COURSESTRUCTURE ANDSYLLABUS

For

M.Tech

Department of Computer Science and Engineering

(Applicable for 2025 Admitted Batch)

PRAGATI ENGINEERING COLLEGE

(An Autonomous Institution)
ADB Road, Surampalem, Kakinada District,A.P.-533437
(Approved by AICTE, New Delhi & Permanently Affiliated to JNTUK, Kakinada)
(Recognized by UGC under sections 2(f) and 12 (b) of UGC act,1956)

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M.TECH CSE COURSE STRUCTURE

I SEMESTER

S. No	Category	Course Code	Course Title	L	T	P	C
1	Professional Core	D251BA01	Advanced Algorithms Analysis	3	1	0	4
2	Professional Core	D251BA02	Advanced Object Oriented Software Engineering	3	1	0	4
3	Professional Core	D251BA03	Artificial Intelligence	3	1	0	4
	Program Elective–I						
4	Program Elective–I	D251BAA0	1.Secure coding	3	0	-	3
	Program Elective–I	D251BAA1	2. Cryptography and Network Security				
	Program Elective–I	D251BAA2	3. High performance Computing				
	Program Elective–I	D251BAA3	4.Computer Vision				
5	**Program Elective–II**			3	0	-	3
	Program Elective–II	D251BAB0	1.Software Project Management				
	Program Elective–II	D251BAB1	2.Knowledge representation and reasoning				
	Program Elective–II	D251BAB2	3.Software Reliability And Quality Management				
	Program Elective–II	D251BAB3	4.Natural Language Processing				
6	Professional Core	D251BA04	Advanced Algorithms Analysis Laboratory	0	1	2	2
7	Professional Core	D251BA05	Advanced Object Oriented Software Engineering laboratory	0	1	2	2
8	Seminar-I	D251BA06	**Seminar-I**	0	0	2	1
Total Credits							23

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II SEMESTER

S. No	Category	Course Code	Course Title	L	T	P	C
1	Professional Core	D252BA01	Full Stack Technologies	3	1	0	4
2	Professional Core	D252BA02	Machine Learning	3	1	0	4
3	Professional Core	D252BA03	Cloud Computing	3	1	0	4
4	**Program Elective–III**			3	0	-	3
	Program Elective–III	D252BAC0	1. Information Storage Management				
	Program Elective–III	D252BAC1	2.Agile Methodologies				
	Program Elective–III	D252BAC2	3.Software Design Methodologies				
	Program Elective–III	D252BAC3	4.Software Architecture & Design Patterns				
5	**Program Elective–IV**			3	0	-	3
	Program Elective–IV	D252BAD0	1.Software Quality Engineering				
	Program Elective–IV	D252BAD1	2.Social Media Analytics				
	Program Elective–IV	D252BAD2	3.Software Requirements and Estimation				
	Program Elective–IV	D252BAD3	4.Block Chain Technologies				
6	Professional Core	D252BA04	Full Stack Technologies Laboratory	0	1	2	2
7	Professional Core	D252BA05	Machine Learning Laboratory	0	1	2	2
8	Seminar-II	D252BA06	Seminar-II	0	0	2	1
			Total Credits				**23**

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III SEMESTER

S. No	Category	Course Code	Course Title	L	T	P	C
1	Credit Course	D253BA01	Research Methodology and IPR/*Swayam12week MOOC course – RM&IPR*	3	0	-	3
2	Internship	D253BA02	Summer Internship/Industrial Training(8-10weeks)*	-	-	-	3
3	-	D253BA03	Comprehensive Viva#	-	-	-	2
4	Project	D253BA04	Dissertation Part–A$	-	-	20	10
Total Credits							**18**

* Student attended during summer/ year break and assessment will be done in 3rd Semester.
# Comprehensive viva can be conducted courses completed up to 2nd Semester.
$ Dissertation – Part A, internal assessment

IV SEMESTER

S. No	Category	Course Code	Course Title	L	T	P	C
1	Project	D254BA01	Dissertation Part – B	-	-	32	16
Total Credits							**16**

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M.Tech I Semester

Advanced Algorithms Analysis

Course Category	Professional Core	**Course Code**	D251BA01
Course Type	Theory	**L-T-P-C**	3-1-0-4
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Introduce students to the advanced methods of designing and analyzing algorithms.
2	The student should be able to choose appropriate algorithms and use it for specific problem.
3	To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4	Students should be able to understand different classes of problems concerning their computation difficulties.
5	To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Analyze the complexity/performance of different algorithms.	K4
CO2	Determine the appropriate data structure for solving a particular set of problems.	K3
CO3	Categorize the different problems in various classes according to their Complexity	K4
CO4	Discuss Dynamic Programming and Fast Fourier Trans form algorithm	K4
CO5	Explain Linear Programming	K5

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	0	3	0	0	0
CO2	3	0	3	0	0	0
CO3	3	2	3	0	0	0
CO4	3	2	3	0	0	0
CO5	3	0	2	0	2	0

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UNIT	CONTENTS	Contact Hours
UNIT–1	**Sorting:** Review of various sorting algorithms, to pological sorting **Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correct ness Proof of the algorithm and time/space analysis, example of amortized analysis.	10Hrs
UNIT–2	**Matroids:** Introduction to greedy paradigm, algorithm to computer maximum weight maximal independent set. Application to MST. **Graph Matching:** Algorithm to compute maximum matching. Characterization of maxim matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	12Hrs
UNIT–3	**Flow-Net works:** Max flow-mincuttheorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. **Matrix Computations:** Strassen's algorithm and introduction to divide and conquerparadigm,inverseofatriangularmatrix,relationbetweenthetime Complexities of basic matrix operations, LUP decomposition.	12Hrs
UNIT–4	**Shortest Path in Graphs:** Floyd- Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion betweenbase-representation and modulo- representation. Extension Topoly nomials. Application: Interpolation problem. **Discrete Fourier Trans form (DFT):** In complex field, DFT in modulo ring. FastFourier Transform algorithm.Schonhage- Strassen Integer Multiplication algorithm	12Hrs
UNIT–5	**Linear Programming:** Geometry of the feasibility region and Simplex algorithm **NP-completeness:** Examples, proof of NP-hardness and NP-completeness. Recent Trends in problem solving paradigms using recent searching and Sorting techniques by applying recently proposed data structures.	12Hrs
	Total	BAHrs

Text Books:

1. Cormen, Leiserson, Rivest, Stein,"Introduction to Algorithms".
2. Aho, Hopcroft, Ullman "TheDesignand Analysis of Computer Algorithms".
3. Kleinberg and Tardos. "Algorithm Design".
4. Data Structures: APseudocode Approach with C, 2ndEdition,RichardF.Gilberg,BehrouzA. Forouzon, Cengage Learning, 2004
5. Data Structures, Algorithms and Applications in java, 2 nd Edition, SartajSahni, University Press/Orient Black Swan, 2005

Reference Books:

1. DataStructuresAndAlgorithmAnalysis,2ndEdition,MarkAllenWeiss,Pearson,2002
2. Data Structures And Algorithms in C++, 3 rd Edition, Adam Drozdek, Cengage Learning, 2005
3. C and Data Structures: ASnap Shot Oriented Treatise Using Live Engineering Examples,1st Edition, N.B.Venkateswarulu, E.V. Prasad, S Chand & Co, 2009
4. ClassicDataStructures,2ndEdition,DebasisSamantha,PHILearning,2009

e-Resources:

1. **MIT OpenCourseWare – Advanced Algorithms (6.854J)**
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-854j-advanced-algorithms-fall-2008/
2. **Coursera – Algorithms Specialization (Stanford University)**
   https://www.coursera.org/specializations/algorithms

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M.Tech I Semester

Advanced Object Oriented Software Engineering

Course Category	Professional Core	**Course Code**	D251BA02
Course Type	Theory	**L-T-P-C**	3-1-0-4
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To enable students to design, develop, and analyze complex software systems.
2	To equip students with the skills to apply advanced software engineering methodologies

CO	**Course Outcomes**	**Knowledge Level**
CO1	Understand and apply the fundamental principles of Object-Oriented Programming (OOP) concepts and Unified Modeling Language (UML) basics, in the development of software solutions.	K3
CO2	Analyze and specify software requirements, develop use case sand scenarios, Apply object-oriented analysis and design (OOAD) principles	K4
CO3	Experiment with the concept of test-driven development (TDD) and its practical implementation	K3
CO4	Analyze and Evaluate Software Maintenance and Evolution Strategies	K4
CO5	Apply Advanced Object-Oriented Software Engineering Concepts	K3

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	0	0
CO2	3	3	3	0	0	0
CO3	2	2	2	0	2	2
CO4	2	2	3	0	3	2
CO5	3	2	3	0	2	3

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UNIT	CONTENTS	Contact Hours
UNIT–1	Introduction to Object-Oriented Programming: Overview of software engineering, Introduction to Object-Oriented Programming (OOP) concepts (classes, objects, inheritance, polymorphism), Unified Modeling Language (UML) basics, Introduction to soft ware development process and software Development life cycle (SDLC).	10Hrs
UNIT–2	Requirements Analysis and Design: Requirements analysis and specification, Use cases and scenarios, Object-oriented analysis and design (OOAD), Design patterns, UML modeling techniques (class diagrams, sequence diagrams, state machine diagrams, activity diagrams)	10Hrs
UNIT–3	Software Construction and Testing: Soft ware construction basics, Object-oriented design principles, Object-oriented programming languages (Java, C++,Python), Software testing basics (unit testing, integration testing, System testing),Test-driven development (TDD)	12Hrs
UNIT–4	Software Maintenance and Evolution: Soft ware maintenance basics, refactoring techniques Software version control, Code review and inspection, Soft ware evolution and reengineering	10Hrs
UNIT–5	Advanced Topics in Object-Oriented Soft ware Engineering: Model-driven engineering (MDE), Aspect-oriented programming (AOP), Component- based soft ware engineering (CBSE), Service-oriented architecture (SOA), Agile soft ware development and Scrum methodologies.	12Hrs
	Total	54Hrs

