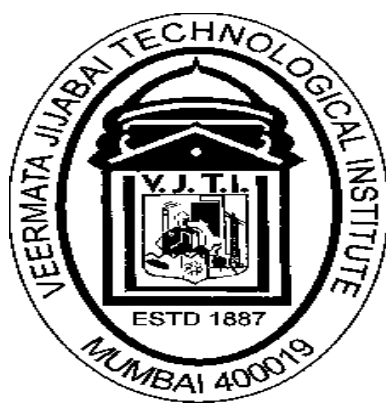


**VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)
MATUNGA, MUMBAI 400 019**

(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 | Hours/Week | | | Credit | Evaluation Scheme | | |
|---------|----------------|-------------------------------|------------|---|---|--------|-------------------|-----|-----|
| | | | L | T | P | | 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 | Hours / Week | | | Credits | Evaluation Scheme | | |
|-------|-------------|-----------------------------------|--------------|---|----|---------|-------------------|-----|-----|
| | | | 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, 10th Edition, 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 Firouz Mosharraf, “Computer Networks, A Top-Down Approach”, McGraw-Hill, 1st Edition, 2012.
- 2 Andrew S. Tanenbaum, “Computer Networks”, Pearson Education, 4th Edition, 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: 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 | 4 | 3 |
| 7 | Code Optimization: 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 | 4 | 3 |
| 8 | Code Generation: 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. | 3 | 4 |
| 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", Addison Wesley
- 2 Kenneth C. Loudon; "Compiler Construction, Principles and Practice", Cengage Learning.
- 3 D.M.Dhamdhare, "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, 10th Edition, 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 Firouz Mosharraf, "Computer Networks, A Top-Down Approach", McGraw-Hill, 1st Edition, 2012.
- 2 Andrew S. Tanenbaum, "Computer Networks", Pearson Education, 4th Edition, 2003

RECOMMENDED READING

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

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|-----------------------|--|---------------------|
| 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
- 2 Ethem Alpaydin, 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”, Morgan Kaufmann Publishers.

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|-----------------------|--|----------------------|
| 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.

| | | |
|-----------------------|---|----------------------|
| Programme Name | B. Tech. (Information Technology) | Semester – VI |
| Course Code | R4IT3013T | |
| Course Title | Parallel Computing | |
| Prerequisite | Computer Organization and Architecture , Operating Systems | |

COURSE OUTCOMES

Student will be able to

| | |
|---|--|
| 1 | Understand the different ways of achieving parallelism. |
| 2 | Demonstrate architectural fundamentals and operation of a memory hierarchy & I/O and the performance issues influencing its design. |
| 3 | Analyse the organisation and operation of different parallel computer architectures such as Pipelined processor, SIMD Array processor, Multiprocessor and Multi-core systems, superscalar processor & GPU based architectures. |
| 4 | Understand the parallel hardware constructs and operating system support for parallel computing. |

COURSE CONTENTS

| Unit No | Topics | Hrs | CO |
|---------|--|-----|-----|
| 1 | Introduction to Parallel and Pipeline Processing a. Evolution of Computer Systems, Necessity of high performance, Constraints of conventional architecture b. Parallelism in Uniprocessor Systems, Instruction level Parallelism and Thread Level Parallelism. c. Evolution of Parallel processors, Parallel Computer Structures, Future Trends d. Processor - Architectural Classification Schemes | 4 | 1,4 |
| 2 | Memory Subsystems in parallel environment a. Hierarchical Memory Structure: Interleaved memory - structure, performance b. Virtual Memory - utilisation, locality of reference, performance c. Cache Memory - structure, performance, implementation, optimisation | 5 | 2,4 |
| 3 | I/O and secondary storage a. I/O techniques- polling, interrupts, direct memory access b. I/O channels, I/O processors - structures, bandwidth issues | 4 | 2 |
| 4 | Pipelining and Vector Processing a. Pipelining: An Overlapped Parallelism, Principles and implementation of Pipelining. Classification of pipelining processors. Study and comparison of processors with and without pipelining. General pipelining reservation table | 7 | 3,4 |

- b. Instruction and Arithmetic Pipelining: Design Aspects
 - c. Principles of Designing Pipelined Processors: Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision detection.
 - d. Data level parallelism: Vector processing
 - e. Superscalar Architecture.
- 5 **SIMD Computer Organization** 7 3,4
- a. SIMD Array Processors: Masking and Data network mechanism, Inter PE Communication
 - b. Communication: SIMD Interconnection networks, Static Vs Dynamic Network, Cube, hyper cube, Mesh Interconnection Network
 - c. Associative Array Processors
 - d. Parallel Algorithms for Array Processors: Matrix Multiplication algorithm, Sorting algorithm and their analysis.
 - e. Performance Enhancement Methods of SIMD Array Processors
- 6 **Multiprocessor and Multicore Architectures** 7 1,3
- a. Functional Structures: Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors
 - b. Interconnection Networks: Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency
 - c. Parallel Memory Organizations for multiprocessors
 - d. Exploiting Concurrency for Multiprocessing: Implementation issues of a program on multiprocessor system, critical sections, semaphores, monitor, and producer-consumer problem. Deadlocks: prevention, avoidance, detection e. Parallel Algorithms for Multiprocessors, Parallel Programming Languages: Fortran 90
 - f. Multicore systems: Structure, performance, complexity, power consumption, memory utilization g. GPU based Architecture, CPU-GPU integration.
- 7 Advances in the domain

TEXTBOOKS

- 1 Computer Architecture: A Quantitative Approach (Third Edition), John Hennessy and David Patterson, Morgan Kaufmann Publishers, 2003.
- 2 Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw Hill international Edition.
- 3 D. E. Culler and J. P. Singh with A. Gupta, "Parallel Computer Architecture", Morgan- Kaufmann publishers.

