VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
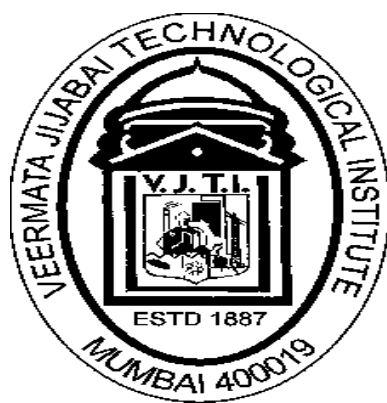## (VJTI)
MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum
(Scheme of Instruction & Evaluation and Course contents)
(Revision 2018)

For
Third Year
of
Four Year Undergraduate Programmes Leading to
Bachelor of Technology (B Tech) Degree in Information Technology

Implemented from the batch admitted in Academic Year 2018-2019

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(Autonomous Institute Affiliated to University of Mumbai)

Curriculum

(Course Contents)

For

Third Year

of

Four Year Undergraduate Programmes Leading to

Bachelor of Technology (B. Tech.)

In

INFORMATION TECHNOLOGY

(2020-21)

Institute Vision and Mission

Vision

To establish global leadership in the field of Technology and develop competent human resources for providing service to society

Mission

- To provide students with comprehensive knowledge of principles of engineering with a multi-disciplinary approach that is challenging
- To create an intellectually stimulating environment for research, scholarship, creativity, innovation and professional activity.
- To foster relationship with other leading institutes of learning and research, alumni and industries in order to contribute to National and International development.

Department Vision and Mission

Vision

To become the world-class student-centered department which fosters high- quality learning and research for both undergraduate and graduate students.

Mission

To equip our graduates with the knowledge and expertise to contribute significantly to the knowledge and information industry and to continue to grow professionally.

- To collaborate with local, state, national, and international entities in education and research.
- To engage faculty, students and alumni in research activities.
- To nurture our graduate's interpersonal and entrepreneurial skills so they can provide leadership within the information industry's diverse culture.

B.Tech. Information Technology

Program Educational Objectives (PEOs)

1. Achieve excellence in their profession and demonstrate leadership skills in multidisciplinary domain.

2. Promote design, analysis, product implementation, research, and services in the field of Information Technology through strong technical, communication and entrepreneurial skills.

3. To complement the class room teaching with live projects, fieldwork, seminars to build self-learning, and lifelong learning capability, and to develop out of box thinking.

Program Outcomes (POs)

After the completion of the B.Tech. Information Technology programme, the graduates of the department will have

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

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

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

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

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

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

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

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

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

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

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

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

Program Specific Outcomes (PSOs)

1. Develop an ability to use and apply Engineering conceptual knowledge and practices in the core information technologies of programming, networking, web technologies, human computer interaction and information management.

2. Skills to synthesize extensible and reusable code or systems to strive balance between increasing complexity and reduction in time available for development.

3. Understanding of professional ethics like confidentiality, restraining from use of unethical practices, due respect to IPR issues.

4. Aptitude for contemporary technological developments.

B. Tech. Information Technology
Scheme of Instruction and evaluation
SEMESTER III

	Scheme of Instruction					Scheme of Evaluation			
S. No	Course Code	Course Name	L-T-P (Hours / Week)			Credits	Evaluation Scheme		
			L	T	P		TA	MST	ESE
1	R4MA2007S	Linear Algebra	3	1	0	4	20	20	60
2	R4IT2001S	Discrete Mathematics	3	1	0	4	20	20	60
3	R4IT2002T	Fundamentals of Data Structures	3	0	0	3	20	20	60
4	R4IT2002P	Data Structures Lab	0	0	3	1.5	60	0	40
5	R4IT2003S	Digital Systems and Logic Design	3	0	0	3	20	20	60
6	R4IT2004S	Computer Organizations and Architectures	3	0	0	3	20	20	60
7	R4IT2005A	Program Development Lab	0	1	3	2.5	60	0	40
8	R4CH2001A	Environmental Studies	2	0	1	MNC	60	0	40
9	R4IT2006A	Development Engineering	2			P/NP	20	20	60
		Total	19	3	7	21			

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two in semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

B. Tech. Information Technology
Scheme of Instruction and evaluation

SEMESTER -IV

S. No	Course Code	Course Name	Hours/Week			Credits	Evaluation Scheme		
			L	T	P		TA	MST	ESE
1	R4MA2017S	Data Interpretation and Analysis	3	1	0	4	20	20	60
2	R4IT2007S	Design and Analysis of Algorithms	3	0	0	3	20	20	60
3	R4IT2008S	Theory of Computations	3	0	0	3	20	20	60
4	R4IT2009T	Operating Systems	3	0	0	3	20	20	60
5	R4IT2009P	Operating Systems Lab	0	0	2	1	60	0	40
6	R4IT2010T	Database Management Systems	3	0	0	3	20	20	60
7	R4IT2010P	Database Management Systems Lab	0	0	2	1	60	0	40
8	R4IT2011S	Introduction to Geospatial Technologies	2	0	2	3	60	20	40
9	R4IT2012A	Open Source Computing	2			MNC	60	0	40
			19	1	6	21			

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B. Tech. Information Technology
Scheme of Instruction and evaluation

SEMESTER-V

S No	Course Code	Course Name	L	T	P	Credit	TA	MST	ESE
1	R4IT3001S	Artificial Intelligence	3	1	0	4	20	20	60
2	R4IT3002T	Software Engineering	3	0	0	3	20	20	60
3	R4IT3003T	Spatial & Graph Databases	3	0	0	3	20	20	60
4	R4IT3004T	Computer Networks	3	0	0	3	20	20	60
5	R4IT3005S	Compiler Design	3	0	0	3	20	20	60
6	R4IT3006A	Financial Technologies	2	0	0	P/NP			
7	R4IT3002P	Software Engineering Lab	0	0	2	1	60	0	40
8	R4IT3003P	Spatial & Graph Databases Lab	0	0	2	1	60	0	40
9	R4IT3004P	Computer Networks Lab	0	0	2	1	60	0	40
10	R4IT3007S	Web Information Management	1	0	2	2	60	0	40
			18	1	8	21			

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B. Tech. Information Technology
Scheme of Instruction and evaluation

SEMESTER-VI

S. No	Course Code	Course Name	L	T	P	Credits	TA	MST	ESE
			L	**T**	**P**		**TA**	**MST**	**ESE**
1	R4IT3011T	Machine Learning	3	0	0	3	20	20	60
2	R4IT3012T	Wireless Networks	3	0	0	3	20	20	60
3	R4IT3013T	Parallel Computing	3	0	0	3	20	20	60
4		Professional Elective1	3	0	0	3	20	20	60
5		Open Elective 1	3	0	0	3	20	20	60
6	R4HM3002L	Professional Communication Skills	1	0	2	2	60		40
7	R4IT3011P	Machine Learning Lab	0	0	2	1	60	0	40
8	R4IT3012P	Wireless Networks lab	0	0	2	1	60	0	40
9	R4IT3013P	Parallel Computing Lab	0	0	2	1	60	0	40
10		Professional Elective1 Lab	0	0	2	1	60	0	40
			16	0	10	21			

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two in semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

Minimum six weeks mandatory internship in industry/research Institute after 6th Semester

	Professional Electives –1
S. No	Course Title
R4IT3101T	Spatial Data Analysis and Visualization
R4IT3102T	Object Oriented Analysis and Design
R4IT3103T	Number Theory
R4IT3104T	Digital Image Processing
R4IT3105T	Digital Forensic Analysis

	Professional Electives –1 Lab
S. No	Course Title
R4IT3101P	Spatial Data Analysis and Visualization Lab
R4IT3102P	Object Oriented Analysis and Design Lab
R4IT3103P	Number Theory Lab
R4IT3104P	Digital Image Processing Lab
R4IT3105P	Digital Forensic Analysis Lab

Open Electives –I

S No	Course Title
R4IT3601S	System Administration
R4CO3601S	Network Security

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3001S	
Course Title	Artificial Intelligence	
Prerequisite	Design and Analysis Algorithms	

COURSE OUTCOMES	
Student will be able to	
1	Demonstrate the key aspects of Artificial Intelligence.
2	Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning for problem solving
3	Analyze algorithms in game playing,search.
4	Demonstrate the key aspects of propositional logic and AI applications

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction:** Overview and historical perspective, turing test, physical symbol systems and the scope of symbolic AI, Agents.	6	1
2	**Searching techniques**: State Space Search: Depth First Search, Breadth first Search, DFID. Heuristic Search Best First Search, Hill Climbing, Beam Search, Tabu Search. Randomized Search, Simulated annealing, Genetic Algorithms, Ant colony optimization.	8	1
3	**Finding Optimal Paths:** Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search.	6	2
4	**Problem Decomposition:** Goal Trees, AO*, Rule Based Systems, Rete Net.	6	2
5	**Game Playing:** Minimax Algorithm, Alpha Beta Algorithm, SSS*.	4	3
6	**Planning and Constraint Satisfaction:** Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Constraint Propagation.	4	3
7	**Logic and Inferences:** Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.	4	4

| 8 | **AI Applications**: AI applications in Natural Language Processing, Vision and Robotics. Advances in the domain | 3 | 4 |
| 9 | **Advance in the domain** | 2 | 4 |

