabus	Total Hours:48
Unit-I	**9Hrs**

Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit-II	10Hrs

Real-World Design Constraints- Introduction, Technical Design constraints, hardware, Data representation and visualization, Interaction and remote control.

Unit-III	9Hrs

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, **Routing:** Transport Protocols, Network Security, Middleware, Databases

Unit-IV		**10Hrs**
Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation-Introduction,		
Unit-V		**10Hrs**
Case study: phase one-commercial building automation today. **Case study:** phase two commercial building automation in the future. Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.		

Text Books:

1. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication
2. Internet of Things: A Hands-On Approach Paperback – 2015, by ArsheepBahga (Author), Vijay Madisetti (Author)
3. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017 ,by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author).

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M.Tech I Year I Semester

COMPUTING FOR DATA ANALYTICS
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5804Tc	3:0:0:0	3	CIE: 30 SEE:70	3 Hours	PE

Course Objectives:

This course will enable students to:

- Provide knowledge of the **data analytics lifecycle**, including business understanding, data science roles, and project deliverables.
- Develop a strong foundation in **statistical methods, probability, and hypothesis testing** for data-driven decision-making.
- Equip students with skills to apply **predictive analytics, regression, time series forecasting, and experimental design techniques** to real-world datasets.

Course Outcomes(CO):

On completion of this course, student will be able to

- **Understand the data analytics lifecycle** and identify the roles and responsibilities of data scientists in business analytics projects.
- **Apply statistical techniques** such as measures of central tendency, variation, skewness, and kurtosis for data summarization and interpretation.
- **Analyze probability distributions** (binomial, Poisson, normal, exponential, gamma, etc.) and apply them in modeling uncertain events.
- **Perform hypothesis testing and predictive analytics** using t-tests, chi-square tests, regression, correlation, and multiple correlation methods.
- **Design forecasting models** (moving average, exponential smoothing, seasonal trends) and conduct **design of experiments** (ANOVA, Latin square, factorial design) for analytical problem solving.

Syllabus		Total Hours:48
Unit-I	**DATA ANALYTICS LIFE CYCLE**	**10Hrs**

Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

Unit-II	**STATISTICS**	**9Hrs**

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

Unit-III	**PROBABILITY AND HYPOTHESIS TESTING**	**10Hrs**

Random variable, distributions, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang - Normal distribution.

Unit-IV	PREDICTIVE ANALYTICS	9Hrs
Sampling distribution – Estimation - point, confidence - Test of significance, 1& 2 tailed test, uses of t-distribution, F-distribution, $\chi 2$ distribution - Predictive modeling and Analysis - Regression Analysis, Correlation analysis, Rank correlation coefficient, Multiple correlation.		
Unit-V	**TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS**	**10Hrs**
Forecasting Models for Time series : MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classification, ANOVA, Latin square, Factorial Design		

Text Books:

1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., —Understanding Big Data, Mc Graw Hill, 2012.
2. Alberto Cordoba, —Understanding the Predictive Analytics Lifecycle, Wiley, 2014.
3. Eric Siegel, Thomas H. Davenport, —Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2013.

Reference Books:

1. James R Evans,—Business Analytics – Methods, Models and Decisions, Pearson 2013.
2. R. N. Prasad, Seema Acharya, —Fundamentals of Business Analytics, Wiley, 2015.
3. S M Ross, —Introduction to Probability and Statistics for Engineers and Scientists‖, Academic Foundation, 2011.
4. David Hand, HeikiMannila, Padhria Smyth, —Principles of Data Mining, PHI 2013.
5. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, —Forecasting methods and applications Wiley 2013(Reprint).
6. David Hand, HeikkiMannila, Padhraic Smyth, —Principles of Data mining, PHI 2013.

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M.Tech I Year I Semester

ADVANCED DATA STRUCTURES AND ALGORITHMS LAB (Common to M.Tech CSE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
25D5805P	**0:0:4:0**	**2**	**CIE: 30 SEE:70**	**3 Hours**	**PC**

Course Objectives:

This course will enable students to:

- To introduce students to the implementation of linear and non-linear data structures using linked representation.
- To provide practical knowledge on stack and queue operations and their applications in problem solving.
- To enable students to implement tree structures and perform operations like traversal, insertion, deletion, and balancing.
- To develop skills in implementing searching and sorting techniques to improve problem-solving efficiency.
- To expose students to advanced data structures such as AVL Trees, B-Trees, and Hashing for efficient storage and retrieval.
- To enhance the ability to design, test, and analyze algorithms for graph traversal and dictionary

Course Outcomes(CO):

On completion of this course, student will be able to

1. **Implement linear data structures** such as single, double, and circular linked lists to perform insertion, deletion, searching, and traversal operations.
2. **Apply stack and queue concepts** using linked lists to solve real-world computational problems such as expression evaluation and infix-to-postfix conversion.
3. **Develop and test tree-based and Graph-based data structures** including Binary Search Trees, AVL Trees, and B-Trees using recursive and iterative approaches, Graph traversals.
4. **Implement and compare searching and sorting techniques** to analyze their performance and efficiency.
5. **Apply hashing techniques** for efficient dictionary implementation and collision resolution.
6. **Analyze and evaluate the performance of different data structures** to select appropriate techniques for given computational problems.