RECOMMENDED READING

- 1 V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
- 2 Kai Hwang, "Scalable Parallel Computing"
- 3 Harrold Stone, "High performance computer Architecture".
- 4 Richard Y. Kain, "Advanced Computer Architecture"
- 5 Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

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

TEXTBOOKS

- 1 Ali Bahrami, "Object Oriented System Development ", McGraw Hill.
- 2 Grady Booch, J. Rumbaugh, 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 Laganieri, "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 |

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, 5th 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, 3rd Edition, 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, 2nd Edition, 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 writing 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.

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|-----------------------|--|----------------------|
| 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

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|-----------------------|--|----------------------|
| Programme Name | B. Tech. (Information Technology) | Semester – VI |
| Course Code | R4IT3013P | |
| Course Title | Parallel Computing Lab | |
| Prerequisite | Knowledge of Computer Organization and Architecture , Operating Systems and C/C++ programming | |

COURSE OUTCOMES

Student will be able to

| | |
|---|--|
| 1 | Demonstrate the fundamental knowledge of parallel hardware constructs and operating system support for parallel computing. |
| 2 | Implement different techniques of achieving parallelism. |
| 3 | Evaluate efficiency of different parallel construct programs. |
| 4 | Analyse the organisation and operation of different parallel computer architectures. |

COURSE CONTENTS

| Unit No | Experiment List | Hrs | CO |
|----------------|---|------------|-----------|
| 1 | Write a parallel program to print any input message supplied by user. | 2 | 1, |
| 2 | Write a parallel program to add two one dimensional arrays of size 'n'. | 2 | 1, |
| 3 | Write a parallel program to add two matrices of order n * n. | 2 | 2,3 |
| 4 | Write a parallel program to multiply two matrices. | 2 | 2,3 |
| 5 | Write a parallel program to multiply a matrix of order n x n by a vector of size n. | 2 | 2,3 |
| 6 | Write a parallel Program to count the no. of vowels in a text. | 2 | 2,3 |
| 7 | Write a parallel program to find the largest element of n elements. | 2 | 1,2,3 |
| 8 | Write a parallel program to count no. of characters, words and lines in a file. | 2 | 1,2,3 |
| 9 | Write a parallel program to find factorial value of an integer. | 2 | 1,2,3 |
| 10 | Write a parallel program to find the transpose of a given Matrix. | 2 | 1,2,3 |
| 11 | Write a parallel program to implement ring topology. | 2 | 1,2,3 |
| 12 | Write a parallel program to find the largest and the second largest from a list of elements considering minimum no. of comparisons. | 2 | 1,2,3 |

- | | | | |
|----|---|---|-------|
| 13 | Write a parallel program to sort n elements, using any sorting technique. | 2 | 1,4 |
| 14 | Write a parallel program to solve a set of linear equations using gauss elimination method. | 2 | 1,2,3 |
| 15 | Write a parallel program to find the inverse of a given matrix of n*n order. | 2 | 1,2,3 |
| 16 | Write a parallel program to find minimal path (minimal cost) in an undirected graph. | 2 | 1,4 |
| 17 | Write a parallel program to find roots of an equation using N-R method. | 2 | 3,4 |

TEXTBOOKS

- 1 Computer Architecture: A Quantitative Approach (Third Edition), John Hennessy and David Patterson, Morgan Kaufmann Publishers, 2003.
- 2 Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw Hill international Edition.
- 3 D. E. Culler and J. P. Singh with A. Gupta, "Parallel Computer Architecture", Morgan- Kaufmann publishers.

RECOMMENDED READING

- 1 Fayez Gebali, "Algorithms and Parallel Computing", Wiley, 2011

| | | |
|-----------------------|--|----------------------|
| 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.

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|-----------------------|--|----------------------|
| 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. Rumbaugh, 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 Laganier, “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, 5th Edition, 2007.

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|-----------------------|--|----------------------|
| 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 Arithmetic 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: 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. | 5 | 1 |
| 2 | File system Administration: 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 | 5 | 2 |
| 3 | Network Administration: 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. | 5 | 3 |
| 4 | Devices/server Administration, Backup and Restore: 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 | 5 | 1,3 |

| | | | |
|---|---|---|---|
| | Backup Tools : dump, dd, restore | | |
| 5 | Security Administration: GNU/Linux security architecture, Access control, PAM, Security Tools –nmap, SE Linux, Authentication Mechanisms, LDAP, Firewall, Firewall policies, Proxy Servers, SOCKS Proxy server. | 5 | 4 |
| 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: 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. | 4 | 2 |
| 6 | Database Security: Databases Security requirements – Reliability and Integrity – Sensitive data – Inference – Multilevel database – Proposal for multilevel security, RBAC, MAC and DAC using ORACLE database | 4 | 2 |
| 7 | Network Security: 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. | 4 | 3 |
| 8 | OWASP: Web Application Security and the OWASP top 10: 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. | 4 | 4 |
| 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.