TEXTBOOKS

1   Deepak Khemani,"A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013.

2   Stuart Russell, Peter Norvig,"Artificial Intelligence A Modern Approach", Prentice Hall, 3rd Edition, 2009.

RECOMMENDED READING

1   Stefan EdelKamp and Stefan Schroedl, "Heuristic Search: Theory and Application", Morgan Kaufmann, 2011.

2   Zbigniew Michalewicz and David B. Fogel, " How to Solve it: Modern Heuristics", Springer, 2nd Edition, 2004.

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3002T	
Course Title	Software Engineering	
Prerequisite	Basics of software	

COURSE OUTCOMES

Student will be able to

1	Demonstrate basic knowledge in Software Engineering.
2	Identify, Plan, gather requirements for, analyse, design, develop and test the software development project.
3	Demonstrate cost, effort & time, manage risk, prepare project schedule and track it for a software development project.
4	Apply assure the quality of a software & manage its configuration.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction:** The Product: Software Characteristics, Applications. The Process: Software Process, Software Process Models, Linear Sequential model, Prototyping model, RAD model, Evolutionary models - Incremental model, Spiral model.	4	1
2	**Software project management concepts:** Important factors of project management- People, Product, Process, Project. Software Process and Project Metrics Measures, Metrics, Indicators. Metrics in the process and project domains, Software measurement. Metrics for Software Quality. Integrating metrics. Software Project Planning Software Scope, Resources, Software project estimation - cost/effort estimation, Decomposition techniques, Empirical estimation models	4	2
3	**Risk Analysis and Management:** Reactive versus proactive risk strategies, Software risks, Risk identification, Risk projection, Risk mitigation-monitoring-management, RMMM plan.	5	2,3
4	**Project Scheduling and Tracking:** Defining a task set for the software project, Gantt Chart, Defining a task network, Scheduling.	3	3
5	**Software Quality Assurance:** Software quality assurance, Software reviews, Formal technical reviews, SQA plan. Software Configuration Management: SCM process, Identification of objects in the software configuration, Version control, Change control, Configuration audit,	5	4

	Status reporting.		
6	**Analysis Concepts and Principles**: Requirement Analysis, Requirement elicitation for software, Analysis principles, Software prototyping, Requirements Specification. Analysis Modelling: Data modelling, Functional modelling and information flow, Behavioural modelling.	5	2
7	**Design Concepts and Principles:** Software design process, Design principles, Design concepts, Effective modular design. Design Modelling**:** Data Design. Architectural Design: Software architecture, Mapping requirements into a software architecture. User Interface Design: Human Factor, User interface design process. Component-Level Design: Structured programming design notations.	6	3
8	**Software Testing Techniques &Strategies:** White-box & Black-box testing techniques. Strategic Approach to Software Testing.	3	4
9	**Advances in software engineering**		

TEXTBOOKS

1 Roger Pressman, "Software Engineering", McGraw Hill, 8th Edition
2 Ian Sommerville, "Software Engineering", Pearson Education, 10thEdition, 2015.

RECOMMENDED READING

1 James Peter ,"Software Engineering an Engineering approach", John Wiley, First Edition
2 W. S. Jawadekar, "Software Engineering", TMH. 1st Edition
3 R. Mall, "Fundamentals of Software Engineering", Prentice Hall of India, 2nd Edition

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3003T	
Course Title	Spatial & Graph Databases	
Prerequisite	Database Management System	

COURSE OUTCOMES

Student will be able to

1	Demonstrate basic concepts spatial database and graph database.
2	Apply spatial query language and apply it in real time application.
3	Apply spatial indexing techniques.
4	Identify and compare graph databases and its application

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction to spatial databases** : Requirement of spatial databases , DBMS Support for Geospatial Data, Users in SDBMS, Example of SDBMS, Spatial Concepts and Data Models: Models of Spatial Information, Three-step Database Design, Extending the ER Model with spatial concept	7	1
2	**Spatial Query Language**: Standard Database Query Language, Basic SQL Primer, Extending SQL for Spatial Data, Example Queries that Emphasize Spatial Concept	3	2
3	**Spatial Data Structure and Indexing**: Fundamental Data Structures on spatial data, B-trees, quad trees, grid structure, kd-tree. BSP tree, R-Tree, Spatial Indexing	4	3
4	**Query processing and Optimization**: Two-step Query Processing of Object Operations, Techniques for Spatial Selection, General Spatial Selection, Algorithm for Spatial-Join Operations, Query optimization: Logical Transformation, Cost-Based Optimization: Dynamic Programming	5	3
5	**Graph Database**: Graph.,A High-Level View of the Graph Space, Models and Graphs ,Querying Graph: Introduction to Cypher	7	3,4
6	**Building a Graph Database Application**: Data Modeling, Application Architecture , Testing ,Graph Database Internals: Native Graph Processing Native Graph Storage. Advances in the domain	7	4

TEXTBOOKS

1   Shashi Shekhar, Sanjay Chawala, "Spatial Databases a Tour"

2   Ian Robinson, Jim Webber & Emil Eifren "Graph Databases" O'Reilly

3   H. Samet. "Applications of spatial data structures: Computer Graphics, Image Processing and GIS"

RECOMMENDED READING

1   H. Samet "Design and analysis of spatial data structures"

2   Paul Bolstad – "GIS Fundamentals_ A First Text on Geographic Information" Systems-XanEdu (2016)

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3004T	
Course Title	Computer Networks	
Prerequisite	NIL	

COURSE OUTCOMES	
Student will be able to	
1	Demonstrate basics of networking and layered architectures
2	Apply fundamentals of Physical, MAC, IP, transport and application layer protocols to provide efficient solutions to the clients.
3	Design computer network specifications to meet client needs.
4	Analyse the network design specifications to meet client needs

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction :**Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and wired networks, broadcast and point to point networks, Network topologies, Network software: concept of layers, protocols, interfaces and services, ISO-OSI reference model, TCP/IP reference model	6	1,2
2	**Physical Layer:** Fundamentals of physical layer, transmission media.	4	1,2
3	**Mac Layer:** Design issues, error detection and correction, data link protocols, Channel access protocols	5	1,2,3
4	**Network Layer** :Design issues, Bridges – Routers , Gateways, Routing algorithms, Congestion control , algorithms, Quality of Service, Internetworking, Address learning bridges, Spanning tree, IP datagram, routing algorithms, ARP/RARP, Subnet addressing , Address, masking, ICMP, RIP/RIPV2, OSPF, DNS	8	2,3,4
5	**Transport Layer**: Services, Transport layer protocols, UDP, TCP: State Transition diagram, flow control, error control, TCP Timers. Congestion control and Quality of Service: Queuing disciplines, TCP Congestion control, Congestion Avoidance Mechanisms, Quality of Service	8	2,3,4
6	**Applications: Traditional** Applications (WWW, HTTP, FTP, Email, Telnet, SSH, DNS), Peer-to-Peer Networks. Advances in the domain	4	1,2

TEXTBOOKS

1. B. A. Forouzan and FirouzMosharraf, "Computer Networks, A Top-Down Approach", McGraw-Hill, 1st Edition, 2012.
2. Andrew S. Tanenbaum, "Computer Networks", Pearson Education, 4thEdition, 2003.
3. J.F. Kurose and K. W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson, 2nd Edition, 2003.

RECOMMENDED READING

1. Larry L Peterson and B S Davie, "Computer Networks: A Systems Approach", Elsevier,2012
2. B. A. Forouzan, "Data Communications and Networking", McGraw Hill, 4th Edition ,2010.
3. William Stallings, "Data and computer Communication", Pearson Education, 7th Edition.
4. Alberto Leon Garcia and Indra Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", McGraw-Hill, 2nd Edition, 2004.