Syllabus	**Total Hours:48**

Experiment 1:
Write a program to perform various operations on single linked list

Experiment 2:
Write a program for the following
a) Reverse a linked list
b) Sort the data in a linked list
c) Remove duplicates
d) Merge two linked lists

Experiment 3: Write a program to perform various operations on doubly linked list.

Experiment 4: Write a program to perform various operations on circular linked list.

Experiment 5: Write a program for performing various operations on stack using linked list.

Experiment 6: Write a program for performing various operations on queue using linked list.

Experiment 7: Write a program for the following using stack
a) Infix to postfix conversion.
b) Expression evaluation.

Experiment 8: Write a program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.

Experiment 9: Write a program to implement the following for a graph. a) BFS b) DFS

Experiment 10: Write a program to implement various Sorting Techniques

Experiment 11: Write a program to implement various Searching Techniques

Experiment 12: Write a program to implement various operations on AVL trees.

Experiment 13: Write a program to perform the following operations:
a) Insertion into a B-tree
b) Searching in a B-tree

Experiment 15: Write a program to implement all the functions of Dictionary (ADT) using Hashing.

Reference Books:

1. **Ellis Horowitz, SartajSahni, and SanguthevarRajasekaran** – *Fundamentals of Computer Algorithms*, Universities Press, 2008.
2. **Mark Allen Weiss** – *Data Structures and Algorithm Analysis in C++ / Java*, Pearson Education, 4th Edition, 2013.
3. **Seymour Lipschutz** – *Data Structures with C*, Schaum's Outline Series, McGraw Hill, 2011.
4. **Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein** – *Introduction to Algorithms*, MIT Press, 3rd Edition, 2009.

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M.Tech I Year I Semester

DISTRIBUTED OPERATING SYSTEMS LAB
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5806P	0:0:4:0	2	CIE: 30 SEE:70	3 Hours	PC

Course Objectives:

This course will enable students to:

- To provide hands-on experience in implementing synchronization, deadlock detection, and resource management algorithms in distributed and multiprocessor systems.
- To develop the ability to design and simulate mechanisms for fault tolerance, load balancing, task migration, and secure communication using cryptographic techniques.
- To enable students to apply concurrency control methods in distributed databases and critically analyze the performance of various distributed algorithms

Course Outcomes(CO):

On completion of this course, student will be able to

- Implement and analyze synchronization mechanisms in distributed environments.
- Develop and evaluate distributed deadlock detection techniques.
- Design and implement distributed shared memory models and scheduling algorithms.
- Apply security and cryptographic techniques to distributed systems.
- Implement concurrency control algorithms in database operating systems.
- Gain hands-on experience in developing efficient multiprocessor operating system components.

Syllabus **Total Hours:48**

List of Experiments

Unit I: Architectures & Synchronization

1. **Implementation of Lamport's Logical Clocks** – Simulate logical clock updates in a distributed system.
2. **Vector Clocks and Causal Ordering** – Implement vector clocks and analyze message ordering.
3. **Distributed Mutual Exclusion Algorithms** – Implement Ricart-Agrawala and Maekawa's mutual exclusion algorithms.

Unit II: Deadlock Detection & Resource Management

4. **Simulation of Distributed Deadlock Detection Algorithms** – Implement centralized and distributed deadlock detection techniques.
5. **Hierarchical Deadlock Detection** – Implement a hierarchical approach to detecting deadlocks in a distributed system.

Unit III: Shared Memory, Scheduling & Fault Tolerance

6. **Implementation of Load Balancing Algorithms** – Compare load balancing techniques (static and dynamic).
7. **Task Migration Mechanism** – Implement and analyze task migration in a distributed system.