Text Books:

1. An Introduction to Object-Oriented Analysis and Design and the Unified Process, 3rd Edition, Craig Larman, Prentice-Hall.
2. Programming in Java by Sachin Malhotra, Ox ford University Press

Reference Books:

1. Requirements engineering: processes and techniques, G.Kotonyaand, I.Sommerville, 1998, Wiley
2. Design Patterns, E.Gamma, R.Helm, R.Johnson, and J.Vlissides
3. The Unified Modeling Language Reference Manual, J.Rumbaugh, I.Jacobson and G. Booch, Addison Wesley

e- Resources:

1. **MIT OpenCourseWare – Software Engineering**
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-005-software-construction/
2. **Coursera – Object-Oriented Design***(University of Alberta):*
https://www.coursera.org/learn/object-oriented-design

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M.Tech I Semester

Artificial Intelligence

Course Category	Professional Core	**Course Code**	D251BA03
Course Type	Theory	**L-T-P-C**	3-1-0-4
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Gain historical perspective of Artificial Intelligence (AI) and its foundations.
2	Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
3	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4	Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Experiment with a machine learning model for simulation and analysis.
5	Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Demonstrate knowledge of the building blocks of AI as presented in Terms of intelligent agents.	K2
CO2	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.	K4
CO3	Develop intelligent algorithms for constraint satisfaction problems And also design intelligent systems for Game Playing.	K5
CO4	Determine the capability to represent various real life problem domains using logic based techniques and use this to perform Inference or planning.	K5
CO5	Solve problems with uncertain information using Bayesian approaches.	K3

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	0	0	0
CO2	3	2	3	0	0	0
CO3	3	2	3	0	2	0
CO4	3	2	3	0	2	0
CO5	3	2	3	0	2	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Introduction to artificial intelligence:** Introduction , history, intelligent systems, foundations of AI, applications, tic-tac-toe playing, development of AI languages, current trends in AI **Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepeninga*,constraint satisfaction	10Hrs
UNIT– 2	**Problem reduction and game playing:** Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games **Logic concepts:** Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic	10Hrs
UNIT– 3	**Knowledge representation:** Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames **Advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.	12Hrs
UNIT– 4	**Uncertainty measure: probability theory:** Introduction, probability theory, Bayesian be life networks, certainty factor theory, dempster-shafer theory, non-monotonic reasoning, TMS.	12Hrs
UNIT– 5	**Fuzzy sets and fuzzy logic:** Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, Inference rules for fuzzy propositions, fuzzy systems.	12Hrs
	Total	56Hrs

Text Books:

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence, Saroj Kaushik, 1st Edition,CENGAGEL earning,2011.

Reference Books:

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3. Artificial Intelligence, Anew Synthesis, 1st Edition, Nils JNilsson, Elsevier, 1998

e-Resources:

1. **Stanford University – CS221: Artificial Intelligence: Principles and Techniques** http://web.stanford.edu/class/cs221/
2. **MIT OpenCourseWare – Artificial Intelligence:** https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2020/

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M.Tech I Semester

Secure Coding

Course Category	**Program Elective–I**	**Course Code**	D251BAA0
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities.
2	Knowledge of outline of the techniques for developing a secure application.
3	Recognize opportunities to apply secure coding principles

Course Objectives:

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Outline the secure systems and various security attacks	K3
CO2	Demonstrate the development of process of soft ware leads to secure coding practices	K5
CO3	Apply Secure programs and various risk in the soft ware's	K5
CO4	Class if yvarious errors that lead to vulnerabilities	K6
CO5	Design Real time soft ware and vulnerabilities	K6

Mapping of course out comes with program out comes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	0	0
CO2	3	2	3	0	0	0
CO3	3	2	3	0	2	0
CO4	3	2	3	0	2	0
CO5	3	2	3	0	2	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Introduction-**Need for secure systems, Proactive security Development process, Security principles to live by and threat modelling.	10Hrs
UNIT– 2	**Secure Coding in C-**Character strings-String manipulation errors, String Vulnerabilities and exploits Mitigation strategies for strings, Pointers, Mitigation strategies in pointer based vulnerabilities Buffer Over flow based vulnerabilities	10Hrs
UNIT– 3	**Secure Coding in C++and Java-**Dynamic memory management, Common errors in dynamic memory management, Memory managers, Double–free vulnerabilities, Integer security, Mitigation Strategies	12Hrs
UNIT– 4	**Database and Web Specific Input Issues-** Quoting the Input, Use of stored procedures, Building SQL statements securely, XSS Related attacks and remedies	12Hrs
UNIT– 5	**Soft ware Security Engineering-**Requirements engineering for secure software: Misuse and abuse cases, SQUARE process model Software Security practices and knowledge for architecture and design	12Hrs
	Total	56Hrs

Text Book:

1. Writing Secure Code, 2nd Edition, Michael Howard, David LeBlanc, Microsoft Press, 2003

Reference Books:

1. Secure Coding in C and C++, Robert C. Sea cord, 2nd edition, Pearson Education, 2013
2. Software Security Engineering: A guide for Project Managers, 1st ed, Julia H. Allen, Sean J.Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, Addison-Wesley Professional,2008

e-Resources:

1. OWASP Secure Coding Practices Quick Reference Guide https://owasp.org/www-project-secure-coding-practices/
2. CERT Secure Coding Standards (SEI – CarnegieMellon University) https://wiki.sei.cmu.edu/confluence/display/seccode/

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M.Tech I Semester

Cryptography and Network Security

Course Category	**Program Elective–I**	**Course Code**	D251BAA1
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Explain the objectives of information security
2	Explain the importance and application of each of confidentiality, integrity, authentication and availability
3	Understand the basic categories of threats to computers and networks
4	Discusses the Mathematics of Cryptography
5	Discuss the fundamental ideas of Symmetric and Asymmetric cryptographic

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Student will be able to understand security issues related to computer networks and learn different symmetric key techniques	**K2**
CO2	Students will be able learn mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	**K3**
CO3	Students will be able learn different types of symmetric and Asymmetric algorithms	**K3**
CO4	Students will be able learn different algorithms of Hash functions, message authentication and digital signature and their importance to the security	**K4**
CO5	Students will be able learn different Enhanced security protocols of Application Layer, Transport Layer and Network layer	**K4**

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	2	0
CO2	3	2	3	0	3	0
CO3	3	2	3	0	3	0
CO4	2	2	3	0	2	0
CO5	3	2	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Security Concepts:** Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography. Classical Encryption Techniques-symmetric cipher model, Substitution techniques, Transposition techniques, Rotor Machines, Stegnography.	10Hrs
UNIT– 2	**Introduction to Symmetric Cryptography: Algebraic Structures**-Groups, Rings, Fields, GF(2^n) fields, Polynomials. **Mathematics of Asymmetric cryptography:** Primes, Checking For Primness, Eulers phi-functions, Fermat's Little Theorem, Euler's Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation And Logarithm..	12Hrs
UNIT– 3	**Symmetric key Ciphers:** Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5 **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	12Hrs
UNIT– 4	**Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA) **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S,MAC'S Based On Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Scheme, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.	12Hrs
UNIT– 5	**Network and Internet Security: Transport-Level Security:** Web Security Considerations, Transport Level Security, HTTPS, SSH. **IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Authentication HeaderProtocol. **Electronic-Mail Security:** Internet-mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.	12Hrs
	Total	BAHrs

Text Books:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
2. Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill, 3rd Edition, 2015

Reference Books:

1. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3. Modern Cryptography: Theory and Practice By Wenbo Mao. Pearson

e-Resources:

1. StanfordUniversity–Applied-Cryptography
https://crypto.stanford.edu/~dabo/courses/OnlineCrypto/
2. NPTEL–Cryptography and Network Security*(IIT Kharagpur)*
https://nptel.ac.in/courses/106/105/106105031/

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M.Tech I Semester

High Performance Computing

Course Category	**Program Elective–I**	**Course Code**	D251BAA2
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To study parallel computing hardware and programming models, performance analysis and modeling of parallel programs
2	To introduce students to the principles, architectures, and programming models

CO	**Course Outcomes**	**Knowledge Level(K)#**
CO1	Describe different parallel architectures, inter-connect networks, programming Models	K3
CO2	Develop an efficient parallel algorithm to solve given problem	K4
CO3	Analyze and measure performance of modern parallel computing systems	K5
CO4	Build the logic to parallelize the programming task	K2

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0		
CO2	3	2	3	0		
CO3	3	2	3	0	2	
CO4	3	2	3	0	2	1

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UNIT	CONTENTS	Contact Hours
UNIT – 1	Introduction: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.	10Hrs
UNIT – 2	Parallel Programming: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU	12Hrs
UNIT – 3	**Basic Communication:** Operations- One-to-All Broadcast and All- to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads-basics, synchronization, Open MP programming	12Hrs
UNIT – 4	**Analytical Models:** Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: Matrix Vector Multiplication, Matrix-Matrix Multiplication.	12Hrs
UNIT – 5	**Parallel Algorithms- Sorting and Graph:** Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best First Search. CUDA Architecture : CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDAC kernels, Manage GPU memory, Manage communication And synchronization, Parallel programming in CUDA-C.	12Hrs
	Total	BAHrs

Text Books:

1. AnanthGrama,AnshulGupta,GeorgeKarypis,andVipinKumar,"Introductionto Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jasonsanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN- 13: 978-0-13-138768-3

Reference Books:

1. Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. DavidCullerJaswinderPalSingh,”ParallelComputerArchitecture:AHardware/ Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-5BA60-343-1
4. RodStephens,“EssentialAlgorithms”,Wiley,ISBN:ISBN:978-1-118-61210-1

e-Resources:

1. **NPTEL – High Performance Computing (IIT Kharagpur)**
   https://nptel.ac.in/courses/106/105/106105216/
2. **Argonne National Laboratory – HPC Training and Tutorials**
   https://www.alcf.anl.gov/support-center/training-education

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M.Tech I Semester

Computer Vision

Course Category	**Program Elective–I**	**Course Code**	D251BAA3
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To understand the Fundamental Concepts related to sources, shadows and shading
2	To understand the Geometry of Multiple Views

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Demonstrate different parallel architectures, inter-connect networks, programming models	**K2**
CO2	Develop an efficient parallel algorithm to solve given problem	**K3**
CO3	Analyze and measure performance of modern parallel computing systems	**K4**
CO4	Build the logic to parallelize the programming task	**K4**
CO5	Apply geometric and model-based vision techniques for camera calibration, localization, and image-based registration.	**K2**

Mapping of course outcomes with program outcomes

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	0	0
CO2	3	2	3	0	0	0
CO3	3	2	3	0	2	0
CO4	3	2	3	0	2	1

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UNIT	CONTENTS	Contact Hours
UNIT– 1	CAMERAS : Pinhole Cameras Radiometry–Measuring Light: Light in Space, Light Surfaces ,Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.	10Hrs
UNIT– 2	Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges Texture0:Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.	12Hrs
UNIT– 3	The Geometry of Multiple Views: Two Views Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph Theoretic Clustering,	12Hrs
UNIT– 4	Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models , Kalman Filtering, Data Association, Applications and Examples	12Hrs
UNIT–5	Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, Case study: Mobile Robot Localization Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.	12Hrs
	Total	BAHrs

Text Books:

1. David A .Forsyth and Jean Ponce: Computer Vision–A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez and R. E. Woods "Digital Image Processing" Addison Wesley 2008. 3. Richard Szeliski "Computer Vision: Algorithms and Applications" Springer-Verlag London Limited 2011.

e- Resources:

1. **Coursera – Computer Vision Specialization (University at Buffalo & The State University of New York)**
   https://www.coursera.org/specializations/computer-vision
2. **PyImageSearch – Practical Computer Vision Tutorials**
   https://pyimagesearch.com/

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M.Tech I Semester

Software Project Management

Course Category	**Program Elective–II**	**Course Code**	D251BAB0
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project
2	To compare and differentiate organization structures and project structures
3	To implement a project to manage project schedule, expenses and resources with the application of suitable project management tools

Course Outcomes: At the end of the course, student will be able to (Four to Six)

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Recall how old software methods worked, why they had problems, and how new ways like teamwork and automation make software better and faster.	**K1**
CO2	Demonstrate the different phases of software development and identify the key documents and outputs created in each phase, like plans, designs, and reports.	**K2**
CO3	Organize soft ware architecture from both management and technical views. Use iterative planning to organize tasks, set milestones, and estimate time and cost.	**K3**
CO4	Determine how software project teams are organized and how automation and metrics help manage and improve the project and its quality.	**K5**
CO5	Choose the basics of Agile and DevOps, how to use Scrum, and understand how DevOps tools, people, and processes help in faster and better software delivery.	**K5**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	2	0
CO2	2	3	3	0	2	0
CO3	3	2	3	0	2	2
CO4	3	2	3	0	3	3
CO5	3	2	3	0	3	3

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Conventional Software Management:** The waterfall model, conventional software Management performance. **Evolution of Software Economics:** Software Economics, pragmatics of software cost estimation. **Improving Software Economics:** Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections. **The old way and the new:** The principles of conventional software Engineering, principles of modern soft ware management, transitioning To an iterative process.	10Hrs
UNIT– 2	**Life cyclephases:** Engineering and production stages, inception, Elaboration, construction, transition phases. **Artifacts of the process:** The artifact sets, Management artifacts, Engineering artifacts, program aticartifacts.	12Hrs
UNIT– 3	**Model based software architectures:** A Management perspective and technical perspective. **Work Flows of the process:** Software processes work flows, Iteration work flows. **Checkpoints of the process:** Major milestones, Minor Milestones, Periodic status assessments. **Iterative Process Planning:** Work break down structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning	12Hrs
UNIT– 4	**Project Organizations and Responsibilities:** Line-of Business Organizations, Project Organizations, evolution of Organizations. **Process Automation:** Automation Building blocks, The Project Environment. Project Control and **Process instrumentation:** The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.	12Hrs
UNIT– 5	Agile Methodology, ADAP Ting to Scrum, Patterns for Adopting Scrum, Iterating towards Agility. Fundamentals of **DevOps:** Architecture, Deployments, Orchestration, Ne ed, Instance of applications, DevOps delivery pipeline,DevOps ecosystem. DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes	12Hrs
	Total	BAHrs

Text Books:

1. Software Project Management, Walker Royce,PEA,2005.
2. Succeeding with Agile: Software Development Using Scrum, Mike Cohn, Addison Wesley.
3. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim, John Willis, Patrick Debois, Jez Humb,1st Edition, O'Reilly publications,2016.

Reference Books:

1. SoftwareProjectManagement,BobHughes,3/e, Mike Cotterell, TMH
2. Software Project Management, Joel Henry, PEA
3. SoftwareProjectManagementinpractice,PankajJalote,PEA,2005,
4. EffectiveSoftwareProjectManagement,RobertK.Wysocki,Wiley,2006.
5. Project Management in IT, Kathy Schwalbe, Cengage

e-Resources:

1. **NPTEL – Software Project Management (IIT Roorkee)**
   https://nptel.ac.in/courses/106/105/106105218/
2. **Coursera – Software Project Management (University of Alberta)**
   https://www.coursera.org/learn/software-project-management

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M.Tech I Semester

Knowledge Representation and Reasoning

Course Category	**Program Elective–II**	**Course Code**	D251BAB1
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To investigate the key concepts of Knowledge Representation (KR) techniques and different notations.
2	To integrate the KR view as a knowledge engineering approach to model organizational knowledge.
3	To introduce the study of ontologies as a KR paradigm and applications of ontologies.
4	To understand various KR techniques and process, knowledge acquisition and sharing of ontology.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Analyze and design knowledge-based systems intended for computer implementation.	K4
CO2	Demonstrate theoretical knowledge about principles for logic-based representation and reasoning.	K2
CO3	Make use of knowledge-engineering process	K3
CO4	Experiment with production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge.	K3

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	0	0
CO2	3	2	3	0	0	0
CO3	3	2	3	0	0	0
CO4	2	2	3	0	2	1

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UNIT	CONTENTS	Contact Hours
UNIT–	The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity	10Hrs
UNIT– 2	**Ontology:** Ontological categories, Philosophical background, Toplevel categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time	12Hrs
UNIT– 3	**Knowledge Representations:** Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation	12Hrs
UNIT– 4	**Processes:** Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.	12Hrs
UNIT– 5	**Knowledge Soup:** Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition	12Hrs
	Total	BAHrs

Text Books:

1. Knowledge Representation logical, Philosophical, and Computational Foundations by John F. Sowa, Thomson Learning.
2. Knowledge Representation and Reasoning by Rona ld J. Brachman, Hector J. Levesque, Elsevier.

Reference books:

1. Brachman, R.J., & Levesque, H.J. – *Knowledge Representation and Reasoning*, Morgan Kaufmann, 2004.
2. Russell, S., & Norvig, P. – *Artificial Intelligence: A Modern Approach* (Chapters on KR&R), 4th Edition, Pearson, 2020.

e-Resources:

1. **Stanford University – CS227B: Knowledge Representation and Reasoning.** http://web.stanford.edu/class/cs227b/
2. **NPTEL – Artificial Intelligence: Knowledge Representation & Reasoning***(IIT Madras)* https://nptel.ac.in/courses/106/106/106106226/

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M.Tech I Semester

Software Reliability And Quality Management

Course Category	**Program Elective–II**	**Course Code**	D251BAB2
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Understand and apply software reliability principles
2	Implement quality management practices
3	Develop skills in defect prevention and process improvement

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Demonstrate Software Reliability during different phases of Software Development Life Cycle	K2
CO2	Analyze Software Reliability parameters using Markovian Modeling.	K4
CO3	Estimate Software Reliability parameters using Maximum Likelihood and Least Square Method	K3
CO4	Evaluate performance of Binomial-Type, Poison-Type and Markovian Models	K4
CO5	Predict Software Reliability using Intelligent Techniques.	K3

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	3	0
CO2	3	0	3	0	0	0
CO3	3	0	3	0	0	0
CO4	3	0	3	0	0	0
CO5	3	0	3	0	2	0

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UNIT	CONTENTS	Contact Hours
UNIT–1	**Introduction to Software Reliability:** The need for Software Reliability, Some Basic Concepts, Software Reliability and Hardware Reliability, Availability, Modelling and General Model Characteristics.	10Hrs.
UNIT–2	**Software Reliability Modeling:** Halstead's Software Metric, McCabe's Cyclomatic Complexity Metric, Error Seeding Models, Failure Rate Models, Curve Fitting Models, Reliability Growth Models, Markov Structure Models, Time Series Models, Non-homogeneous Poison Process Models.	12Hrs.
UNIT–3	**Markovian Models:** General Concepts, General Poison-Type Models, Binomial -Type Models, Poison- Type Models, Comparison of Binomial-Type and Poison-Type Models, Fault Reduction Factor for Poison- Type Models.	10Hrs.
UNIT–4	**Descriptions of Specific Models:** Finite Failure Category Models, Infinite Failure Category Models. Parameter Estimation: Maximum Likelihood Estimation, Least Squares Estimation, Bayesian Inference. Comparison of Software Reliability Models: Comparison Criteria, Comparison of Predictive Validity of Model Groups, Evaluation of other Criteria. **Software Reliability Prediction:** Problems associated with different Software Reliability Models, Software Reliability prediction parameters, Intelligent Techniques for Software Reliability Prediction.	14Hrs.
UNIT–5	**Software Quality Management:** Software Quality Attributes, Quality Measurement & Metrics, Verification & Validation Techniques, Verification &Validation in the Life Cycle, Software Quality Assurance functions, Tool support for SQA	10Hrs.
	Total	56Hrs

Text Books:

1. M. Xie, Software Reliability Modelling, World Scientific;1991.
2. John D.Musa, Anthony Iannino, Kazuhira Okumoto, Software Reliability Measurement,Prediction, Application. McGraw-Hill Book Company; 1987.