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3005S	
Course Title	Compiler Design	
Prerequisite	Automata Theory	

COURSE OUTCOMES

Student will be able to

1	Demonstrate and design code generator
2	Apply the knowledge of Lex tool & Yacc tool to develop a scanner & parser.
3	Design new code optimization techniques.
4	Identify issues in code generation

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Language Processors:** Translators – Compilers and Interpreters, The Phases of Compilers, Errors in different phases, Analysis and Synthesis phases, Compiler Construction Tools.	2	1
2	**Lexical Analysis**: Role of Lexical Analyzer, , Input buffering, Expressing Tokens by Regular Expressions , Converting regular expressions to DFA, Minimization of DFA, LEX tool, Design of Lexical Analyzer for a sample Language	4	1
3	**Syntax Analysis:** Role of the Parser, Context Free Grammars ,Top-down parsing, Recursive descent and predictive parsers LL(1) parser, Bottom-Up parsing, Operator precedence parsing, LR, SLR and LALR Parser, Error Handling and Recovery in Syntax Analyzer, YACC tool, Design of a Syntax Analyzer for a Sample Language	6	2
4	**Syntax Directed Translation:** Syntax directed Definitions, Construction of Syntax Tree, Top-down translation and Bottom-up evaluation of inherited attributes, Design of predictive translator ,Type Systems, Specification of a simple type checker, Equivalence of Type Expressions, Type Conversions	5	2
5	**Run Time Environments:**	5	3

	Storage Organization, Activation Trees, Activation Records, Stack Allocation of activation records, Parameter passing mechanisms		
6	**Intermediate Code Generation:**	4	3
	Intermediate languages: graphical representations, data flow analysis, DAGs, Three address code, Types of three address statements, Syntax directed translation into three address codes, Implementation of three address statements		
7	**Code Optimization:**	4	3
	Machine dependent and machine independent code optimization, Sources of Optimization, Early Optimizations: Constant-Expression Evaluation (Constant Folding, Algebraic Simplifications and Reassociation, Value numbering, Copy Propagation. Redundancy Elimination: Common Subexpression Elimination, Loop-Invariant Code Motion, Partial Redundancy Elimination, Redundancy Elimination and Reassociation, Code Hoisting. Loop Optimizations: Induction- Variable optimizations, Unnecessary Bounds Checking Elimination		
8	**Code Generation:**	3	4
	Issues in the design of a code generator, The target machine, Run time storage Management, Basic blocks and flow graphs, Next-use information, A simple code generator.		
9	Advances in the domain		

TEXTBOOKS

1   Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Pearson ,2nd edition

RECOMMENDED READING

1   Leland Beck , "System Software", Addision Wesley

2   Kenneth C. Louden; "Compiler Construction, Principles and Practice", Cengage Learning.

3   D.M.Dhamdhere, "System programming and Operating System", McGraw Hill, 2nd revised edition, 1999.

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3006A	
Course Title	Financial Technologies	
Prerequisite	NIL	

COURSE OUTCOMES	
Student will be able to	
1	Identify and understand issues in financial technologies.
2	Design and apply models using R programming of financial technologies.
3	Demonstrate summarize stock market and trends.
4	Apply the knowledge of crypto currency market.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction to FinTech**: Introduction to finance and technologies, current trends in financial technologies, Fintech ecosystems, emerging markets and social Impact.	4	1
2	**Financial Solutions**: Predictive Algorithms – Building Innovative Online Banking Solutions, Big Data is the Cornerstone of Regulatory Compliance Systems, FinTech Solutions in Complex Contracts Optimization, FinTech Solutions for Small Businesses	4	1
3	**Capital, Investment and Innovations**: Investment and Capital – Back to Basics, Angel Investing, Access to "Smart Money" to Fund the Best FinTech Companies. Crowd funding and Marketplace (P2P) Lending – Online Capital Marketplaces as New Asset Classes to Access Funding. The Digital Investment Space , Spanning from Social Trading to Digital Private Banking – A FinTech Sector Made for Disruption?, Leading the Way with an Investor-led Approach to Crowd funding.	4	1
4	**Financial Technology in R**: Computation, Programming, plotting, statistics and Inference, utility functions, assets management, option valuation, and portfolio design.	4	2
5	**Stock Market analysis**: Introduction to stock market, equity, derivatives, put options and call options, trading algorithms implementation using R.	2	3
6	**Crypto-currencies & Block chain**: Digital currencies, convergence and collisions, Block chain technology.	4	4
7	Advances in the domain:	2	4

TEXTBOOKS

1   The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Susanne Chishti, Janos Barberis, 2016.
2   Basic R for finance, Diethelm Würtz, Tobias Setz, Yohan Chalabi, Longhow Lam, Andrew Ellis, 2015.
3   Learning Quantitative Finance with R, ParamJeet, Prashant Vats, 2017.

RECOMMENDED READING

1   Data Analytics Using R, Seema Archarya, 2018.

2   Analyzing Financial Data and Implementing Financial Models Using R, Ang. Clifdord,
3   Technical Analysis of Stock Trends, John Magee, 2009.

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3002P	
Course Title	Software Engineering Lab	
Prerequisite		

COURSE OUTCOMES

Student will be able to

1	Demonstrate different umbrella activities of software development project such as cost & time estimation.
2	Demonstrate. different framework activities of software development project such as requirements gathering, analysis, design, coding, testing and maintenance
3	Identify issues in software design risk management, project scheduling &tracking.
4	Describe software quality assurance & software configuration management.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Give detailed Problem Statement and Prepare Software scope	2	1
2	Estimate required Resources, and Perform Software cost and time Estimation	2	1
3	Perform Risk Analysis and prepare RMMM plan for case study	2	2
4	Prepare Project Schedule, and Project Plan	2	2
5	Prepare Software Quality Assurance Plan (SQA plan)	2	2,3
6	Carry out Requirement Analysis Modelling , and prepare SRS in IEEE format	4	1,3
7	Carry out Software Design	4	2,3
8	Develop test cases for white box testing.	4	2
9	Assignment / code for stubs and drivers.	2	4
10	Change specifications and make different versions using any SCM tool.	2	2,4

TEXTBOOKS
1 "Software Engineering", Roger Pressman, McGraw Hill, 8th Edition
2 "Software Engineering", Ian Sommerville, Pearson Education, 10thEdition, 2015.

RECOMMENDED READING

1 Software Engineering an Engineering approach, James Peter, John Wiley, First Edition

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3003P	
Course Title	Spatial & Graph Databases Lab	
Prerequisite	Database Management System	

COURSE OUTCOMES	
Student will be able to	
1	Demonstrate basic understanding of PostGIS and QGIS tool.
2	Implement Database in PostGIS.
3	Execute spatial queries and evaluate the performance after applying different indexing technique.
4	Implement Graph Query using Cypher graph query languages & project.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	**Installation of Postgres, PostGIS and QGIS, pgAdmin** Ice cream entrepreneurs Jen have opened business and now need a database to track orders. When taking an order they record the customer's name, the details of the order such as the flavours and quantities of ice cream needed, the date the order is needed and the delivery address. Their database needs to help them answer two important questions: Which orders are due to be shipped within the next two days? Which flavors must be produced in greater quantities? Implement a Database Design for above scenario.	2	1
2	**Introduction to Postgres's graphical interface: pgAdmin** A. Create a new schema, B. Load data from a shapefile C. Create a new table D. Load data using the COPY command E. Write queries in pgAdmin	2	1
3	**Query-Writing Assignment**	2	2
4	**Spatial Select Queries**	2	2
5	**PostGIS Geometry Types Queries.** A. Create a new empty spatial table B. Add rows to the spatial table C. Create and populate a table of line strings	2	2

D. Create and populate a table of polygons

E. 3- and 4-dimensional geometries

F. Multipart geometries

G. Mixing geometries

6	**Add PostGIS data to QGIS** Quantum GIS (QGIS, pronounced kyü'-jis) is a free and open-source desktop GIS package view the tables we created and populated in the previous Assignments	2	3
7	**PostgreSQL provides several index types:** B-tree, R-tree, Hash, and GiST. Each index type uses a different algorithm that is best suited to different types of queries. Create a database execute all index type queries and measure the performance.	2	3
8	**Write queries on following using following Spatial Relationship Functions :** ST_Contains(), ST_Within(), ST_Covers(), ST_CoveredBy(), ST_Intersects(), ST_Disjoint(), ST_Overlaps(), ST_Touches(), ST_Dwithin(), ST_DFullyWithin()	2	3
9	**Write queries on following using following Spatial Measurement Functions :** ST_Area(), ST_Centroid(), ST_Distance(), ST_Distance_Spheroid() and ST_Distance_Sphere(), ST_Length(), ST_Length_Spheroid(), ST_Length3D(), ST_Length3D_Spheroid(), ST_Perimeter(), ST_Perimeter3D()	2	3
10	Working with Cypher graph query languages: Query-Writing Assignment	2	4
11	Indexing on Graph Databases	2	4
12	Mini Project	2	4

TEXTBOOKS

1   Regian O. Obe, Leo S. Hsu , "PostGIS in Action"
2   Ian Robinson, Jim Webber & Emil Eifren, "Graph Databases" O'Reilly

Programme Name	**B. Tech. (Information Technology)**	Semester – V
Course Code	**R4IT3004P**	
Course Title	**Computer Networks Lab**	
Prerequisite	**NIL**	

COURSE OUTCOMES
Student will be able to

1	Demonstrate the working of network components and commands.
2	Design and implement network scenarios using network devices.
3	Apply protocols of different layers to implement networks to satisfy user's requirement.
4	Analyse the implemented solutions for the protocols used at different layers such as MAC, IP, transport and application layer protocols.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	To study basic networking commands.	2	1
2	To study different Networking Devices.	2	1,2
3	Analysis of packet sniffer tools (Wireshark)	2	1,2
4	Study of Physical Layer, MAC Layer, Network Layer, Transport Layer Parameter Using Wireshark	6	2,3
5	Study of functionality of Hub, switches routers using Packet Tracer	2	2,3
6	Study of Implementation Internet Services by telnet, ssh, ftp, scp utilities	2	3,4
7	Implementation of CRC and Hamming code using C++/Java	2	3,4
8	Analysis of different layer protocols	2	3,4

TEXTBOOKS
1 B. A. Forouzan and FirouzMosharraf, "Computer Networks, A Top-Down Approach", McGraw-Hill, 1st Edition, 2012.