Unit IV: Security & Cryptography

8. **Access Matrix Model Implementation** – Simulate access control using an access matrix.
9. **Implementation of Data Encryption Standard (DES) Algorithm** – Encrypt and decrypt messages using DES
10. **Public Key Cryptography using RSA** – Implement RSA encryption and authentication mechanisms

Unit V: Multiprocessor & Database OS

11. **Process Synchronization in Multiprocessor Systems** – Implement and analyze thread synchronization.
12. **Concurrency Control using Lock-Based Algorithms** – Implement two-phase locking protocol.
13. **Timestamp-Based Concurrency Control** – Develop a timestamp-based concurrency control mechanism.
14. **Optimistic Concurrency Control Algorithm** – Implement an optimistic concurrency control protocol.`

Reference Books:

1. **MukeshSinghal and Niranjan G. Shivaratri** – *Advanced Concepts in Operating Systems: Distributed, Database, and Multiprocessor Operating Systems*, McGraw Hill, 2001.
2. **Andrew S. Tanenbaum and Maarten Van Steen** – *Distributed Systems: Principles and Paradigms*, Pearson Education, 2nd Edition, 2007.
3. **George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair** – *Distributed Systems: Concepts and Design*, Pearson Education, 5th Edition, 2012.
4. **Pradeep K. Sinha** – *Distributed Operating Systems: Concepts and Design*, PHI Learning, 2008.

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M.Tech I Year I Semester

FULL STACK DEVELOPMENT USING MERN
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25D5807P	0:1:2:0	2	CIE: 30 SEE:70	3 Hours	SE

Course Objectives:

This course will enable students to:

- Provide strong foundations in web development technologies (HTML, CSS, JavaScript, ES6).
- Introduce server-side programming with Node.js and Express.js for building scalable applications.
- Enable students to work with relational (MySQL) and non-relational (MongoDB) databases.
- Impart skills to design and develop interactive user interfaces using ReactJS.
- Enhance problem-solving abilities through full-stack web application development experiments.

Course Outcomes(CO):

On completion of this course, student will be able to

- **CO1:** Apply fundamental web technologies (HTML, CSS, JavaScript, ES6) to design responsive web pages.
- **CO2:** Develop server-side applications using Node.js and Express.js with REST API integration.
- **CO3:** Perform database operations using MySQL and MongoDB and integrate them with backend services.
- **CO4:**Design and implement dynamic, component-based user interfaces using ReactJS.
- **CO5:** Develop and deploy full-stack applications by combining frontend, backend, and database skills.
- **CO6:** Demonstrate problem-solving, debugging, and version control skills in web development projects.

Syllabus **Total Hours:42**

Module 1: Web Development Fundamentals

Fundamentals of Web Design, Webpage and Website, Web application HTML Typography, Images, Tables, Lists, Hyperlinks etc. CSS Syntax and usage, CSS Selectors, CSS on body, CSS on Text, CSS on Links, CSS on Tables, CSS on Lists, CSS on Forms, CSS on Images, CSS on DIV, W3.CSS Framework

List of Experiments :

- **HTML & CSS Basics** – Create a personal portfolio webpage using HTML (headings, lists, tables, hyperlinks, forms) and style it with CSS selectors.
- **Responsive Layout** – Develop a responsive webpage using DIV, CSS box model, and W3.CSS framework.
- **Styled Components** – Design a webpage for a college event with images, tables, and styled navigation menu using CSS.

Module 2: JavaScript and ECMA Script 6

JavaScript Fundamentals - Grammar and types, Control flow and error handling - Loops, Function - Objects, Arrays, Promises - ES6 Let and const, Template literals - Arrow Function, Default parameter, Async Await

List of Experiments :

- **JavaScript Fundamentals** – Build a simple calculator app using functions, loops, and control flow.
- **Array & Object Manipulation** – Write a program using ES6 features (let/const, arrow functions, template literals) to manage student records.
- **Async Programming** – Create a webpage that fetches and displays random user data from a public API using Promises and Async/Await.

Module 3: Node.js

overview, Node.js - basics and setup - Node.js console, Node.js command utilities - Node.js modules, concepts - Node.js events, database access - Node.js with Express.js, Express.js Request/Response - Express.js Get, Express.js Post - Express.js Routing, Express.js Cookies - Express.js File Upload, Middleware - Express.js Scaffolding, Template

List of Experiments:

- **Node.js Basics** – Write a Node.js script to create a local server and display "Hello World" in the browser.
- **Express.js Routing** – Build a REST API with Express.js that handles GET and POST requests for a student information system.
- **File Handling** – Develop a Node.js application to upload, read, and display a text/JSON file using Express middleware.