Reference Books:

3. Hoang Pham, System Software Reliability, Springer; 2005
4. David C. Kung, Object-Oriented Software Engineering: An Agile Unified Methodology, McGrawHill Education (India) Edition 2015.

e-Resources:

1. NPTEL – Software Testing and Quality Assurance (IIT Kharagpur) https://nptel.ac.in/courses/106/105/106105150/
2. Carnegie Mellon University – Software Engineering Institute: Software Quality Resources https://resources.sei.cmu.edu/library/subject-areas/software-quality/

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M.Tech I Semester

Natural Language Processing

Course Category	**Program Elective–II**	**Course Code**	D251BAB3
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
2	The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
3	Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

CO	**Course Outcomes**	**Knowledge Level(K)#**
CO1	Demonstrate a given text with basic Language features	K2
CO2	Design an innovative application using NLP components	K6
CO3	Explain a rule based system to tackle morphology/syntax of a language	K1
CO4	Design a tag set to be used for statistical processing for real-time applications	K6
C05	Compare and contrast the use of different statistical approaches for different types of NLP applications	K5

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	3	0	2	1
CO2	3	2	3	0	3	2
CO3	3	2	3	0	2	1
CO4	3	2	3	0	3	2
CO5	3	3	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT – 1	**INTRODUCTION:** Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance	10Hrs
UNIT – 2	**WORD LEVEL ANALYSIS:** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models	12Hrs
UNIT – 3	**SYNTACTIC ANALYSIS:** Context-Free Grammars, Grammar rules for English, Tree banks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures	12Hrs
UNIT – 4	**SEMANTICS AND PRAGMATICS:** Requirements for representation, First-Order Logic, Description Logics – SyntaxDriven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.	12Hrs
UNIT – 5	**DISCOURSE ANALYSIS AND LEXICAL RESOURCES:** Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, Word Net, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC)	12Hrs
	Total	**BAHrs**

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication, 2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

1. Language Processing with Java and Ling Pipe Cook book,1st Edition,Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2ndEdition, Richard MReese, OReilly Media, 2015.

e-Resources:

1. **Stanford University – CS224N: Natural Language Processing with Deep Learning** https://web.stanford.edu/class/cs224n/
2. **Coursera – Natural Language Processing Specialization (DeepLearning.AI)** https://www.coursera.org/specializations/natural-language-processing

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M.Tech I Semester

Advanced Algorithms Analysis Laboratory

Course Category	**Professional Core**	**Course Code**	D251BA04
Course Type	**Laboratory**	**L-T-P-C**	0-1-2-2
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	The student can able to attain knowledge in advanced algorithms.

CO	**Course Outcomes**	**Knowledge Level**
CO1	**Analyze and compare algorithmic efficiency**	K3
CO2	Design and implement optimized solutions	K4
CO3	Apply problem-solving techniques	K2

List of Experiments:

UNIT	**CONTENTS**	**Contact Hours**
1	Implement assignment problem using Brute Force method	3Hrs
2	Perform multiplication of long integers using divide and conquer method.	3Hrs
3	Implement a solution for the knapsack problem using the Greedy method.	3Hrs
4	Implement Gaussian elimination method.	3Hrs
5	Implement LU decomposition	3Hrs
6	Implement Warshall algorithm	3Hrs
7	Implement the Rabin Karp algorithm.	3Hrs
8	Implement the KMP algorithm.	3Hrs
9	Implement Harspool algorithm	3Hrs
10	Implement max-flow problem.	3Hrs
	Total	30Hrs

TEXTBOOK:

1. Design and Analysis of Algorithms, S.Sridhar, OXFORD University Press

REFERENCES:

1. IntroductiontoAlgorithms,secondedition,T.H.Cormen,C.E.Leiserson,R.L.Rivest and C. Stein, PHI Pvt. Ltd./ Pearson Education.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahniand Rajasekharam, Universities Press.

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Department of Computer Science and Engineering

M.Tech I Semester

Advanced Object Oriented Software Engineering Laboratory

Course Category	**Professional Core**	**Course Code**	D251BA05
Course Type	**Laboratory**	**L-T-P-C**	0-1-2-2
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To capture the requirements specification for an intended software system
2	To draw the UML diagrams for the given specification
3	To map the design properly to code
4	To test the software system thoroughly for all scenarios

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Understanding the concepts of object-oriented design paradigms and their applications.	K3
CO2	Develop the functional and non-functional requirements for the case studies	K4
CO3	Design behavioural diagrams that model the dynamic aspects of an object-oriented system	K3

UNIT	**CONTENTS**	**Contact Hours**
Experiment–1	Develop the Requirement Analysis and Prepare SRS for Library Management System	3Hrs
Experiment–2	Draw the Entity Relation Diagram and the Data Flow Diagrams at Level 0 & Level 1	3Hrs
Experiment–3	Design the Use case diagram, Class diagram for the Automated Teller machine	3Hrs
Experiment–4	Design the Sequence Diagram, Collaboration Diagram for Bank management system.	3Hrs
Experiment–5	Design the State Diagram, Activity Diagram for Reservation Management System.	3Hrs
Experiment–6	Develop component and deployment diagrams for the case study for Stock maintenance system.	3Hrs
Experiment–7	Draw relevant State Chart and Activity Diagrams for online exam registration application.	3Hrs
Experiment–8	Develop Unit test cases for Conference management system.	3Hrs
Experiment–9	Design black box test cases for Recruitment system.	6Hrs
	Total	30Hrs

Text Books:

1. An Introduction to Object-Oriented Analysis and Design and the Unified Process, 3rd Edition, Craig Larman, Prentice-Hall.
2. Requirements engineering: processes and techniques, G.Kotonyaand, I.Sommerville, 1998, Wiley.

Reference Books:

1. The Unified Modeling Language Reference Manual, J.Rumbaugh, I.Jacobson and G. Booch, Addison Wesley

e-Resources: https://onlinecourses.nptel.ac.in/noc21_cs57/previe

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M.Tech II Semester

Full Stack Technologies

Course Category	Professional Core	**Course Code**	D252BA01
Course Type	Theory	**L-T-P-C**	3-1-0-4
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Translate user requirements into the overall architecture and implementation of new systems and Manage Project and coordinate with the Client.
2	Write backend code in Python/Java, PHP languages and Writing optimized front end code HTML and JavaScript.
3	Understand, create and debug database related queries and Create test code to validate the applications against client requirement.
4	Monitor the performance of web applications & infrastructure and troubleshooting web application with a fast and accurate a resolution

CO	**Course Outcomes**	Knowledge Level
CO1	Identify the Basic Concepts of Web & Markup Languages	K3
CO2	Develop web Applications using Scripting Languages & Frameworks	K3
CO3	Creating & Running Back-end scripts & Connecting to Databases	K4
CO4	Demonstrate Database Queries & DBMS and Working with JQuery Framework	K2
CO5	Adapt to Deployment Techniques & Working with cloud	K4

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	3	0	1	1
CO2	2	2	3	0	2	2
CO3	2	2	3	0	2	2
CO4	2	2	3	0	2	2
CO5	2	2	3	3	3	3

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Introduction to web-** Internet and world wide web, Domain name service, Protocols: HTTP, FTP, SMTP, **Html5** concepts, **CSS3**, Anatomy of a web page, **XML-** Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches.	10Hrs
UNIT– 2	**Java script- The Basics of Java script:** Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions, Angular Java Script- **Angular JS Expressions**: ARRAY, Objects, $eval, Strings, Angular JS Form Validation & Form Submission.	10Hrs
UNIT– 3	**PHP Programming:** Back – end- Scripts PHP, Node js, Working with PHP- Using variables, Using constants, Data types, Operators. Conditional & Control statements, Arrays, functions. Working with forms and Databases such as MySQL, Node.js- Introduction, Advantages, Node.js Process Model, Node JS Modules	12Hrs
UNIT– 4	JQuery: Introduction to JQuery, Syntax, Selectors & Events, MySQL: Practice MySQL Queries, Aggregate Functions, Regular Expressions, Joins & Unions, Sub-Queries, Database Connectivity with MySql.	12Hrs
UNIT– 5	**Mongo DB-** Introduction, Architecture, Features, Examples, Database Creation & Collection in Mongo DB**, Deploying Applications**- Web hosting & Domains, Deployment Using Cloud Platforms, **Web Services-** SOAP, WSDL and REST ful Architecture	12Hrs
	Total	**56Hrs**

Text Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013
2. Web Technologies,1st Edition 7th impression, Uttam K Roy, Oxford, 2012.
3. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly, 2016
4. JavaScript & jQuery the missing manual,2nd Edition, David sawyer mcfarland, O'Reilly, 2011
5. Web Hosting for Dummies, 1st Edition, Peter Pollock, John Wiley & Sons,2013
6. RESTful web services, 1st Edition, Leonard Richardson, Ruby, O'Reilly, 2007

Reference Books:

1. Ruby on Rails Up and Running, Lightning fast Web development, 1st Edition, Bruce Tate, Curt Hibbs, Oreilly, 2006
2. Programming Perl, 4th edition, Tom Christiansen, Jonathan Orwant, O'Reilly ,2012
3. Web Technologies, HTML< JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, 2009
4. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning, 2003

e-Resources : 1. http://www.upriss.org.uk/perl/PerlCourse.html

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Department of Computer Science and Engineering

M.Tech II Semester
Machine Learning

Course Category	Professional Core	**Course Code**	D252BA02
Course Type	Theory	**L-T-P-C**	3-1-0-4
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Define machine learning and its different types (supervised and unsupervised) and understand their applications.
2	Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
3	Implement unsupervised learning techniques, such as K-means clustering.