2 Andrew S. Tanenbaum, "Computer Networks", Pearson Education, 4thEdition, 2003

RECOMMENDED READING

1 Larry L Peterson and B S Davie, "Computer Networks: A Systems Approach", Elsevier,2012

Programme Name	B. Tech. (Information Technology)	Semester – V
Course Code	R4IT3007S	
Course Title	Web Information Management	
Prerequisite	NIL	

COURSE OUTCOMES

Student will be able to

1. Explain basics of internet.

2. Connect with basics of web design.

3. Perform scripting using and languages for web pages.

4. Design interactive web sites as per the requirements of applications.

Unit No.	COURSE CONTENTS	HRS	CO
1	**INTRODUCTION:** Basic tools of internet access, email, ftp, news, www, introduction to internet programming, Electronic Mail, File Transfer protocol, domain Name, client server application.	4	1
2	**WEB PAGE DESIGNING:** Standard use for www documents on internet, HTTP, MIME, SGML,DTD, MTNL, URL, URL, Static and Dynamic Web sites ,Creation of web pages: HTML tags, special characters, images, tables, forms, the hyperlinks, Frames , style sheets	2	2
3	**SCRIPTING:** JAVA SCRIPT Introduction to JavaScript, Basic Syntax, Control Structures, Writing Functions, The Document Object Model, Events Handling	4	2
4	**XML:** XML basics, analysing markup languages, structures and syntax, valid vs. well-formed XML, DTD (document type Definitions) classes. Scripting XML, XML processor, parent child relationship, XML as a data, data type in XML, XML namespaces,	2	3
5	**ASP.NET Fundamentals:** HTTP and HTML, ASP.NET Controls, Data Validation Controls, Working with Images, CSS	2	3
6	**WEBSITE DESIGN USING ASP.NET:** Designing sample application in ASP.net, GET & POST Requests in forms	2	4
7	Advances in web designing		

TEXTBOOKS

1. Web Technologies: Achyut S. Godbole & Atul Kahate, 2nd edition Tata McGraw Hill publication.
2. Internet and World Wide Web – How to program by Dietel and Nieto PHI/Pearson Education Asia

RECOMMENDED READING

1. ASP.NET 3.5 Unleashed, By Stephan Walther

2. Sams Teach Yourself JavaScript in 24 Hours, By Michael Moncur

Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3011T	
Course Title	Machine Learning	
Prerequisite	Linear Algebra, Probability, Statistics	

COURSE OUTCOMES

Student will be able to

1	Demonstrate fundamentals of different Machine Learning Techniques.
2	Apply regression, classification, and clustering methods for problem solving.
3	Demonstrate the usages of supervised and unsupervised learning methods.
4	Apply advanced techniques of machine learning to solve complex problems.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction:** Learning Problems , Perspectives and Issues , Concept Learning , Version Spaces and Candidate Eliminations , Inductive bias , Decision Tree learning , Representation , Algorithm , Heuristic Space Search	5	1
2	**Instant Based Learning:** K- Nearest Neighbour Learning, Locally weighted Regression, Radial Bases Functions , Case Based Learning. Association Rule Learning: Apriori, FP Growth ,Clustering: Centroid based , K-means, Distribution based , EM, Density based ,DBScan ,Regression: Linear Regression, Interpolation & Extrapolation, Nonlinear regression Artificial Neural Networks: Network Function, Cost, Learning Paradigms, Gradient Descent ,SVM: Classifier, Kernel, Parameter Selection	8	2
3	**Bayesian And Computational Learning:** Bayes Theorem , Concept Learning , Maximum Likelihood , Minimum Description Length Principle , Bayes Optimal Classifier , Gibbs Algorithm , Naïve Bayes Classifier , Bayesian Belief Network , EM Algorithm , Probability Learning , Sample Complexity , Finite and Infinite Hypothesis Spaces , Mistake Bound Model	8	2
4	**Neural Networks And Genetic Algorithms:** Neural Network Representation , Problems ,Perceptron, Multilayer Networks and Back Propagation Algorithms , Advanced Topics , Genetic Algorithms , Hypothesis Space Search , Genetic Programming , Models of Evaluation and Learning Softmax Function , One Hot Encoding , Cross Entropy , Stochastic Gradient Descent , Learning Rate Decay , Parameter Hyperspace ,ReLU - Regularization , Deep NN	6	3

	Architectures , Back propagation, CNN, RNN, LSTM, Deep Boltzmann Machine		
5	**Advanced Learning:** Learning Sets of Rules ,Sequential Covering Algorithm ,Learning Rule Set , First Order Rules, Sets of First Order Rules , Induction on Inverted Deduction , Inverting Resolution , Analytical Learning , Perfect Domain Theories , Explanation Base Learning , FOCL Algorithm ,Reinforcement Learning , Task , Q-Learning , Temporal Difference Learning	7	4
6	Advances in the domain		

TEXTBOOKS

1 Tom M. Mitchell, Machine Learning, McGraw-Hill, 1st edition, 1997 Ethem Alpaydin
2 Introduction to Machine Learning (Adaptive Computation & Machine Learning), The MIT Press 2004
3 Foundations of Machine Learning, Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar
4 Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989

RECOMMENDED READING

1 Hastie. T, Tibshirani. R, Friedman. J. H, The Elements of Statistical Learning, Springer,1st edition, 2001
2 William W.Hsieh, "Machine Learning Methods in the Environmental Sciences", Cambridge
3 Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3012T	
Course Title	Wireless Networks	
Prerequisite	Computer Networks	

COURSE OUTCOMES	
Student will be able to	
1	Demonstrate the fundamentals of wireless technology.
2	Apply the layered protocols and fundamentals for the design of wireless
3	Analyse and apply resource optimization techniques for better performance
4	Apply the working of different wireless networks.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction:** History of wireless communication , Frequency spectrum, Applications	2	1
2	**Wireless Transmission:** Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, modulation, Spread spectrum, Cellular systems.	4	1,2
3	**Medium Access Control:** Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals, multiplexing techniques.	4	1,2
4	**Wireless LAN:** Infrared vs. Radio transmission, Infrastructure and Ad hoc Networks, IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium access control layer, MAC management, Future development; Brief Overview of HIPERLAN, Bluetooth.	7	2,3
5	**Mobile Network Layer:** Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunnelling and Encapsulation, Optimizations, Reverse tunnelling, Ipv6; Dynamic host configuration protocol, Ad hoc networks: Routing, Destination sequence distance vector, Dynamic source routing, Hierarchical algorithms, Alternative metrics.	7	2,3
6	**Mobile Transport Layer:** Traditional TCP, indirect TCP, Snooping TCP, Fast retransmit/fast recovery, transmission/time out freezing, selective retransmission, transaction oriented TCP.	5	2,3,4

| 7 | **Support for Mobility :**File system , World Wide Web, Wireless application protocol | 4 | 1,2 |

TEXTBOOKS

1 Jochen Schiller, "Mobile communications", Addison wesley, Pearson education, 2nd

Edition, 2002.

RECOMMENDED READING

1 Wiiliam Stallings, "Wireless Communications and Networks" Prentice Hall, 2nd edition, 2005.
2 Rappaport, "Wireless Communications Principals and Practices", 2nd Edition, Pearson Education Pvt. Ltd, 2003.

Program Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3013T	
Course Title	Parallel Computing	
Prerequisite	COA, OS, Data Structure.	

COURSE OUTCOMES: Students will be able to	
1.	Student will be able to analyze and appreciate the applications which can use parallel computing, distributing processing.
2.	Student will be able to understand pipeline processing methods
3.	Student will be able to understand the interconnection network, multi-core/ many-core architecture.
4.	Analyze parallel Programming environments using MPI, CUDA, and Open MP.