Module 4: MySQL and MongoDB

MySQL Concepts - Create, Read, Update, Delete Operation - SQL and NoSQL concepts - Create and manage MongoDB - Migration of data into MongoDB - MongoDB with NodeJS - Services offered by MongoDB

List of Experiments :

- **MySQL CRUD** – Create a MySQL database for employee records and perform Create, Read, Update, Delete (CRUD) operations.
- **MongoDB CRUD with Node.js** – Build a Node.js application that connects to MongoDB and manages student data.
- **Migration Project** – Write a script to migrate data from MySQL to MongoDB and display it through a Node.js API.

Module 5: React JS

ReactJS introduction and overview - ReactJS installation and environment setup - Introducing JSX, Rendering Elements - Components and Props - State and Lifecycle - Handling Events - Conditional Rendering - Lists and Keys, Forms - Lifting State Up

List of Experiments :

- **React Components** – Build a React app to display a list of courses using functional components and props.
- **State & Events** – Create a counter and a form component in React using useState and event handling.
- **Conditional Rendering & Lists** – Develop a React to-do list application with add/delete functionality and conditional rendering of completed tasks.

Text Books:

1. **Alex Banks, Eve Porcello** – *Learning React: Modern Patterns for Developing React Apps*, O'Reilly.
2. **StoyanStefanov** – *React Up & Running: Building Web Applications*, O'Reilly.
3. **Mario Casciaro, Luciano Mammino** – *Node.js Design Patterns*, Packt.
4. **Seyed M.M. Iravani** – *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, O'Reilly.

Reference Books:

1. **Robin Wieruch** – *The Road to React*, Leanpub.
2. **Carl Rippon** – *React 18 Design Patterns and Best Practices*, Packt.
3. **KirupaChinnathambi** – *Learning React: A Hands-On Guide to Building Web Applications*, Addison-Wesley.
4. **Ethan Brown** – *Web Development with Node and Express: Leveraging the JavaScript Stack*, O'Reilly.
5. **Kristina Chodorow** – *MongoDB: The Definitive Guide*, O'Reilly.
6. **Ben Forta** – *SQL in 10 Minutes, Sams Teach Yourself*, Sams Publishing.

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M.Tech I Year I Semester

RESEARCH METHODOLOGY AND IPR (Common to M.Tech CSE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
25MMC01	**2:0:0:0**	**2**	**CIE: 30 SEE:70**	**3 Hours**	**MC**

Course Objectives:

This course will enable students to:

- To understand the research design process and data collection methods.
- To develop skills in data analysis and reporting.
- To familiarize students with intellectual property rights (IPR) and patents.
- To apply research skills in real-world contexts.

Course Outcomes(CO):

On completion of this course, student will be able to

- CO1- Recall key concepts and terminology related to research design, data collection, and intellectual property rights.
- CO2 - Explain the importance of research design and data analysis in research studies, and describe the concept of intellectual property rights.
- CO3 - Design a research study, including data collection and analysis methods, and apply intellectual property rights principles to protect research findings.
- CO4 - Analyze research studies to identify strengths and limitations, and evaluate the effectiveness of data collection and analysis methods.
- CO5- Assess the impact of intellectual property rights on research and innovation, and evaluate the effectiveness of research designs and methods.
- CO6 - Develop a comprehensive research plan, including a detailed research design, data collection and analysis methods, and a plan for protecting intellectual property.

Syllabus		**Total Hours:42**
Unit-I	**FUNDAMENTALS OF RESEARCH METHODOLOGY**	**8Hrs**

Overview of research process and design - Types of Research - Approaches to Research (Qualitative vs Quantitative) - Observation studies, Experiments and Surveys - Use of Secondary and exploratory data to answer the research question - Importance of Reasoning in Research and Research ethics - Documentation Styles (APA/IEEE etc.) - Plagiarism and its consequences

Learning Outcomes

- Recall key concepts of the research process, including different types and approaches to research, and the importance of ethics.
- Differentiate between qualitative and quantitative research approaches and the various uses of secondary data.
- Identify the core principles of research design and ethics, including plagiarism and documentation styles.
- Explain the significance of reasoning and ethical conduct in all stages of the research process.
- Apply knowledge of different documentation styles, such as APA and IEEE, to properly cite sources and avoid plagiarism.

Unit-II	**DATA COLLECTION AND SOURCES**	**9Hrs**

Importance of Data Collection - Types of Data - Data Collection Methods - Data Sources - primary, secondary and Big Data sources - Data Quality & Ethics - Tools and Technology for Data Collection

Learning Outcomes

- Identify different types of data and the various methods for collecting both primary and secondary data.
- Explain the importance of data quality and ethical considerations in data collection.
- Differentiate between primary, secondary, and Big Data sources.
- Describe the various tools and technologies used for effective data collection.
- Analyze the ethical implications of data collection and ensure data quality in a research study.