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Enumerate the Fundamentals of Machine Learning	K2
CO2	Build Nearest neighbor based models	K2
CO3	Apply Models based on decision trees and Bayes rule	K4
CO4	Choose appropriate clustering technique.	K2
CO5	Determine algorithms to generate code for a target machine	K4

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	1	1
CO2	3	2	3	0	2	2
CO3	3	2	3	0	2	2
CO4	3	2	3	0	2	2
CO5	3	2	3	0	2	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Introduction to Machine Learning:** Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets	10Hrs
UNIT–2	Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms	12Hrs
UNIT– 3	**Models Based on Decision Trees:** Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression **The Bayes Classifier:** Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, MultiClass Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)	12Hrs
UNIT– 4	Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptron's (MLPs), Backpropagation for Training an MLP.	12Hrs
UNIT– 5	Clustering : Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering	12Hrs
	Total	**BAHrs**

Text Books:

1. "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1. Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
2. "Machine Learning in Action",Peter Harrington, DreamTech
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019

e-Resources:

1. Stanford University – CS229: Machine Learning :https://cs229.stanford.edu/
2. Google Machine Learning Crash Course: **https://developers.google.com/machine-learning/crash-course**

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M.Tech II Semester

Cloud Computing

Course Category	Professional Core	**Course Code**	D252BA03
Course Type	Theory	**L-T-P-C**	3-1-0-4
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To explain the evolving utility computing model called cloud computing.
2	To introduce the various levels of services offered by cloud.
3	To discuss the fundamentals of cloud enabling technologies such as distributed computing, service-oriented architecture and virtualization.
4	To emphasize the security and other challenges in cloud computing.
5	To introduce the advanced concepts such as containers, server less computing and cloud-centric Internet of Things.

CO	**Course Outcomes**	Knowledge Level(K)
CO1	Explain different types of Services	K3
CO2	Discuss the hardware architectures for parallel computing	K5
CO3	Demonstrate the building blocks of containers	K4
CO4	Explain the different challenges in cloud computing	K3

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	2	1
CO2	3	2	3	0	2	2
CO3	3	2	3	0	2	2
CO4	3	2	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT–1	**Introduction to Cloud Computing Fundamentals:** Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services(IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).	10Hrs
UNIT–2	**Cloud Enabling Technologies:** Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.	12Hrs
UNIT–3	**Virtualization and Containers:** Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM(e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service)offerings	12Hrs
UNIT–4	**Cloud computing challenges:** Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.	12Hrs
UNIT–5	**Advanced concepts in cloud computing :** Server less computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and opensource (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.	12Hrs
	Total	**BAHrs**

Text Books:

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly,2015.

Reference Books:

1. Andrew stellman, Jennifer Green, HeadfirstAgile, O'Reilly, 2017.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley,2013

e-Resources:

1. NPTEL – Cloud Computing (IIT Kharagpur)
   https://nptel.ac.in/courses/106/105/106105167/
2. IBM SkillsBuild – Introduction to Cloud Computing
   https://www.ibm.com/training/cloud

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M.Tech II Semester

Information Storage Management

Course Category	**Program Elective–III**	**Course Code**	D252BAC0
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To understand various segments of storage technology and architectures
2	To explore the inherent power of information
3	To describe the different backup, recovery and replication strategies

CO1	Understand the evolution of storage technology and Intelligent Storage Systems	K2
CO2	Explore the key concepts of various Storage Networking Technologies-DAS, SANs, NAS and CAS	K2
CO3	Understand the basics of Storage Virtualization	K2
CO4	Understand the concepts of Storage security and Storage Infrastructure Management	K2
CO5	Analyze the purpose of backup, recovery and replication Strategies	K3

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	0	2	1
CO2	3	2	3	0	2	2
CO3	3	2	3	0	2	2
CO4	3	2	3	0	3	2
CO5	3	2	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT–1	**Introduction to Information Storage and Management:** Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment - Data Protection: RAID - Intelligent Storage System.	10Hrs
UNIT–2	**Direct-Attached Storage and Introduction to SCSI:** Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model, Storage Area Networks: Fibre Channel: Overview, The SAN and Its Evolution, Components of SAN, FC Connectivity, Fibre Channel Ports, Fibre Channel Architecture, Zoning, Fibre Channel Login Types, FC Topologies, Concepts in Practice: EMC Connectrix Network-Attached Storage: General-Purpose Servers vs. NAS Devices, Benefits of NAS, NAS File I/O, Components of NAS, NAS Implementations, NAS File-Sharing Protocols, NAS I/O Operations, Factors Affecting NAS Performance and Availability, Concepts in Practice: EMC Celerra	12Hrs
UNIT–3	**Content-Addressed Storage:** Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples, Concepts in Practice: EMC Centera Storage Virtualization: Forms of Virtualization, SNIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization, Concepts in Practice	12Hrs
UNIT–4	**Backup and Recovery:**Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies, Concepts in Practice: EMC Net Worker **Local Replication:** Local Replication, Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface, Concepts in Practice: EMC Time Finder and EMC Snap View **Remote Replication:** Modes of Remote Replication, Remote Replication Technologies, Network Infrastructure, Concepts in Practice: EMC SRDF, EMC SAN Copy, and EMC Mirror View	12Hrs
UNIT–5	**Securing the Storage Infrastructure**: Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking **Managing the Storage Infrastructure:** Monitoring the Storage Infrastructure, Storage Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution, Concepts in Practice: EMC Control Center	12Hrs
	Total	**BAHrs**

Text Books:

1. MarcFarleyOsborne,"BuildingStorageNetworks'',TataMcGraw-Hill,2001.
2. Robert Spalding and Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, 2003.
3. MeetaGupta,"StorageAreaNetworkFundamentals",PearsonEducationLtd., 2002.

Reference Books:

1. Gerald JKowalski and MarkT May bury, "Information Storage Retrieval Systems theory &Implementation", BS Publications, 2000.
2. The jendra BS, "Disaster Recovery& Business continuity", Shroff Publishers& Distributors, 2006.

e-Resources:

1. **EMC Education Services – Information Storage and Management Learning Resources**
   https://education.dellemc.com/content/emc/en-us/home/learninghub.html
2. **NPTEL – Storage Area Networks***(relevant to ISM concepts)*
   https://nptel.ac.in/courses/106/105/106105164/

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Department of Computer Science and Engineering

M.Tech II Semester

Agile Methodologies

Course Category	**Program Elective–III**	**Course Code**	D252BAC1
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To introduce the important concepts of agile software development Process, emphasize the role of stand-up meetings in software collaboration, impart the knowledge on values and principles in understanding agility
2	To provide students with an in-depth understanding of Agile principles, frameworks, and practices

CO	**Course Outcomes**	Knowledge Level(K)
CO1	How to learn Agile and get into brain	K1
CO2	Explain about the Agile Principles and Agile Project	K3
CO3	Describe the concepts of XP, Simplicity, and Incremental Design	K2
CO4	Develop a new Lean, Eliminating Waste, and Seeing	K4

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	3	0	1	1
CO2	3	2	3	0	2	2
CO3	3	2	3	0	2	2
CO4	3	2	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT – 1	**Learning Agile:** Getting Agile into your brain, Understanding Agile values, No Silver Bullet, Agile to the Rescue, adding Agile makes a difference. A fractured perspective, How a fractured perspective causes project problems. The Agile Manifesto, Purpose behind Each Practice. Individuals and Interactions Over Processes and Tools, Working Software over Comprehensive Documentation, Customer Collaboration over Contract Negotiation, Responding to Change over Following a Plan, Principles over Practices. Understanding the Elephant, Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology	10Hrs
UNIT – 2	**The Agile Principles:** The 12 Principles of Agile Software, The Customer Is Always Right, "Do As I Say, Not As I Said". Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Better Communication for the Ebook Reader Project. Project Execution—Moving the Project Along, A Better Working Environment for the Ebook Reader Project Team. Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together	12Hrs
UNIT – 3	**SCRUM and Self-Organizing Teams:** The Rules of Scrum, Act I: I Can Haz Scrum?, Everyone on a Scrum Team owns the Project, The Scrum Master Guides the Team's Decisions, The Product Owner Helps the Team Understand the Value of the Software, Everyone Owns the Project, Scrum Has Its Own Set of Values ,Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the VisibilityInspection-Adaptation Cycle, The Last Responsible Moment, How to Hold an Effective Daily Scrum. Sprinting into a Wall, Sprints, Planning, and Retrospectives, Iterative or Incremental?, The Product Owner Makes or Breaks the Sprint, Visibility and Value, How to Plan and Run an Effective Scrum Sprint **ScrumPlanning And Collective Commitment:** Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Make Your Software Useful, User Stories Help Build Features Your Users Will Use, Conditions of Satisfaction, Story Points and Velocity, Burndown Charts, Planning and Running a Sprint Using Stories, Points, Tasks, and a Task Board. Victory Lap, Scrum Values Revisited, Practices Do Work Without the Values (Just Don't Call It Scrum), Is Your Company's Culture Compatible with Scrum Values.	12Hrs

Text Books:

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly,2015.