COURSE CONTENTS	Hrs	CO
1. **Introduction:** Parallel Computing, Parallel Architectures: Architecture classification scheme, Many core GPGPU architectures, Performance matrices of processors, Parallel Programming model, Parallel Algorithms, Distributed processing.	4	1
2. **Pipeline Processing:** Pipeline performance, Arithmetic pipeline, Mathematic pipeline, Pipeline instruction processing, Pipeline stage design, Hazards, Dynamic instruction scheduling, memory system used in pipeline processors, Pipeline scheduling, Theory, Branch Prediction.	4	2
3. **Interconnection Network:** Introduction to permutation, Elementary permutation used in Interconnection Network, Network classification, complete processors, commonly used interconnection network.	4	3
4. **Multi-core/many-core Architecture:** Basics of parallel architecture. Inter-process communication, Synchronization, Mutual exclusion, Introduction to multi-core/many-core architecture Introduction to multi core/many-core programming, AMD/ATI GPU architectures, GPU Hardware: Streaming Multiprocessors, Kernel, Thread Blocks, Threads, GPU Memory Model: Synchronization, Barrier, Memory access, Coalesce, Atomics.	6	4
5. **Parallel Programming Models:** Parallel programming with message passing using MPI, Directives based parallel programming models, OpenMP, OpenACC, Thread-level parallelism, GPU architectures and the programming model for GPGPU (CUDA). Communication Patterns: Map, Gather, Scatter, Stencil, Transpose, Strategies for efficient CUDA programming.	4	1,4
6. **Principles of Parallel Algorithm Design:** Pure parallel algorithms and data dependencies, Decomposition Techniques, Characteristics of task and interactions, Mapping technique for load balancing, Method for containing Interaction overhead, Parallel algorithm model.	4	1
7. **Analytical modeling and parallel program:** Basic performance measures, measures of data communication, Multiplication factors, effect of software, cognitive system, benchmarking, defining and measuring cost, scalability of parallel system.	4	3

8	**Numerical and Non-numerical algorithms:** Sorting, graphs, dynamic programming, dense matrix algorithms, sparse matrix algorithms.	3	3,4
9	**Supercomputing:** Introduction to Grid, Cluster, GPGPUs architectures, Job Management Systems, File Systems: Shared File Systems (e.g. NFS), Parallel File Systems (e.g. GPFS, PVFS, Lustre), interconnection networks for supercomputers. Case studies on Supercomputers.	4	3,4
10.	**Advances in the domain**	2	4

TEXTBOOKS
1. Ananth Grama, "An Introduction to Parallel Computing: Design and Analysis of Algorithms", Pearson publication, 2009.
2. Michael J Quinn, Parallel Programming in C with MPI and OpenMP, Tata McGraw-Hill 2011.
3. Hawang Kai and Briggs F. A., "Computer Architecture and Parallel Processing", McGraw Hill, 1984.

RECOMMENDED READING
1 Barbara Chapman, Using OpenMP. Portable Shared Memory Parallel Programming, The MIT Press Cambridge, Massachusetts London, England 2008
2 David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors A Hands-on Approach Second Edition, Elsevier 2013.
3 T. J. Fountain, "Parallel Computing: Principles and Practice", Cambridge University Press, 2006.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3101T	
Course Title	Spatial Data Analysis and Visualization	
Prerequisite	NIL	

COURSE OUTCOMES

Student will be able to

1	Understand the nature of spatial data
2	Identify the error in spatial data
3	Analyse spatial data using numerical methods
4	Apply smoothing methods for spatial data

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Spatial data analysis: scientific and policy context:** Spatial data analysis in science, Generic issues of place, context and space in scientific explanation, Location as place and context, Location and spatial relationships, Place and space in specific areas of scientific explanation, Environmental criminology, Geographical and environmental (spatial) epidemiology, Regional economics and the new economic geography, Spatial data analysis in the policy area	4	1
2	**The nature of spatial data:** The spatial data matrix: conceptualization and representation issues, The spatial data matrix: its form, The spatial data matrix: its quality, Quantifying spatial dependence	5	1
3	**Obtaining spatial data through sampling:** Sources of spatial data, Spatial sampling, The purpose and conduct of spatial sampling, Design- and model-based approaches to spatial sampling, Sampling plans, Selected sampling problems, Maps through simulation	5	2
4	**Data quality: implications for spatial data analysis**: Errors in data and spatial data analysis, Models for measurement error, Gross errors, Error propagation, Data resolution and spatial data analysis, Variable precision and tests of significance, The change of support problem, Analysing relationships using aggregate data, Data consistency and spatial data analysis, Data completeness and spatial data analysis, The missing-data problem.	6	2
5	**Exploratory spatial data analysis: conceptual models:** EDA and ESDA, Conceptual models of spatial variation, The regional model, Spatial `rough' and `smooth, Scales of spatial variation	5	3
6	**Exploratory spatial data analysis: visualization methods:** Data	4	3

visualization and exploratory data analysis, Visualizing spatial data, Data preparation issues for aggregated data: variable values, Data preparation issues for aggregated data: the spatial framework, Data visualization and exploratory spatial data analysis. Spatial data visualization: selected techniques for bi- and multi-variate datasemi-variogram, DEM, TIN,slope, aspect, hill shade and viewshed

| 7 | **Exploratory spatial data analysis: numerical methods:** Smoothing methods, Resistant smoothing of graph plots, Resistant description of spatial dependencies, Map smoothing, The exploratory identification of global map properties: overall clustering, Clustering in area data, The exploratory identification of local map properties. Advances in the domain | 5 | 4 |

TEXTBOOKS

1   Haining, Robert P., and Robert Haining. Spatial data analysis: theory and practice. Cambridge University Press, 2003.

RECOMMENDED READING

1   Fischer, Manfred M., and Jinfeng Wang. Spatial data analysis: models, methods and techniques. Springer Science & Business Media, 2011.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3102T	
Course Title	Object Oriented Analysis and Design	
Prerequisite	Software Engineering	

COURSE OUTCOMES

Student will be able to

1	Identify and model the requirement of the software requirement.
2	Apply Object oriented design and development techniques to problems.
3	Apply architectural design to the problems.
4	Analyze and apply the deployment techniques for the complex problems

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction:** Overview Of OOL; Object Classes; Meta Types. Object Oriented Methodologies; The Unified Approach Modeling; Why Modeling? Static And Dynamic Models; Functional Models.	3	1
2	**Object Modeling:** Object. Links. Association. Inheritance. Grouping Constructs; Problems On Object Modeling; Advantages Of Object Modeling.	3	1
3	**Analysis :** Problem Analysis. Problem Domain Classes. Identify Classes And Objects Of Real World Problems. Using Use Case Analysis; Recording Analysis	3	2
4	**Basic Object Modeling:** Multiplicity. Constraints. Aggregation. Component	2	1,2
5	**Sequence Diagram:** Modeling Scenarios. Mapping Events To Object. Interfaces. Discovering Attributes. Modeling Simple Collaboration Modeling. Logical Database Schema. Activity Diagram. Modeling Workflow.	2	1,2
6	**Class Diagram:** Test Scenarios. Interfaces. Classes. Methods. Stress Testing. System Testing. Scalability Testing. Regression Testing.	2	2,3

	Behavioral Modeling. State Chart Diagram.		
7	**Design:**	3	2,3
	Architectural Design. Refining The Model. Refactoring. Coupling And Cohesion. Who Should Own The Attribute? Who Should Own The Operations? Process And Threads.		
8	**Design Classes:**	3	2,3
	Classes Visibility; User Interface. Subsystem Interface.		
9	**Deployment Diagram:**	3	3,4
	Modeling deployment diagrams		
10	Advances in the domain		

TEXTBOOKS

1   Ali Bahrami, "Object Oriented System Development ", McGraw Hill.

2   Grady Booch, J. Rambaugh, Ivar Jacobson, "The UML Users guide", Pearson

3   Andrew Haigh, "Object Oriented Analysis and Design", Tata McGrawHill

RECOMMENDED READING

1   Simon Benett, Steve McRobb, Ray Farmer, "Object Oriented System Analysis and Design Using UML", McGrawHill.

2   Timothy C. Lethbridge, Robert Laganiere, "Object Oriented Software Engineering", McGrawHill.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3103T	
Course Title	Number Theory	
Prerequisite	Knowledge of Mathematics	

COURSE OUTCOMES	
Student will be able to	
1	Demonstrate conceptual understanding of the theoretical basis of number theory and cryptography.
2	Implement and solve problems in elementary number theory.
3	Apply elementary number theory to cryptography.
4	Design the use cases of Cryptography to solve real life problems.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Divisibility and Factorization:** Divisibility: Definition, properties, division algorithm, and greatest integer function Primes: Definition, Euclid's Theorem, Prime Number Theorem (statement only), Goldbach and Twin Primes conjectures, Fermat primes, Mersenne primes. The greatest common divisor: Definition, properties, Euclid's algorithm, linear combinations and the GCD. The least common multiple: Definition and properties The Fundamental Theorem of Arithmetic: Euclid's Lemma, canonical prime factorization, divisibility, GCD, and lcm in terms of prime factorizations Primes in arithmetic progressions: Dirichlet's Theorem on primes in arithmetic progressions (statement only).	8	1
2	**Congruence's:** Definitions and basic properties, residue classes, complete residue systems, reduced residue systems. Linear congruence's in one variable, Euclid's algorithm. Simultaneous linear congruence's, Chinese Remainder Theorem. Wilson's Theorem. Fermat's Theorem, pseudo primes and Carmichael numbers. Euler's Theorem.	7	2
3	**Arithmetic functions:** Arithmetic function, multiplicative functions: definitions and basic examples. The Moebius function, Moebius inversion formula. The Euler phi function, Carmichael conjecture. The number-of-divisors and sum-of-divisors functions. Perfect numbers, characterization of even perfect numbers.,applications	6	2
4	**Quadratic residues:** Quadratic residues and nonresidues The Legendre symbol: Definition and basic properties, Euler's Criterion, Gauss' Lemma The law of quadratic reciprocity.	7	3

| 5 | **Advances in number theory** | 4 | 4 |

TEXTBOOKS
1   James Strayer, Elementary Number Theory, Waveland Press, 2014.
2   Kenneth Rosen, Elementary Number Theory and its Applications, McGraw Hill, 6th Edition, 2007.
3   I. Niven, H. Zuckerman, H. Montgomery, An Introduction to the Theory of Numbers, Wiley, 5[th]Edition, 2007.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3104T	
Course Title	Digital Image Processing	
Prerequisite	NIL	