Unit-III	**DATA ANALYSIS AND REPORTING**	**9Hrs**

Overview of Multivariate analysis - Experimental research, cause-effect relationship, and development of hypotheses- Measurement systems analysis, error propagation, and validity of experiments - Guidelines for writing abstracts, introductions, methodologies, results, and discussions - Writing Research Papers & proposals

Learning Outcomes

- Apply knowledge of multivariate analysis and experimental research to develop hypotheses and analyze data.
- Explain the process of measurement systems analysis and error propagation in experimental design.
- Formulate clear and concise abstracts, introductions, and methodologies for research papers.
- Write effective results and discussion sections based on data analysis.
- Develop comprehensive research papers and proposals based on proper data analysis and reporting guidelines.

Unit-IV	**UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS**	**8Hrs**

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

Learning Outcomes

- Recall the fundamental concepts of Intellectual Property (IP) and its evolution.
- Describe the roles of organizations like **WIPO** and **WTO** in the establishment of IPR.
- Differentiate between various types of IPR, including trade secrets and trademarks.
- Explain the common rules and features of IPR agreements and the role of UNESCO.
- Analyze the relationship between IPR and biodiversity, and its broader impact.

Unit-V	**PATENTS**	**10Hrs**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification - Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents

Learning Outcomes

- Explain the objectives, benefits, and key features of a patent, including the concept of an inventive step.
- Differentiate between the various types of patent applications and the e-filing process.
- Describe the process of patent examination, grant, and revocation.
- Identify the roles of patent agents and the process for their registration.
- Analyze the concepts of equitable assignments, licenses, and licensing of related patents

Text Books:

1. Stuart Melville and Wayne Goddard, *Research Methodology: An introduction for Science & Engineering students*, Juta and Company Ltd, 2004
2. Catherine J. Holland, *Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*, Entrepreneur Press, 2007.

Reference Books:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education 11e (2012).
2. Ranjit Kumar , *Research Methodology: A Step-by-Step Guide for Beginners.* . David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
3. Deborah E. Bouchoux , *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 6th Edition,* Cengage 2024.
4. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, 5th Edition, University of Chicago Press, 2024
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
6. Peter Elbow, *Writing With Power*, Oxford University Press, 1998.

Online Resources:

- **Coursera / edX** – Research Methodology and Data Analysis courses
- **Springer Link & ScienceDirect** – Latest journals on research design and statistics
- **Google Scholar** – Free access to research papers
- **NCBI Bookshelf** – Open-access research methodology resources
- **Khan Academy (Statistics & Probability)** – For fundamentals of hypothesis testing, regression, and ANOVA.

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M.Tech I Year I Semester

ENGLISH FOR RESEARCH PAPER WRITING (Common to M.Tech CSE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
25MAC01	**2:0:0:0**	**0**			**MC**

Course Objectives:

This course will enable students to:

- To equip students with the fundamentals of academic English for research paper writing.
- To develop students' advanced reading skills for analyzing and evaluating research articles.
- To refine students' grammar and language skills for clarity and precision in research writing.
- To master the skills of revising, editing, and proofreading research papers.
- To familiarize students with the role of technology and AI in research writing, including digital literacy and ethical considerations.

Course Outcomes(CO):

On completion of this course, student will be able to

- CO1 - Recall the key language aspects and structural elements of academic writing in research papers.
- CO2 –Explain the importance of clarity, precision, and objectivity in research writing.
- CO3 - Apply critical reading strategies and advanced grammar skills to analyze and write research papers.
- CO4 –Analyze research articles and identify the strengths and limitations of different methodologies.
- CO4 – Evaluate research papers to check for plagiarism, structure, clarity, and language accuracy.
- CO5 – Evaluate the effectiveness of different language and technology tools in research writing, including AI-assisted tools and plagiarism detection software.
- CO6 – Develop a well-structured research paper that effectively communicates complex ideas.

Syllabus		**Total Hours:42**
Unit-I	**Fundamentals of Academic English**	**8Hrs**

Academic English - MAP (Message-Audience-Purpose) - Language Proficiency for Writing - Key Language Aspects - Clarity and Precision - Objectivity - Formal Tone - Integrating References - Word order - Sentences and Paragraphs - Link Words for Cohesion - Avoiding Redundancy / Repetition - Breaking up long sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title and Sub-headings

Unit-II	**Reading Skills for Researchers**	**9Hrs**

Reading Academic Texts - Critical Reading Strategies - Skimming and Scanning - Primary Research Article vs. Review Article - Reading an Abstract - Analyzing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes

Unit-III	**Grammar Refinement for Research Writing**	**9Hrs**

Advanced Punctuation Usage - Grammar for Clarity - Complex Sentence Structures - Active- Passive Voice - Subject-Verb Agreement - Proper Use of Modifiers - Avoiding Ambiguous Pronoun

References - Verb Tense Consistency - Conditional Sentences

Unit-IV	Mastery in Refining Written Content/Editing Skills	8Hrs

Effective Revisions - Restructuring Paragraph - Editing vs Proofreading, Editing for Clarity and Coherence - Rectifying Sentence Structure Issues - Proofreading for Grammatical Precision – Spellings - Tips for Correspondence with Editors - Critical and Creative Phases of Writing

Unit-V	Technology and Language for Research	10Hrs

Digital Literacy and Critical Evaluation of Online Content - Technology and Role of AI in Research Writing – Assistance in Generating Citations and References - Plagiarism and Ethical Considerations – Tools and Awareness – Fair Practices

Text Books:

1. 1.Bailey. S. A*cademic Writing: A Handbook for International Students.* London and New York: Routledge,2015.
2. Adrian Wallwork, *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, 2011.

Reference Books:

1. Craswell, G. *Writing for Academic Success,* Sage Publications, 2004.
2. Peter Elbow, *Writing With Power, E-book*, Oxford University Press, 2007
3. Oshima, A. & Hogue, A. *Writing Academic English*, Addison-Wesley, New York, 2005
4. Swales, J. & C. Feak, Academic Writing for Graduate Students: Essential Skills and Tasks. Michigan University Press, 2012.
5. 5Goldbort R.*Writing for Science*, Yale University Press (available on Google Books), 2006
6. Day R.*How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006

Online Learning Resources:

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge04/
2. https://onlinecourses.swayam2.ac.in/ntr24_ed15/preview
3. "Writing in the Sciences" – Stanford University (MOOC on Coursera) https://www.coursera.org/learn/sciwrite
4. Academic Phrasebank – University of Manchester http://www.phrasebank.manchester.ac.uk
5. OWL (Online Writing Lab) – Purdue University, https://owl.purdue.edu *(Resources on APA/MLA formats, grammar, structure, paraphrasing)*
6. Zotero or Mendeley (Reference Management Tools) – Useful for managing citations and sources.

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M.Tech I Year I Semester

DISASTER MANAGEMENT
(Common to M.Tech CSE)

Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
25MAC02	2:0:0:0	0			MC

Course Objectives:

This course will enable students to:

- **To enable the students to understand** the fundamental concepts of disasters, hazards, their factors, and significance with special reference to India.
- **To prepare them to classify and analyze** different types of natural and man-made disasters, their causes, magnitude, and impacts.
- **To foster them develop understanding** of disaster preparedness, monitoring systems, and the role of government, community, and media.
- **To equip them in learning** risk assessment techniques, disaster risk reduction strategies, and the importance of global and national cooperation.
- **To foster their ability to think critically and respond to disasters and design** effective mitigation measures (structural and non-structural) with a focus on emerging trends and Indian disaster management programs.

Course Outcomes(CO):

On completion of this course, student will be able to

- **CO1 - Define and distinguish** between hazards and disasters, and explain their types, nature, and impacts.
- **CO2 Identify and map** disaster-prone areas in India and understand the epidemiological consequences of disasters.
- **CO3 Assess** the economic, social, and ecological repercussions of major natural and man-made disasters.
- **CO4 Demonstrate knowledge** of disaster preparedness tools such as remote sensing, meteorological data, risk evaluation, and community awareness.
- **CO5 Apply** risk assessment methods and propose disaster risk reduction strategies at local, national, and global levels.
- **CO6: Formulate and evaluate** structural and non-structural disaster mitigation strategies, with emphasis on Indian programs and emerging trends.

Syllabus		Total Hours:42
Unit-I	**Introduction**	**8Hrs**

Disaster - Definition, Factors and Significance - Difference Between Hazard and Disaster - Natural and Man-made Disasters - Difference, Nature, Types and Magnitude -
Disaster Prone Areas in India - Study of Seismic Zones - Areas Prone to Floods and Droughts, Landslides and Avalanches - Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami - Post-Disaster Diseases and Epidemics.