Reference Books:

1. Andrewstellman, JenniferGreen, HeadfirstAgile,O'Reilly,2017.
2. RubinK,EssentialScrum:ApracticalguidetothemostpopularAgileprocess,Addison-Wesley, 2013

e-Resources: Agile Alliance – Resources and Guides : https://www.agilealliance.org/agile101/

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M.Tech II Semester

Software Design Methodologies

Course Category	**Program Elective–III**	**Course Code**	D252BAC2
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To develop the knowledge, understanding, skills and values to solve problems through the creation of software solutions
2	To design and experiment with software prototypes
3	To elicit, analyze and specify software requirements through a productive working relationship with project stakeholders.
4	To build solutions using different technologies, architectures and life-cycle approaches.

CO	**Course Outcomes**	Knowledge Level
CO1	Understand the need of software design and challenges.	K2
CO2	Demonstrate architectures and methods for software design.	K2
CO3	Analyze software design process with objects and components.	K3
CO4	Identify suitable metrics for project and process management.	K3
CO5	Analyze project scheduling and risk management strategies	K3

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	3	0	2	1
CO2	2	2	3	0	2	1
CO3	3	2	3	0	2	2
CO4	2	2	2	0	3	2
CO5	3	2	2	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT–1	**Software Requirements:** Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.	10Hrs
UNIT–2	**Software Design**: The nature of the design process, transferring design knowledge, constraints upon the design process and product, recording design decisions, designing with others, context for design, economic factors, assessing design qualities, quality attributes of the design product, assessing the design process. Representing abstract ideas, design viewpoints, the architecture concept, design methods, design patterns, design representations, rationale for design methods. Design Processes and Strategies: The role of strategy in design methods, describing the design process – The D – Matrix, design by top-down decomposition, design by composition, organizational influences upon design.	12Hrs
UNIT–3	**Designing with objects and components:** Designing with objects- Design practices for object-oriented paradigm, Object-oriented paradigm, Object-oriented frameworks, Hierarchical object oriented design process and heuristics, the fusion method, the unified process. Component - based design- The component concept, designing with components, designing components, COTS. User Interface design-The Golden rules, Interface analysis and design models, user and task analysis, analysis of display content and work environment, applying interface design issues, design evaluation.	12Hrs
UNIT–4	**Project Management Concepts:** Project Management- The management spectrum, people, product, process and project, W5HH principle, Critical practices. Metrics for Process and Projects- Process metrics, project metrics, size- oriented metrics, function-orientedmetrics,Object-orientedandusecasemetrics,metricsforsoftware quality, integrating metrics within software process.	12Hrs
UNIT–5	**Project Scheduling and Management**: Project Scheduling- Basic concepts, project scheduling, defining at asksetandtask network, timeline charts, tracking the schedule, tracking the progress for an OO project, Earned value analysis. Risk Management- Reactive vs. Proactive risk strategies, software risks, risk identification, risk projection, risk refinement, risk mitigation and monitoring, the RMMM plan.	12Hrs
	Total	**BAHrs**

Text Books:

1. Soft ware design, David Budgen,secondedition,Pearsoneducation,2003.
2. Software Engineering: A practitioner's Approach, Roger S Pressman, sixth edition. McGraw- Hill International Edition, 2005.

Reference Books:

1. Applying domain-driven design and patterns, jimmy Nilsson, Pearson education,2006
2. Software Engineering Foundations,IanSomerville, seventhedition, Pearson education, 2004.
3. Software Project Management, Bob Hughes& Mike Cotterell, Fourth edition, TataMc Graw Engineering: A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008

e-Resources:

1. Carnegie Mellon University – Software Architecture and Design Resources https://resources.sei.cmu.edu/library/subject-areas/software-architecture/
2. NPTEL – Software Engineering (Modules on Design Methodologies)*(IIT Kharagpur)* https://nptel.ac.in/courses/106/105/106105087/

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M.Tech II Semester

Software Architecture & Design Patterns

Course Category	**Program Elective–III**	**Course Code**	D252BAC3
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Understand fundamental software architecture concepts
2	Apply design patterns effectively
3	Integrate architecture and patterns in system development

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Understand the basic concepts to identify state behavior of real world objects	K2
CO2	Apply Object Oriented Analysis and Design concepts to solve complex problems	K3
CO3	Construct various UML models using the appropriate notation for specific problem context	K4
CO4	Design models to Show the importance of systems analysis and design in solving complex problems using case studies	K4
CO5	Study of Pattern Oriented approach for real world problems	K2

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	0	1	1
CO2	3	2	3	0	2	2
CO3	2	2	3	0	2	1
CO4	3	3	3	0	2	2
CO5	2	2	3	0	2	1

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Introduction:** What is a design pattern? Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern What is object oriented development? key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm	10Hrs
UNIT– 2	**Analysis a System:** Overview of the analysis phase, stage 1 gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain Design and Implementation, discussions and further reading	12Hrs
UNIT– 3	**Design Pattern Catalog:** Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.	12Hrs
UNIT– 4	**Interactive systems and the MVC architecture:** Introduction The MVC architectural pattern, analyzing a simple drawing program designing the system, designing of the subsystems, getting into implementation, implementing undo operation drawing incomplete items, adding a new feature pattern based solutions	12Hrs
UNIT– 5	**Designing with Distributed Objects:** Client server system, java remote method invocation, implementing an object oriented system on the web, Web services (SOAP, Restful), Enterprise Service Bus	12Hrs
	Total	**BAHrs**

Text Books:

1. Object oriented analysis, design and implementation, brahma dathan, sarnathrammath ,universities press,2013
2. Designpatterns,ErichGamma,Richardhelan,Ralphjohman,johnvlissides,PEARSON Publication,2013

Reference Books:

1. Frank Bachmann, Regine Meunier, Hans Rohnert "Pattern OrientedSoftware Architecture" Volume 1, 1996.
2. William J Brown et al., "Anti Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998

e-Resources:

1. **Vogella – Design Patterns and Best Practices in Java**
   https://www.vogella.com/tutorials/DesignPattern/article.html
2. **Carnegie Mellon University – Software Architecture Resources (SEI)**
   https://resources.sei.cmu.edu/library/subject-areas/software-architecture/

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Department of Computer Science and Engineering

M.Tech II Semester

Software Quality Engineering

Course Category	**Program Elective–IV**	**Course Code**	D252BAD0
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Knowledge on significance of Quality, quality assurance, quality engineering
2	To develop the ability to apply quality models, metrics, and testing strategies

Course Outcomes: At the end of the course, student will be able to (Four to Six)

CO	Course Outcomes	Knowledge Level(K)
CO1	Understand software quality and its perspectives	**K2**
CO2	Analyze defect prevention and defect reduction in software quality assurance	**K2**
CO3	Illustrate software quality engineering activities and its process	**K4**
CO4	Understand and apply various test planning, execution, automation, and management techniques for software testing..	**K2**
CO5	Analyze coverage and usage-based testing methods using checklists, partitions, and operational profiles with real-world case studies.	**K3**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	0	3	1
CO2	3	2	3	0	3	2
CO3	2	2	3	0	2	1
CO4	2	2	3	0	3	2
CO5	3	2	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Software Quality:** perspectives and expectations, Quality frameworks and ISO-9126, correctness and defects: Definitions, properties and Measurements, Ahistorical perspective of quality, software quality.	10Hrs
UNIT– 2	**Quality Assurance: Classification:** QA as dealing with defects, Defect prevention- Education and training, Formal method, Other defect prevention techniques, Defect Reduction- Inspection: Direct fault detection and removal, Testing: Failure observation and fault removal, other techniques and risk identification, Defect Containment- software fault tolerance, safety assurance and failure containment	12Hrs
UNIT– 3	**Quality Engineering:** Activities and process, Quality planning: Goal setting and Strategy formation, Quality assessment and Improvement, Quality engineering in software process.	12Hrs
UNIT– 4	**Test Activities, Management and Automation:** Test planning and preparation, Test execution, Result checking and measurement, Analysis and follow- up, Activities People and Management, Test Automation.	12Hrs
UNIT– 5	**Coverage and usage testing based on checklist and partitions:** Checklist based testing and its limitations, Testing for partition Coverage, Usage based Statistical testing with Musa's operational profiles, Constructing operational profiles Case Study: OP for the cartridge Support Software	12Hrs
	Total	**BAHrs**

Text Books:

1. JeffTia`n, Soft ware Quality Engineering, Testing, Quality Assurance, and Quantifiable improvement
2. RichardN.Taylor,SoftwareArchitecture:Foundations,Theory,andPractice

Reference Books:

1. **Pressman, R.S.** – *Software Engineering: A Practitioner's Approach*, 8th Edition, McGraw Hill, 2014.
2. **Kan, S.H.** – *Metrics and Models in Software Quality Engineering*, 2nd Edition, Addison-Wesley, 2002

e- Resources:

1. **NPTEL – Software Testing and Quality Assurance (IIT Kharagpur)** https://nptel.ac.in/courses/106/105/106105150/
2. **Carnegie Mellon University – SEI Software Quality Resources** https://resources.sei.cmu.edu/library/subject-areas/software-quality/

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M.Tech II Semester

Social Media Analytics

Course Category	**Program Elective–IV**	**Course Code**	D252BAD1
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Knowledge on social media and its analytics
2	Explore the evolution, characteristics, and classifications of social media platforms.