COURSE OUTCOMES

Student will be able to

1	Apply knowledge of various transforms in image processing.
2	Demonstrate the mathematical principles of digital image enhancement, encoding, feature extraction, segmentation and restoration.
3	Analyse, apply and critically evaluate various image processing algorithms.
4	Design and develop image processing applications in practice.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Introduction to Signal and Image Processing:** Discrete-time signals and systems: linearity, time-invariance, causality, stability, and convolution; discrete time random signals, cross and auto correlation sequences. The origins and examples of Digital Image Processing (DIP), Visual Perception, Images Sensing and Acquisition, Image Sampling and Quantization, Relationship between Pixels.	3	1
2	**Intensity Transformations and Spatial Filtering:** Intensity Transformation Functions, Histogram Processing, Spatial Filtering, Smoothing and Sharpening.	3	1
3	**Filtering in the Frequency Domain:** Sampling, Fourier Transform, 1D, 2D DFT, Properties of DFT, Filtering in Frequency Domain, Image Smoothing, Image Sharpening, Selective Filtering, and Implementation.	4	2
4	**Image Restoration and Reconstruction:** A model of Image Restoration/ Degradation, Noise Models, Restoration in the Presence of Noise, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position , Invariant Degradation, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.	4	3
5	**Color Image Processing:** Color Fundamentals, Color Models, Pseudo Color Image Processing, Color Transformations, Smoothing and Sharpening.	4	3
6	**Wavelets and Multiresolution Processing:** Background, Multi resolution on expansions, Wavelets Transforms. Fundamentals, Compression Methods.	3	3

7	**Morphological Image Processing:** Erosion and Dilation, Opening and Closing, Hit-or-Miss Transformation, Morphological Algorithms, Grey Scale Morphology.	4	3
8	**Image Segmentation:** Point, Line, and Edge Detection, Thresholding, Region Based Segmentation, Image Representation, Boundary Descriptors, Regional Descriptor.	4	4
9	**Applications of Image Processing:** Character recognition, Digital watermarking, Image compression, Finger, Iris, Face recognition	4	4
10	Advances in the domain		

TEXTBOOKS

1   R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Prentice Hall

Publication, 3rdEdition, 2009

2   K. Jain, Fundamentals of Digital Image Processing, PHI, 1st Edition, 2010.

RECOMMENDED READING

1   Chris Solomen, Toby Brecken, Fundamentals of Digital Image Processing: A

Practical Approach with Examples in Matlab, Wiley Blackwell Publication,

December 2010.

2   M. Sonka, V. Hlavac, R. Boyle, Image Processing, Analysis and Machine Vision,

Thomas Learning, 3rd Edition, 2007.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3105T	
Course Title	Digital Forensic Analysis	
Prerequisite		

COURSE OUTCOMES

Student will be able to

1	Understand the basics of different security mechanisms.
2	Design the digital forensic model.
3	Apply digital forensics analysis upon Windows and LINUX operating systems.
4	Demonstrate an awareness of current methods of reducing the effectiveness of anti-forensics.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Information Security:** Security Attacks, Types of Attacks: active, passive, services and mechanisms, classical crypto systems, substitution and transposition cycle, crypt analysis, stream and block cipher, Shannon Theory of confusion and diffusion, symmetric and asymmetric key cryptography	5	1
2	**Database Security:** Databases Security requirements, Reliability and Integrity, Sensitive data, Inference, Multilevel database, Proposal for multilevel security, RBAC, MAC and DAC using ORACLE database.	5	1
3	**Digital Forensics Fundamentals:** Use of Digital forensics in law enforcement, computer forensics assistance, to human resources/employment proceedings, benefits of professional forensics methodology, steps taken by Digital forensics specialists.	6	2
4	**Evidence Capture, Duplication and Preservation of Digital Evidence:** Evidence Collection and Data Seizure: evidence, collection options, obstacles, types of evidence, the rules of evidence, volatile evidence, general procedure. Preserving the digital crime scene computer evidence processing steps, legal aspects of collecting and preserving computer forensic evidence,	6	3
5	**Processing Crime and Incident Scenes:** Identifying digital evidence, collecting evidence in private sector incident scenes, processing law enforcement crime scenes, preparing for a search securing a computer incident or crime, scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.	6	4
6	**Windows Registry Basics:** Windows Registry Structure, Registry	7	5

Hives and Keys, Registry Data Types, Structural Representation of Registry in Memory, Importance of Analyzing Registry in Memory, Registry Keys with forensic Importance, Collecting Evidences against criminal. Case study on Windows Registry forensic, Understanding Linux file systems, exploring Microsoft file structures, examining NTFS disks, understanding whole disc encryption, windows registry, Microsoft startup tasks, MSDOS startup tasks, virtual machines, Current Forensic Tools: Evaluating computer forensic tool needs, computer forensic software Tools, computer forensic hardware tools, validating and testing forensic software.

7   Advances in the domain

TEXTBOOKS
1   Behrouz Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security Tata McGraw Hill, 2ndEdition, 2010.
2   John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, Elsevier Publication, 1st Edition, 2012.
3   Dr. B.B. Meshram, Ms K.A. Shirsath, TCP/IP and Network Security, Attacks and Defence Mechanisms with open source tools, Shroff Publishers & Distributors PVT. LTD.

RECOMMENDED READING

1   Warren G. Kruse II and Jay G. Heiser, Computer Forensics: Incident Response Essentials, Addison Wesley, 2002.
2   Nelson B, Phillips A, Enfinger F, Stuart C., Guide to Computer Forensics and Investigations, Thomson Course Technology, 2nd Edition, 2006.
3   Warren G. Kruse II and Jay G. Heiser, Computer Forensics: Incident Response Essentials, Addison Wesley, 2002.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4HM3002L	
Course Title	Professional communication skills	
Prerequisite	NIL	

COURSE OUTCOMES

Student will be able to

1	Study organizational problems related to communication and make a presentation.
2	Speak with clarity, confidence and use appropriate voice modulation within the given time.
3	Scrutinize what lies beneath a news report; examine reporting of current issues; summarize.
4	Identify three technical writing process; differentiate between technical writing and general writing; practice styles of technical writing. Draft a technical document using good practices of technical witting principal
5	Participate in a group discussion.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Communication in an organization:** process, types, barriers	2	1
2	**Speaking Skills:** Voice modulation, pronunciation, speaking with confidence, prepared and extempore speeches, video-conferencing	4	2
3	Listening, Note-making and Minutes of Meeting	4	3,4
4	**Technical Writing:** Vocabulary building, effective sentences and paragraph, organizational pattern, and summarizing	4	4
5	**Special Types of Technical writing**: Business Letter, Email, Brochure, Report, Memo, Proposal, Research paper, Conference Paper	4	4
6	**Interview skills:** Resume and job application, preparation for interviews, Interview questions and answers, Group Discussion	5	4,5
7	**Presentation Skills:** Planning, preparing, organizing and delivering an oral presentation	5	2,4

8   **Assignments:**
   1. **Communication:**
      Analysis of cases on communication in an organization with students' presentation in groups

   2. **Speaking Skills:**

      a.   Each student gives a prepared speech on any topic (current affair / news analysis / film review)
      b.   Demonstration of a simulated video-conference

3. **Listening and Note-making:**
Participating in role-play of a business meeting and making notes of the meeting (minutes)

4. **Technical Writing:**
Solving exercises in vocabulary building, effective sentences and paragraph, organizational pattern, and summarizing

5. **Special Types of Technical writing:**
Each student has to submit 2 written assignments of 1500 words each on any two types of writing, selecting an industry related communication problem.

6. **Interview skills:**
Every student has to compulsorily participate in a mock interview or Group discussion

7. **Presentation:**
Group of 5-7 students will select a topic and make a formal powerpoint presentation and submit a formal report.

TEXTBOOKS
1   Effective Technical Communication, Ashraf Rizvi, Tata McGraw Hill
2   Technical Communication, Meenakshi Raman, Sangeeta Sharma, OUP

RECOMMENDED READING

1   Business communication- process and product, Mary Ellen Guffey, Thomson

2   Report writing for Business, Raymond Lesikar, John Petit, Irwin McGraw hill
3   Basic Business Communication, Raymond Lesikar, John Petit, Irwin McGraw hill
4   Guide to Presentation, Mary Munter, Lynn Russell, Prentice hall
5   Speaking Effectively; Jeremy Comfort, Pamela Rogerson et al, CUP
6   Effective Technical Communication, Anne Eisenberg, Mc Graw Hill

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	**R4IT3011P**	
Course Title	**Machine Learning Lab**	
Prerequisite		

COURSE OUTCOMES	
Student will be able to	
1	Demonstrate the usage of Preparation of data sets for implementation of machine learning algorithms
2	Implement the machine learning concepts and algorithms in any suitable language of choice.
3	Evaluate the machine learning algorithms which are more appropriate for various types of learning tasks in various domains related to data set.
4	Apply and analyse deep learning algorithms to solve research problems.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	2	1
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	2	1,2
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2	1,2
4	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	2	2,3
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets	2	2,3
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set	2	2
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	2	3,4

8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	2	2,3,4
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	2	3,4
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	2	3,4

TEXTBOOKS

1   Tom M. Mitchell, "Machine Learning", McGraw-Hill, 1st Edition, 2017
2   Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation & Machine Learning)", 2nd Edition, 2009.
3   Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning",Addison Wesley, N.Y., 1989.