Unit-II	**Repercussions of Disasters and Hazards**	**9Hrs**

Economic Damage - Loss of Human and Animal Life - Destruction of Ecosystem - Natural Disasters - Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster - Nuclear Reactor Meltdown - Industrial Accidents - Oil Slick sand Spills - Outbreaks of Disease and Epidemics War and Conflicts

Unit-III	Disaster Preparedness and Management	9Hrs
Preparedness - Monitoring of Phenomena - Triggering a Disasteror Hazard - Evaluation of Risk-Application of Remote Sensing - Data from Meteorological and Other Agencies - Media Reports-Governmental and Community Preparedness		
Unit-IV	**Risk Assessment**	**8Hrs**
Disaster Risk -Concept and Elements, Disaster Risk Reduction - Global and National Disaster Risk Situation -Techniques of Risk Assessment – Global Co-Operation in Risk Assessment and Warning - People's participation in Risk Assessment – Strategies for Survival		
Unit-V	**Disaster Mitigation**	**10Hrs**
Meaning, Concept and Strategies of Disaster Mitigation – Emerging Trends in Mitigation - Structural Mitigation and Non- Structural Mitigation - Programs of Disaster Mitigation in India.		

Text Books:

1. Gupta, H. K. *Disaster Management*. Universities Press, 2003
2. Singh, R. B. *Natural Hazards and Disaster Management*. Rawat Publications, 2006.

Reference Books:

1. Coppola, D. P. (2020). *Introduction to International Disaster Management* (4th ed.). Elsevier.
2. Shaw, R., & Izumi, T. (2022). *Science and Technology in Disaster Risk Reduction in Asia*. Springer.
3. Wisner, B., Gaillard, J. C., & Kelman, I. (2021). *Handbook of Hazards and Disaster Risk Reduction and Management* (2nd ed.). Routledge.
4. Saini, V. K. (2021). *Disaster Management in India: Policy, Issues and Perspectives*. Sage India.
5. Kelman, I. *Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes*, Oxford University Press, 2022
6. Sahni, P. & Dhameja, A. *Disaster Mitigation: Experiences and Reflections*. Prentice Hall of India, 2004.

Online Learning Resources:

- **National Disaster Management Authority (NDMA), India**: https://ndma.gov.in – official guidelines, reports, and policy frameworks.
- **United Nations Office for Disaster Risk Reduction (UNDRR)**: https://www.undrr.org – Sendai Framework, global risk reduction strategies.
- **Global Disaster Alert and Coordination System (GDACS)**: https://www.gdacs.org – real-time disaster alerts.
- **World Health Organization (WHO)** – https://www.who.int/emergencies – disaster-related health guidelines.

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M.Tech I Year I Semester

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (Common to M.Tech CSE)					
Course Code	**L:T:P:S**	**Credits**	**Exam Marks**	**Exam Duration**	**Course Type**
25MAC03	**2:0:0:0**	**0**			**MC**

Course Objectives:

This course will enable students to:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system.
- To make them understand the need for protecting traditional knowledge and its significance in the global economy.
- To make them understand the legal frame work and policies related to traditional knowledge protection.
- To enable them to understand the relationship between traditional knowledge and intellectual property rights.
- To make them explore the applications of traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology

Course Outcomes(CO):

On completion of this course, student will be able to

- Define and explain the concept of traditional knowledge, its nature, characteristics, and scope
- Understand the need for protecting traditional knowledge and its significance in the global economy
- Explain the legal framework and policies related to traditional knowledge protection
- Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology
- Analyze the importance of traditional knowledge in various contexts, including its historical impact and social change
- Analyze the relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms

Syllabus	**Total Hours:42**
Unit-I	**8Hrs**

Introduction to traditional knowledge - Definition, Nature and characteristics, scope and importance - Kinds of traditional knowledge - Physical and social contexts in which traditional knowledge develop - Historical impact of social change on traditional knowledge systems - Indigenous Knowledge (IK) – Characteristics - traditional knowledge vis-à-vis indigenous knowledge -Traditional knowledge Vs western knowledge, traditional knowledge vis-à-vis formal knowledge

Learning Outcomes:

At the end of the unit the student will able to:

- Understand the concept of traditional knowledge.
- Contrast and compare characteristics, importance& kinds of traditional knowledge.
- Analyze physical and social contexts of traditional knowledge.
- Evaluate social change on traditional knowledge.

Unit-II		**9Hrs**

Protection of traditional knowledge- Need for protecting traditional knowledge - Significance of TK Protection - Value of TK in global economy - Role of Government to harness TK.

Learning Outcomes:

At the end of the unit the student will able to:

- Know the need of protecting traditional knowledge.
- Apply significance of TK protection.
- Analyze the value of TK in global economy.
- Evaluate role of government

Unit-III		**9Hrs**

Legal frame work and TK - A)The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 - Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act) – B)The Biological Diversity Act 2002 and Rules 2004 - the protection of traditional knowledge bill, 2016 - Geographical Indicators Act 2003.