CO	Course Outcomes	Knowledge Level
CO1	Understanding characteristics and types of social media.	K2
CO2	Knowledge on layers of social media analytics	K2
CO3	Apply text analysis tools on social media data	K3
CO4	Understand the significance of action analytics	K2
CO5	Detect viral topics on social media(YouTube)	K2

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	0	1	1
CO2	2	1	3	0	2	1
CO3	3	2	3	0	2	2
CO4	2	2	3	0	2	2
CO5	3	2	3	0	2	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Introduction To Social Media:** World Wide Web, Web 1.0, Web 2.0, Web 3.0, Social Media, Core Characteristics Of Social Media ,Types Of Social Media, Social Networking Sites, Using Face book For Business Purposes, Content Communities	10Hrs
UNIT– 2	**Social Media Analytics Overview:** Purpose of Social Media Analytics, Social Media Vs. Traditional Business Analytics, Seven Layers Of Social Media Analytics, Types Of Social Media Analytics, Social Media Analytics Cycle, Challenges To Social Media Analytics, Social Media Analytics Tools. **Case Study**: The Underground Campaign That Scored Big	12Hrs
UNIT– 3	**Social Media Text Analytics:** Types Of Social Media Text, Purpose Of Text Analytics, Steps In Text Analytics, Social Media Text Analysis Tools. **Case Study**: Tapping into Online Customer Opinions	12Hrs
UNIT– 4	**Social Media Actions Analytics:** Introduction To Actions Analytics, Common Social Media Actions, Actions Analytics Tools. **Case Study:** Cover-More Group	12Hrs
UNIT– 5	**Social Media Hyperlink Analytics:** Types Of Hyperlinks, Hyperlink Analytics, Types Of Hyperlink Analytics, Hyperlink Analytics Tools. **Case Study:** Hyperlinks and Viral YouTube Videos	12Hrs
	Total	**BAHrs**

Text Books:

1. Seven Layers of Social Media Analytics Mining Business Insights From Social MediaText,Actions,Networks,Hyperlinks,Apps,SearchEngine,AndLocationDat aByGoharF.Khan Isbn: 1507823207, Isbn-13: 9781507823200

Reference Books:

1. Social Media Analytics: Techniques and Insights for Extracting Business Value out of Social Media By Matthew Ganis, Avinash Kohirkar, Pearson Education.
2. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, Marshall Sponder, MGH.

e-Resources:

1. Coursera – Social Media Analytics (Emory University) https://www.coursera.org/learn/social-media-analytics
2. edX – Social Media Analytics: Using Data to Understand Public Conversations (Queensland University of Technology) https://www.edx.org/course/social-media-analytics-using-data-to-understand-public-conversations

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M.Tech II Semester

Software Requirements and Estimation

Course Category	Professional Elective-IV	**Course Code**	D252BAD0
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Students will author a software requirements document.
2	Students will demonstrate an understanding of the proper contents of a software requirements document and proficiency in software development cost estimation

Course Outcomes: At the end of the course, student will be able to (Four to Six)

CO	**Course Outcomes**	Knowledge Level
CO1	Identify the importance of software requirements and their validation.	K1
CO2	Analyse the software requirement management and its principles.	K3
CO3	Apply and estimate the factors and approaches for software cost.	K3
CO4	Utilize tools for management requirements and estimation requirements	K4

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	0	2	1
CO2	3	2	3	0	2	2
CO3	3	2	3	0	3	2
CO4	3	2	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT–1	**Software Requirements and Engineering:** Software Requirements - Essential Software requirement, Good practices for requirements engineering, improving requirements processes, Software requirements and risk management. Software Requirements Engineering- Requirements elicitation, requirements analysis documentation, review, elicitation techniques, analysis models, Software quality attributes, risk reduction through prototyping, setting requirements priorities, verifying requirements quality	10Hrs
UNIT–2	**Software Requirements Management and Modeling:** Software Requirements Management - Requirements Management Principles and practices, Requirements attributes , Change Management Process, Requirements Traceability Matrix, and Links in requirements chain. Software Requirements Modeling Use Case Modeling, Analysis Models, Dataflow diagram, state transition diagram, class diagrams, Object analysis, Problem Frames	12Hrs
UNIT–3	**Software Estimation:** Components of Software Estimations, Estimation methods, Problems associated with estimation, Key project factors that influence estimation. Size Estimation-Two views of sizing, Function Point Analysis, Mark II FPA, Full Function Points, LOC Estimation, and Conversion between size measures.	12Hrs
UNIT–4	**Effort, Schedule and Cost Estimation:** Productivity, Estimation Factors, Approaches to Effort and Schedule Estimation, COCOMO II, Putnam Estimation Model, Algorithmic models, Cost Estimation.	12Hrs
UNIT–5	**Tools for Requirements Management and Estimation Requirements Management Tools:** Benefits of using a requirements management tool, commercial requirements management tool, Rational Requisite pro, Caliber – RM, implementing requirements management automation, Software Estimation Tools: Desirable features in software estimation tools, IFPUG, USC's COCOMO II, SLIM (Software Life Cycle Management) Tools.	12Hrs
	Total	**BAHrs**

Text Books:

1. Software Requirements and Estimation by Rajesh Naik and Swapna Kishore, Tata Mc Graw Hill.

Reference Books:

1. Software Requirements by Karl E. Weigers, Microsoft Press.
2. Managing Software Requirements, Dean Leffingwell& Don Widrig, Pearson Education, 2003.
3. Mastering the requirements process, second edition, Suzanne Robertson & James Robertson, Pearson Education, 2006.

e-Resources:

1. NPTEL – Software Engineering (Modules on Requirements Engineering and Estimation)*(IIT Kharagpur)*
   https://nptel.ac.in/courses/106/105/106105087/
2. Software Requirements Specification Guide – IEEE Computer Society
   https://ieeexplore.ieee.org/document/720574

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M.Tech II Semester

Blockchain Technologies

Course Category	**Program Elective–IV**	**Course Code**	D252BAD3
Course Type	Theory	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To learn the fundamentals of Blockchain and various types of blockchain and consensus mechanism.
2	To understand public block chain system, Private blockchain system and consortium block chain.
3	Able to know the security issues of block chain technology.

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	Understand crypto currencies like Bitcoin, altcoins, and how they are used.	K2
CO2	Explain the concept, characteristics, types, and real-world applications of smart contracts and oracles.	K2
CO3	Analyze smart contracts, permissioned algorithms, and applications of blockchain in private and consortium environments.	K4
CO4	Understand the security, privacy, and regulatory aspects of blockchain systems including Bitcoin and Hyperledger Fabric.	K2
CO5	Build real-world blockchain applications across sectors like retail, banking, healthcare, and energy through case studies.	K3

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	0	2	0	2	0
CO2	2	2	3	0	2	0
CO3	3	2	3	0	3	0
CO4	0	2	2	0	3	0
CO5	3	3	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	**Fundamentals of Blockchain:** Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Typesof Cryptocurrencies, Cryptocurrency Usage.	10Hrs
UNIT– 12	**Public Blockchain System:** Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.	12Hrs
UNIT– 3	**Private Blockchain System:** Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.	12Hrs
UNIT– 4	**Security in Blockchain:** Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.	12Hrs
UNIT– 5	**Blockchain Case Studies:** Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities. Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain. Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.	12Hrs
	Total	**BAHrs**

Text Books:

1. "Blockchain Technology", Chandra mouli Subramanian, Asha A.George, Abhilasj K Aand Meena Karthikeyan , Universities Press.

Reference Books:

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Block chain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley

e-Resources:

1. Coursera – Blockchain Specialization (University at Buffalo & The State University of New York)
   https://www.coursera.org/specializations/blockchain
2. edX – Blockchain Fundamentals (University of California, Berkeley)
   https://www.edx.org/course/blockchain-fundamentals

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M.Tech II Semester

Full Stack Technologies Laboratory

Course Category	**Professional Core**	**Course Code**	D252BA04
Course Type	**Laboratory**	**L-T-P-C**	0-1-2-2
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	Learn the core concepts of both the frontend and backend programming course.
2	Get familiar with the latest web development technologies.
3	Learn all about SQL and Mongo databases

UNIT	CONTENTS	**Contact Hours**
Experiment–1	Design a web page consisting of a) Home page b) Login page c) Catalogue page.	4Hrs
Experiment–2	Design a webpage to Embed elements like google maps and youtube into the webpage and make them responsive	4Hrs
Experiment–3	Design a dynamic web page with validation using JavaScript	4Hrs
Experiment–4	Design a HTML having a text box and four buttons viz Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate javascript function should be called to display a. Factorial of that number b. Fibonacci series up to that number c. Prime numbers up to that number d. Is it palindrome or not	4Hrs
Experiment–5	Write JavaScript programs on Event Handling a. Validation of registration form b. Open a Window from the current window c. Change color of background at each click of button or refresh of a page d. Display calendar for the month and year selected from combo box e. On Mouse over event	4Hrs
Experiment–6	Write an XML file which will display the Book information which includes the following: 1) Title of the book 2) Author Name 3) ISBN number 4) Publisher name 5) Edition	3Hrs