RECOMMENDED READING

1   Hastie. T, Tibshirani. R, Friedman. J. H, "The Elements of Statistical Learning", Springer, 1st edition, 2001.
2   William W.Hsieh, "Machine Learning Methods in the Environmental Sciences", Cambridge Publication.
3   Han Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3012P	
Course Title	Wireless Networks Lab	
Prerequisite		

COURSE OUTCOMES

Student will be able to

1	Demonstrate wireless fundamentals and build the topologies for wireless networks
2	Implement to demonstrate the working of protocols of wireless networks.
3	Analyse of protocols in wireless networks
4	Evaluate the performance wireless networks

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Study of Simulators for wireless networks.	2	1
2	Build and configure Ad-hoc networks for various topologies.	2	1,2
3	Study of working Physical MAC, Network, Transport Layer parameters.	4	1,2
4	Study and analysis of protocols at different layers.	2	2,3
5	To Build and Study Star topology for wireless sensor network.	2	2,3
6	To Build and Study Multi-hop topology for wireless sensor network.	2	2,3
7	Study and analysis of protocols for wireless sensor network	2	3,4
8	Evaluate protocols used for different wireless networks	4	2,3,4

TEXTBOOKS

1   Jochen Schiller, "Mobile communications", Addison wesley, Pearson education, 2nd Edition, 2002.

RECOMMENDED READING

1   Wiiliam Stallings, "Wireless Communications and Networks" Prentice Hall, 2nd edition ,2005

2   Rappaport, "Wireless Communications Principals and Practices" , 2nd Edition, Pearson Education Pvt. Ltd, 2003

Program Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3013P	
Course Title	Parallel Computing Lab	
Prerequisite	C/C++ programming	

COURSE OUTCOMES: Students will be able to	
1.	Student will be able to understand Multi-Core Share memory programming (Open MP)
2.	Student will be able to understand the, interconnection network programming (MPI).
3.	Analyze parallel Programming environments using Many core programming (CUDA).
4.	Analyze parallel Programming environments using Hybrid programming.

COURSE CONTENTS	Hrs	CO
1. Case study for Building a LINUX Cluster for Parallel Computing.	2	2,4

OpenMP Programming:

	Hrs	CO
1. Write an OpenMP Program of Matrix Multiplication and measure the performance	2	1
2. Write the OpenMP program to find prime numbers between 2 and the given number, and stores all the prime numbers in an array. Input: No. of thread The Number (in the program, N) Output : total count of prime numbers all the prime numbers till N.	1	1
3. Write an OpenMP program to print Largest of an element in an array Make use of Omp_critical section call and PARALLEL For DIRECTIVE.	1	1
4. Write an OpenMP Program for Ring Topology	1	1
5. Write an OpenMP program for PI calculation.	1	1

MPI Programming:

	Hrs	CO
1. Write a simple MPI program for calculating Rank and Number of processor.	1	2
2. Write a MPI program for PI calculation.	1	2
3. Write an Advanced MPI program that has a total number of 4 processes. The process with rank 0 should send VJTI letter to all the processes using MPI_Scatter call	1	2
4. Write an Advanced MPI program to find maximum value in array of six integers with 6 processes and print the result in root process using MPI_Reduce call.	1	2

Numerical Computing Programming:

	Hrs	CO
1 Write any one numerical computing programming for implement Trapezoid Rule with MPI.	1	2
2 Write any one numerical computing programming for implement Gaussian Filter with MPI.	1	2

Page No 49

CUDA Programming:

1.	Write a simple CUDA Programming for Hello World'.	1	3
2.	Write a CUDA program for Matrix addition	1	3
3.	Write a CUDA program for prefix Sum	1	3
4.	Write a CUDA program for Matrix Transpose	1	3
5.	Write a CUDA program for vector addition	1	3
6.	Write a CUDA program for vector multiplication	1	3

Hybrid Programming:

1	Write a Hybrid program for **MPI + OpenMP** for calculating PI.	1	4
.2.	Write a Hybrid program for **MPI + CUDA** for Hello World'.	1	4

TEXTBOOKS
1. Michael J Quinn, Parallel Programming in C with MPI and OpenMP, Tata McGraw-Hill 2011.
2. Barbara Chapman, Using OpenMP. Portable Shared Memory Parallel Programming, The MIT Press Cambridge, Massachusetts London, England 2008
3. David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors A Hands-on Approach Second Edition, Elsevier 2013.
4 Ananth Grama, "An Introduction to Parallel Computing: Design and Analysis of Algorithms", Pearson publication, 2009.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3101P	
Course Title	Spatial Data Analysis and Visualization Lab	
Prerequisite	Knowledge of Geographic Information System	

COURSE OUTCOMES

Student will be able to

1	Understand the nature of spatial data
2	Implement and identify the error in spatial data
3	Analyse spatial data using numerical methods
4	Apply smoothing methods for spatial data

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	View the raw data in R	2	1
2	Data Exploration in R	2	1
3	Bivariate Plots in R	2	2
4	Find relationship in R	2	2
5	Making maps in R	2	3
6	Making Point in R	2	3
7	Using R as GIS	2	3
8	Representing densities in R	2	3
9	Interpolating point data in R	2	4
10	Function and loops in R	2	4

TEXTBOOKS

1   Haining, Robert P., and Robert Haining. Spatial data analysis: theory and practice. Cambridge University Press, 2003.

RECOMMENDED READING

1   Fischer, Manfred M., and Jinfeng Wang. Spatial data analysis: models, methods and techniques. Springer Science & Business Media, 2011.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3102P	
Course Title	Object Oriented Analysis and Design Lab	
Prerequisite	Software Engineering	

COURSE OUTCOMES

Student will be able to

1	Demonstrate fundamental knowledge of software development life cycle.
2	Design software requirement specification document for a project.
3	Analyze and apply object modeling techniques for solving complex problem.
4	Evaluate different design artifacts developed to provide solution to the problem.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Draw software life cycle with phases.	02	1
2	SRS Documentation for project.	02	1
3	Class Modeling	02	2
4	State Modeling	02	2
5	Interaction Modeling	02	3
6	Analysis and Design	02	3
7	System Design	02	3
8	Class design	02	4
9	Component Diagram	02	4

TEXTBOOKS

1.   Ali Bahrami, "Object Oriented System Development ", McGraw Hill.
2.   Grady Booch, J. Rambaugh, Ivar Jacobson, "The UML Users guide", Pearson
3.   Andrew Haigh, "Object Oriented Analysis and Design", Tata McGrawHill

RECOMMENDED READING

1   Simon Benett, Steve McRobb, Ray Farmer, "Object Oriented System Analysis and Design Using UML", McGrawHill.

2   Timothy C. Lethbridge, Robert Laganiere, "Object Oriented Software Engineering", McGrawHill.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3103P	
Course Title	Number Theory Lab	
Prerequisite	Knowledge of Mathematics	

COURSE OUTCOMES	
Student will be able to	
1	Implement problems of factorisations and obtaining roots using well known theorems.
2	Solve residue related problems
3	Apply elementary number theory to cryptography.
4	Evaluate the conceptual understanding of the theoretical basis of number theory and cryptography.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Write a program to find Greatest common divisor of two numbers.	2	1,2,4
2	Write a program to implement Euclidean algorithm.	2	1,2,3
3	Write a program to implement fermat, Euler Theorems.	2	1,2
4	Write a program to implement Chinese remainder theorem.	2	1,2
5	Write a program to find quadratic residues by Legendre's symbols.	2	2
6	Write a program to find quadratic residues by Jacobi's symbols.	2	2
7	Write a program to find represent and solve Diophantine equations.	2	1,2
8	Write a program to test primality using Fermat's primality test.	2	1,2
9	Write a program to implement RSA algorithm	2	3,4
10	Write a program to find primitive roots using Lagrange's Theorem.	2	1

TEXTBOOKS
1   James Strayer, Elementary Number Theory, Waveland Press, 2014.
2   Kenneth Rosen, Elementary Number Theory and its Applications, McGraw Hill, 6th Edition, 2007.
3   I. Niven, H. Zuckerman, H. Montgomery, An Introduction to the Theory of Numbers, Wiley, 5[th]Edition, 2007.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3104P	
Course Title	Digital Image Processing Lab	
Prerequisite		

COURSE OUTCOMES

Student will be able to

1	Implement Techniques for Arithmetic Coding and Edge Detection.
2	Demonstrate various Linear and Non-linear Filtering Techniques (Spatial / Frequency Domain).
3	Develop Histogram Equalization and Manipulation for Image.
4	Analyse Techniques for Image Segmentation, Compression & De-compression and Enhancement.

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Write Programme for Implementation of Arithmatic Coding for Image.	2	1
2	Write Programme for Histogram Display and Histogram Equalization.	2	3
3	Write Programme to design of Non-linear Filtering.	2	1
4	Write Programme for determination of Edge detection using Operators.	2	1
5	Write Programme for Filtering in frequency domain.	2	2
6	Write Programme for basic JPEG Algorithm Implementation.	2	2
7	Write Programme for Image Enhancement a) using Histogram Processing Technique. b) using Spatial Filtering (Smoothing Filters / Sharpening Filters)	2	4
8	Write Programme for Image Segmentation a) using Split and Merge Technique. b) using Watershed Transform.	2	4
9	Write Programme for Image Compression and De-compression a) using Huffman Coding and Decoding. b) using Arithmetic Coding and Decoding.	2	4
10	Write Programme for Color Image Manipulations, Reading and Writing of Color Image.	2	3
11	Write Programme for Color Image Enhancement	2	3

| 12 | Write Programme for Color Image Histogram Manipulation. | 2 | 3 |

TEXTBOOKS
1   Rafel C. Gonzalez and Richard E. Woods: Digital Image Processing, Prentice Hall, Third Edition
2   William K. Pratt: Digital Image Processing, PIKS Inside, Third Edition

3   Anil K Jain: Fundamentals of Digital Image Processing, Prentice Hall of India, First Edition

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3105P	
Course Title	Digital Forensic Analysis Lab	
Prerequisite	NIL	

COURSE OUTCOMES

Student will be able to

1	Demonstrate an awareness of current methods
2	Apply Digital Forensic Methods related to image.
3	Solve evidence related problems
4	Implement and evaluate Digital Forensic using different tools

COURSE CONTENTS

Unit No	Experiment List	Hrs	CO
1	Recovering deleted files from a hard disk	2	1
2	Viewing files of various formats	2	1
3	Performing image and file conversions	2	2
4	Creating a disk image file of a hard disk partition	2	3
5	Gathering evidence	2	3
6	Locating files needed for a forensics investigation	2	4
7	Handling evidence data	2	3,4

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4IT3601S	
Course Title	System Administration	
Prerequisite		

COURSE OUTCOMES
Student will be able to

1	Demonstrate the fundamental of system administration with emphasis on GNU/Linux based systems commands
2	Apply various Linux distributions File system administration functionality
3	Execute Network Administration, Server administration functionality.
4	Implement and configure a server with security administration policy.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Basic System Administration:**	5	1
	Partitioning, Installation of multiple operating systems on Desktops, Various Unix Shells, Bash Shell, Shell Programing; Various operating system services: cron, cpu usage, system load management, user management, backup, log management, boot loader, process management, file system namespace; Initialization scripts; Kernel upgrade.		
2	**File system Administration:**	5	2
	Formatting, Partitioning, Defragmentation, Quotas, Journal, Logical Volume Management, Disk layouts, File System Check, SAN, NAS; Case Studies: ext2, ext4, NTFS, Samba, CIFS, NFS, B-tree-fs, LVM, fat32. Parallel file system: configuration and management		
3	**Network Administration:**	5	3
	LAN setup, DHCP Server, Configuration of network switch, Cluster Setup, DNS Server, NFS, NIS, Router Setup, Serial Line IP, Point to Point Protocol configuration, Email Setup, Sendmail, IDA, Network News.		
4	**Devices/server Administration, Backup and Restore:**	5	1,3
	Installing and configuring printers, scanners, PCI devices, LAN cards, Troubleshooting, Plug and Play devices, Network printer setup, MySQL server, POSTGRES server, database servers. Backup Elements: User Perspective , Density and Form Factor, Network Bandwidth, Remote Sites , Backup Methods , Explore		

	Backup Tools : dump, dd, restore		
5	**Security Administration:**	5	4
	GNU/Linux security architecture, Access control, PAM, Security Tools –nmap, SE Linux, Authentication Mechanisms, LDAP, Firewall, Firewall policies, Proxy Servers, SOCKS Proxy server.		
6	**Advance Technologies:** Cluster Administration: setup & configuration, parallel process management	5	4
7	Advances in the domain	5	4

TEXTBOOKS

1   Evi Nemeth, Garth Snyder, Ben Whaley, and Trent R. Hein, UNIX and Linux System Administration Handbook, Publisher: Pearson Education; 4th edition, 2010

2   Wale Soyinka, Linux Administration: A Beginner's Guide, McGraw-Hill Osborne Media Publication, 6th Edition, 2012.

RECOMMENDED READING

1   Richard Petersen, Linux: The Complete Reference, Shroff/o/'Reilly, McGraw-Hill Education; 6th edition, 2007.

2   Arnold Robbins, Nelson H. F. Beebe, Classic Shell Scripting, 1st edition, 1999.

3   Richard Blum and Christine Bresnahan, Linux Command Line and Shell Scripting Bible, Wiley India Pvt. Ltd.; 2nd edition, 2011.

Programme Name	B. Tech. (Information Technology)	Semester – VI
Course Code	R4CO3601S	
Course Title	Network Security	
Prerequisite	Computer Network, Operating System	

COURSE OUTCOMES

Student will be able to

1	Demonstrate the concept of cryptography
2	Apply the fundamentals of security in programs, operating systems and databases.
3	Evaluate network security threats and counter measures.
4	Implement and analyze the web security and ESAPI security mechanism.

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1	**Mathematical Foundations:** Basic Number Theory, Congruences , Chinese Remainder theorem, Modular exponentiation, Fermat and Euler's theorem , Finite fields, Discrete Logarithms	4	1
2	**Symmetric key Ciphers**: Modern Block Ciphers - DES, AES, Modes of Operation of Block Ciphers, Differential Cryptanalysis ,Triple DES , Stream Ciphers ,Pseudorandom Functions	4	1
3	**Asymmetric key Cryptography**: RSA Cryptosystem, El Gamal Cryptosystem, Elliptic Curve based Cryptography, Diffie Hellman Key Exchange. Cryptographic Hash Functions: Merkle Damgard Construction, Applications of Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Code- Message Authentication Requirements and Functions, HMAC, Digital Signature Schemes.	4	1
4	**Program Security:** Security, Attacks, the meaning of computer security, Computer Criminals, Methods of Defense, Network security fundamentals: vulnerability and attacks, defense mechanism, Vulnerability based intrusion analysis. Secure Software Architecture and Design: Secure Software Lifecycle, Architectural Risk Analysis, Threat Analysis, Security Principles, Security Guidelines, Attack Patterns. Secure Coding and Testing: Secure Programs, non-malicious Program errors, virus and other malicious code, Targeted malicious	5	2

	code, Control against threats.		
5	**System Security:**	4	2
	Protection in General-purpose Operating System: Security and Controls – Protected objects and Methods of Protection –Memory and address Protection – Control of Access to General Objects – Local access Control – Case study-Hardening Linux Operating Systems: Workstation Security, Server Security and Network Security.		
6	**Database Security:**	4	2
	Databases Security requirements – Reliability and Integrity – Sensitive data – Inference – Multilevel database – Proposal for multilevel security, RBAC, MAC and DAC using ORACLE database		
7	**Network Security:**	4	3
	TCP/IP Stack: TCP/IP Protocol and its Vulnerabilities, Attacks and Defense Mechanism, Open source tools for defense mechanism. Network Design: Routing attacks and defense mechanism, Network Security controls – Firewalls – Intrusion prevention Systems, IPS architecture-Intrusion detection engine, analysis engine, recommendation engine, packet capture and preprocessing engine, How to use network analysis tool: Wireshark and NMAP.		
8	**OWASP: Web Application Security and the OWASP top 10:**	4	4
	Injection, Vulnerability, Cross Site Scripting (XSS) Vulnerability, Broken Authentication and Session Management, Insecure Direct Object References, Cross Site Request Forgery (CSRF) Vulnerability, Failure to Restrict URL Access, Invalidated Redirects and Forwards ESAPI structure: security mechanism to mitigate the top 10 threats of OWASP.		
9	Advances in network security	2	4

TEXTBOOKS
1   Charles P. Pfleeger, Security in Computing, Prentice Hall India, 5th edition, 2015.
2   Dr. B.B. Meshram, Ms K.A. Shirsath, TCP/IP and Network Security: Attacks and Defense Mechanisms With Open Source Tools, Shroff Publishers & Distributors PVT. LTD, 1st edition, 2017.

RECOMMENDED READING

1   Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw, Nancy Mead. Software Security Engineering – A guide for project Managers, Pearson Education, 1st edition, 2008.

2   ISECOM, Hacking Exposed Linux: Linux Security Secret and Solutions, McGraw

Hill Education, 3rd edition, 2008.