Learning Outcomes:

At the end of the unit the student will able to:

- Understand legal frame work of TK.
- Contrast and compare the ST and other traditional forest dwellers
- Analyze plant variant protections
- Understand the rights of farmers forest dwellers

Unit-IV		**8Hrs**

Traditional knowledge and Intellectual property - Systems of traditional knowledge protection - Legal concepts for the protection of traditional knowledge - Certain non-IPR mechanisms of traditional knowledge protection - Patents and traditional knowledge - Strategies to increase protection of traditional knowledge -Global legal FORA for increasing protection of Indian Traditional Knowledge.

Learning Outcomes:

At the end of the unit the student will able to:

- Understand TK and IPR
- Apply systems of TK protection.
- Analyze legal concepts for the protection of TK.
- Evaluate strategies to increase the protection of TK

Unit-V		**10Hrs**

Traditional knowledge in different sectors - Traditional knowledge and Engineering - Traditional medicine system - TK and Biotechnology - TK in Agriculture - Traditional societies depend on it for their food and healthcare needs - Importance of conservation and sustainable development of environment - Management of biodiversity, Food security of the country and protection of TK

Learning Outcomes:

At the end of the unit the student will be able to:

- Know TK in different sectors.
- Apply TK in Engineering.
- Analyze TK in various sectors.
- Evaluate food security and protection of TK in the country.

Text Books:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. *Introduction to Indian Knowledge System: Concepts and Applications*, PHI Learning Pvt.Ltd. Delhi, 2022.
2. Basanta Kumar Mohanta and Vipin Kumar Singh,*Traditional Knowledge System and Technology in India,* PratibhaPrakashan 2012

Reference Books:

1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Kak, S.C. "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), 1987
3. Subbarayappa, B.V. and Sarma, K.V. *Indian Astronomy: A Source Book*, Nehru Centre, Mumbai, 1985.
4. Bag, A.K. *History of Technology in India,* Vol. I, Indian National Science Academy, New Delhi, 1997.
5. Acarya, P.K. *Indian Architecture*, Munshiram Manoharlal Publishers, New Delhi, 1996.
6. Banerjea, P. *Public Administration in Ancient India,* Macmillan, London, 1961.
7. Kapoor Kapil, Singh Avadhesh,*Indian Knowledge Systems Vol – I & II,* Indian Institute of Advanced Study, Shimla, H.P., 2022

Online Learning Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM 2.http://nptel.ac.in/courses/121106003/

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I Year II Semester (Theory-4, Lab-2, MC-1)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PC	25D5808T	Advances in Software Engineering	3	0	0	3
2	PC	25D5809T	Advanced Databases	3	0	0	3
3	PE	25D5810Ta 25D5810Tb 25D5810Tc	**Program Elective – III** 4. Block Chain Technology 5. Advanced Computer Networks 6. Deep Learning and Applications	3	0	0	3
4	PE	25D5811Ta 25D5811Tb 25D5811Tc	**Program Elective – IV** 1. Generative AI 2. Digital Forensics 3. Robotic Process Automation	3	0	0	3
5	PC	25D5812P	Advance in Software Engineering Lab	0	0	4	2
6	PC	25D5813P	Advanced Databases Lab	0	0	4	2
7	MC	25D5814	Quantum Technologies And Applications	2	0	0	2
8	PC	25D5815	Comprehensive Viva Voce	0	0	0	2
9	AC	25MAC04 25MAC05 25MAC06	**Audit Course – II**	2	0	0	0
Total				**16**	**0**	**8**	**20**
****Students have to undergo an Industry Internship after I Year II Semester for a duration of 6 to 8 weeks**							

Category	**Credits**
Professional Core Courses(PC)	12
Professional Elective Courses(PE)	6
Mandatory Course(MC)	2
Audit Course(AC)	0
Total	20

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II Year I Semester (Theory-2, PR-1)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PE	25D5816Ta 25D5816Tb 25D5816Tc	**Program Elective – V** 1.Software Defined Networks 2.Reinforcement Learning 3.Data Science	3	0	0	3
2	OE		**Open Elective - I**	3	0	0	3
3	PR	25D5817	Dissertation Phase – I	0	0	20	10
4		25D5818	Industry Internship	0	0	0	2
5		25D5819	Co-curricular Activities	0	0	0	1
Total				**6**	**0**	**20**	**19**

Category	**Credits**
Professional Elective Courses(PE)	3
Open Elective Courses(OE)	3
Project work (PR)	10
	3
Total	19

II Year II Semester (PR-1)							
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	**C**
1	PR	25D5820	Dissertation Phase – II	-	-	32	16
Total							16

OPEN ELECTIVE OFFERED TO OTHER DEPARTMENS

- **Advanced Data Structures & Algorithms**
- **Cloud Computing**