	6) Price Write a Document Type Definition (DTD) to validate the above XML file.	
Experiment–7	Write a program to create Calculator Node.js Module with functions adds, subtract & multiply and use the Calculator module in another Node.js file.	3Hrs
Experiment–8	Write a Node.js for File System to perform the following operations i) Create a File ii) Read a File iii) Write to a File iv) Delete a File	3Hrs
Experiment–9	Write a program to implement jQuery Selectors and Operations	4Hrs
Experiment–10	Write a program to implement jQuery Event Handling	4Hrs
Experiment–11	Write an example perl program to connect to a MySQl database table and execute simple commands	4Hrs
Experiment–12	Write a PHP program for registering users of a website and login	4Hrs
Experiment–13	User Authentication:Assume four users user1,user2,user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a PHP for doing the following. a. Write a program to Create a Cookie and add these four user id's and passwords to this Cookie. b. Read the user id and passwords entered in the Login form (week1) and uthenticate with the values (user id and passwords) available in the cookies. If he is a valid user (i.e., user-name and password match) you should welcome him by name(user-name) else you should display " You are not an authenticated user ''. Use init-parameters to do this.	4Hrs
Experiment–14	Install a database (Mysql or Oracle): Create a table which should contain at least the following fields: name, password, email-id, phone number(these should hold the data from the registration form). a) Write a PHP program to connect to that database and extract data from the tables and display them. b) Experiment with various SQL queries. c) Insert the details of the users who register with the web site, Whenever a new user clicks the submit button in the registration page.	4Hrs
Experiment–15	Write a PHP program which does the following job: Insert the details of the 3 or 4 users who register with the web site by using registration form. Authenticate the user when he submits the login form using the user name and password from the database (Similar to week8 instead of cookies).	4Hrs
	Total	**BAHrs**

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M.Tech II Semester

Machine Learning Laboratory

Course Category	Professional Core	**Course Code**	D252BA05
Course Type	**Laboratory**	**L-T-P-C**	0-1-2-2
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To learn about computing central tendency measures and Datapre-processing techniques
2	To learn about classification and regression algorithms
3	To apply different clustering algorithms for a problem.

Software's Required: Python/R/Weka

UNIT	CONTENTS	Contact Hours
Experiment– 1	Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.	4Hrs
Experiment– 2	Apply the following Pre-processing techniques for a given data set. a. Attribute selection b. Handling Missing Values c. Discretization d. Elimination of Outliers	4Hrs
Experiment–3	Apply KNN algorithm for classification and regression	4Hrs
Experiment–4	Demonstrate decision tree algorithm for a classification problem and Perform parameter tuning for better results	4Hrs
Experiment– 5	Demonstrate decision tree algorithm for are gression problem	4Hrs
Experiment–6	Apply Random Forest algorithm for classification and regression	4Hrs
Experiment–7	Demonstrate Naïve Bayes Classification algorithm	4Hrs
Experiment–8	Apply Support Vector algorithm for classification	4Hrs
Experiment– 9	Demonstrates imple linear regression algorithm for are gression problem	4Hrs
Experiment–10	Apply Logistic regression algorithm for a classification problem	4Hrs
Experiment–11	Demonstrate Multi-layer Perceptron algorithm for a classification problem	4Hrs
Experiment– 12	Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.	4Hrs
Experiment– 13	Demonstrate the use of Fuzzy C-Means Clustering	5Hrs
Experiment–14	Demonstrate the use of Expectation Maximization based clustering algorithm	5Hrs
	Total	BAHrs

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M.Tech III Semester

Research Methodology and IPR

Course Category	Professional Core	**Course Code**	D253BA01
Course Type	**Theory**	**L-T-P-C**	3-0-0-3
Prerequisites		**Continuous Internal Assessment**	40
		Semester End Examination	60
		Total Marks	100

COURSE OBJECTIVES	
1	To introduce the fundamental concepts of research methodology
2	To develop skills in identifying research problems, formulating hypotheses, and selecting appropriate research methods
3	To familiarize students with the principles and procedures of Intellectual Property Rights (IPR),
4	To enhance students' ability to apply ethical practices in research
5	To prepare students for publishing research findings

CO	**Course Outcomes**	**Knowledge Level(K)**
CO1	**Apply** appropriate research methodologies to design and conduct effective research studies.	K3
CO2	**Formulate** clear research problems, hypotheses, and objectives for academic or industry projects.	K4
CO3	**Demonstrate** knowledge of Intellectual Property Rights, including patents, copyrights, trademarks, and related legal frameworks.	K4
CO4	**Analyze** research data and present findings in a structured, ethical, and professional manner.	K3
CO5	**Evaluate** the commercial potential of research outcomes and apply IPR processes for innovation protection.	K3

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	0	2	0	2	0
CO2	2	2	3	0	2	0
CO3	3	2	3	0	3	0
CO4	0	2	2	0	3	0
CO5	3	3	3	0	3	2

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UNIT	CONTENTS	Contact Hours
UNIT– 1	Introduction to Research Methodology Meaning of research, objectives, motivation, and significance, Types of research: Fundamental, Applied, Quantitative, Qualitative, Analytical, and Empirical research, Research process and steps in research, Criteria for good research, Defining research problem and its selection.	10Hrs
UNIT– 2	Research Design and Data Collection Research design: Meaning, need, and features, Types of research designs,Sampling techniques: Probability and Non-probability sampling,Data collection methods: Primary data (interviews, questionnaires, surveys) and secondary data,Measurement and scaling techniques , Data validation and reliability.	12Hrs
UNIT– 3	Data Analysis and Interpretation Data preparation, coding, and tabulation, Descriptive statistics, inferential statistics, and hypothesis testing,Use of software tools (SPSS, R, MATLAB, etc.) for analysis,Interpretation of results and drawing conclusions,Report writing: Structure, components, and presentation skills.	12Hrs
UNIT– 4	Introduction to Intellectual Property Rights (IPR) Overview of Intellectual Property (IP): Types and significance, Patents: Filing procedure, grant process, and patent rights,Copyrights, Trademarks, Industrial designs, and Geographical indications,Trade secrets and protection,International IPR frameworks (WIPO, TRIPS).	12Hrs
UNIT– 5	IPR Management and Commercialization Innovation management and technology transfer,Licensing and commercialization of IP,Case studies of successful patents and technology commercialization,Ethical issues in research and IPR,Future challenges in IPR and research ethics.	12Hrs
	Total	**BAHrs**

Text Books:

1. **C.R. Kothari, Gaurav Garg** – *Research Methodology: Methods and Techniques*, 4th Edition, New Age International Publishers, 2019.
2. **Deborah E. Bouchoux** – *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets*, *6th Edition, Cengage Learning, 2021.*

Reference Books:

1. **Ranjit Kumar** – *Research Methodology: A Step-by-Step Guide for Beginners*, 5th Edition, SAGE Publications, 2020.
2. **Neeraj Pandey & Khushdeep Dharni** – *Intellectual Property Rights*, PHI Learning, 2014.

e- Resources:

1. **WIPO – World Intellectual Property Organization :** https://www.wipo.int/
2. **NPTEL – Research Methodology***(IIT Madras) :* https://nptel.ac.in/courses/127/106/127106004/

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III Semester

SUMMER INTERNSHIP/ INDUSTRIAL TRAINING

(8-10 WEEKS)

Course Category		**Course Code**	**D253BA02**
Course Type	Project/Seminar/Internship	**L-T-P-C**	0-0-0-3
Prerequisites	-	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 60 100

COURSEOBJECTIVES: The objectives of the course are to	
1	Internships provide students with an opportunity to put into practice skills they have learned while in college.
2	In addition, students should have an opportunity to enhance those skills, obtain the perspective of a work environment and benefit from a mentor or supervisor's experience and advice.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Integrate theory and practice to assess interests and abilities in their field of study.	K2
CO2	Develop work habits, attitudes necessary to appreciate work and its function in the economy.	K3
CO3	Develop communication, interpersonal and other critical skills to build a record of work experience.	K4

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low,2 -Medium, 3– High)

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	2	-	-	
CO2	-	-	2	-	-	2
CO3	-	2	2	-	-	-

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III Semester

DISSERTATION PART – A

Course Category		**Course Code**	**D253BA04**
Course Type	Project	**L-T-P-C**	0-0-20-10
Prerequisites	-	**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 - -

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
2	To familiarize how to incorporate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
3	Expose to the critical aspects like identifying, analyzing and solving problems creatively through sustained critical investigation using effective oral, written and visual communications.
4	To inculcate the key aspects like awareness and application of appropriate personal, societal and professional ethical standards to excellence needed to engage in lifelong learning.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Carryout a critical review of literature on a chosen topic of research and identify gaps in the literature to define a problem for research work.	K3&K4
CO2	Formulate/adapt a clear methodology using multi-disciplinary approach and modern tools.	K3&K6

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

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IV Semester

DISSERTATION PART – B

Course Category		**Course Code**	D254BA01
Course Type	Project	**L-T-P-C**	0-0-32-16
Prerequisites		**Continuous Internal Assessment** **Semester End Examination** **Total Marks**	40 120 160

COURSEOBJECTIVES: The objectives of the course are to	
1	To impart fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
2	To familiarize how to incorporate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
3	Expose to the critical aspects like identifying, analyzing and solving problems creatively through sustained critical investigation using effective oral, written and visual communications.
4	To inculcate the key aspects like awareness and application of appropriate personal, societal and professional ethical standards to excellence needed to engage in lifelong learning.

COURSEOUTCOMES		
Upon successful completion of the course, the student will be able to:		**Cognitive Level**
CO1	Carryout design/analysis of a product/system or devise experiments to study and develop a system/process/product.	K3&K4
CO2	Interpret & validate results of analysis/experiments conducted to study behavior of a product /system/ process considered for the research leading to valid conclusions that add value to the body of knowledge.	K3&K5
CO3	Write and present a technical report of the project work.	K6

K1-Remembering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating