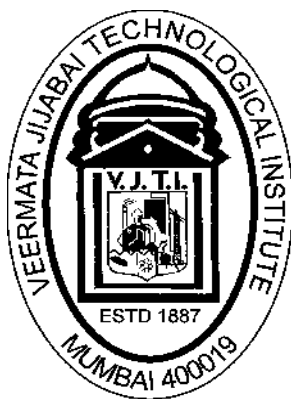


**VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE**

**(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 Programme Leading to  
Bachelor of Technology (B Tech) Degree in Computer  
Engineering

**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 Programme Leading  
to Bachelor of Technology (B. Tech.)

In

**COMPUTER ENGINEERING**

(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. Computer Engineering**

### **Program Educational Objectives (PEOs)**

1. To provide graduates with the ability to communicate effectively & successfully work in multi-disciplinary teams to succeed in diverse range of careers as engineers, consultants, and entrepreneurs.
2. To provide graduates with the ability to apply their skills and concepts acquired to continue further education in Computer engineering and interdisciplinary areas to emerge as researchers, domain experts, and educators.
3. To provide graduates with ability to re-learn and innovate in ever-changing global economic and technological environments of the current era.
4. To provide graduates with ability to practice technical standards and communicate to colleagues and the public at large about their work and accomplishments.
5. To provide graduates with the ability to function ethically and responsibly with good cultural values and integrity which would enable them to apply the best principles and practices of Computer engineering towards the society.

### **Program Outcomes (POs)**

After the completion of the B.Tech. Computer Engineering programme, the graduates of the department will have

1. An ability to apply the knowledge of Mathematics, Science, Applied Mechanics, Engineering Graphics, Basic Electrical and Electronic Engineering, Basic Workshop Practices and Computer Engineering for the solution of complex engineering problems.
2. An ability to identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusion using sound principles of Mathematics, Applied Sciences and Computer Science & Engineering.
3. An ability to 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, & the cultural, societal and environmental considerations using sound principle of Computer Engineering.
4. An ability to use research based knowledge and research methods in Computer Engineering including design of experiments, analysis & interpretation of data and synthesis of the information to provide valid conclusions.

5. An ability to create, select and apply appropriate techniques, resources and modern Computer engineering & IT modelling tools to complex engineering problems.
6. An ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Computer Engineering Practice.
7. An ability to analyze the impact of Computer Engineering solutions in societal & environmental contexts, and will demonstrate the knowledge of and need for sustainable solution development.
8. Ethical principles and will commit to professional ethics, responsibilities, and norms of Computer engineering practice.
9. An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary environments.
10. Demonstrative ability to 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. Knowledge and understanding of the Computer Engineering and Management principles and apply these to his own work as a member and leader in a team to manage projects and in multidisciplinary environments.
12. An ability to recognize the need for, and will have the preparations and ability to engage in independent and life-long learning in the broadest context of technological change in Computer Engineering.

### **Program Specific Outcomes (PSOs)**

PSO1 Professional Skills: The ability to analyze, design and implement application specific computer engineering domains related to Big Data Systems, Cloud Computing, Artificial Intelligence, Machine Learning, Networking and Cyber Security applications for efficient design of computer based system of varying complexity by applying the knowledge of core science, engineering mathematics and engineering fundamentals.

PSO2 Problem-Solving Skills: The ability to adapt and apply rapid changes in tools and technology in software development using open ended programming environment to deliver a quality product relevant to professional engineering practice through life-long learning.

PSO3 Successful Career and Entrepreneurship: Excellent adaptability to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics, societal responsibilities and a zest for higher studies.

**Scheme of Instruction and Evaluation**  
**SEMESTER- III**

Scheme of Instruction			Scheme of Evaluation						
S.N.	Course Code	Course Name	L-T-P			Credits	Evaluation Scheme		
			Hours / Week	L	T		P	TA	MST
1	R4MA2007S	Linear Algebra	3	1	0	4	20	20	60
2	R4CO2001S	Discrete Mathematics and Applications	3	0	0	3	20	20	60
3	R4CO2002S	Digital Logic Design	3	1	0	4	20	20	60
4	R4CO2003T	Data Structures and Algorithms	3	0	0	3	20	20	60
5	R4CO2003P	Data Structures and Algorithms Lab	0	0	3	1.5	60	0	40
6	R4CO2004S	Computer Organization and Architecture	3	0	0	3	20	20	60
7	R4CO2005A	Programming Lab 1	0	1	3	2.5	60	0	40
8	R4CH2001A	Environmental Studies	1	0	1	MNC	60	0	40
9	R4CO2006S	Essence of Indian Traditional Knowledge	2			P/NP	20	20	60
TOTAL			18	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

**Scheme of Instruction and Evaluation**  
**SEMESTER-IV**

Scheme of Instruction			Scheme of Evaluation						
S.N.	Course Code	Course Name	L-T-P 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	R4CO2007S	Automata Theory	3	1	0	4	20	20	60
3	R4CO2008S	Design and Analysis of Algorithms	3	0	0	3	20	20	60
4	R4CO2009T	Operating Systems	3	0	0	3	20	20	60
5	R4CO2009P	Operating Systems Lab	0	0	2	1	60	0	40
6	R4CO2010T	Database Management Systems	3	0	0	3	20	20	60
7	R4CO2010P	Database Management Systems Lab	0	0	2	1	60	0	40
8	R4CO2011A	Web Technologies Lab	0	1	2	2	60	0	40
9	R4CO2012A	Development Engineering	2			P/NP	20	20	60
		TOTAL	17	3	6	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

**Scheme of Instruction and Evaluation  
SEMESTER-V**

Scheme of Instruction			Scheme of Evaluation						
S.N.	Course Code	Course Name	L-T-P Hours / Week			Credits	Evaluation Scheme		
			L	T	P		TA	MST	ESE
1	R4CO3001T	Software Engineering I	3	0	0	3	20	20	60
2	R4CO3002S	Internet of Things	3	1	0	4	20	20	60
3	R4CO3003T	Computer Network	3	0	0	3	20	20	60
4	R4CO3004T	Artificial Intelligence	3	0	0	3	20	20	60
5	R4CO3005S	Compiler Construction	3	0	0	3	20	20	60
6	R4CO3006A	Intellectual Property Rights	2	P/NP					
7	R4CO3001P	Software Engineering I Lab	0	0	2	1	60	0	40
8	R4CO3003P	Computer Network Lab	0	0	2	1	60	0	40
9	R4CO3004P	Artificial Intelligence Lab	0	0	2	1	60	0	40
10	R4CO3007P	Open Source Computing	1	0	2	2	60	0	40
		TOTAL	18	1	8	21			

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **MST**: Mid Semester Tests, **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation, **P/NP**:



**Scheme of Instruction and Evaluation  
SEMESTER-VI**

Scheme of Instruction			Scheme of Evaluation						
S.N.	Course Code	Course Name	L-T-P Hours / Week			Credits	Evaluation Scheme		
			L	T	P		TA	MST	ESE
1.	R4CO3011T	Software Engineering II	3	0	0	3	20	20	60
2.	R4CO3012T	Machine Learning	3	0	0	3	20	20	60
3.	R4CO3013T	Parallel Computing	3	0	0	3	20	20	60
4.		Professional Elective 1	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	0	40
7.	R4CO3011P	Software Engineering II Lab	0	0	2	1	60	0	40
8.	R4CO3012P	Machine Learning Lab	0	0	2	1	60	0	40
9.	R4CO3013P	Parallel Computing Lab	0	0	2	1	60	0	40
10.		Professional Elective 1 lab	0	0	2	1	60	0	40
		TOTAL	16	0	10	21			

Abbreviations: **L:** Lecture, **T:** Tutorial, **P:** Practical, **TA:** Teacher Assessment / Term work Assessment, **MST:** Mid Semester Tests, **ESE:** End Semester Written Examination, **CIE:** Continuous In-semester Evaluation, **MNC:** **P/NP:**

	<b>Professional Elective 1</b>		<b>Professional Elective 1 Lab</b>
R4CO3101T	Spatial Data Analysis and Visualization	R4CO3101P	Spatial Data Analysis and Visualization Lab
R4CO3102T	Wireless Networks	R4CO3102P	Wireless Networks Lab
R4CO3103T	Digital Image Processing	R4CO3103P	Digital Image Processing Lab
R4CO3104T	Information Storage Management	R4CO3104P	Information Storage Management Lab

	<b>Open Elective 1</b>
R4CO3601S	Network Security
R4IT3601S	System Administration

**Minimum six weeks mandatory internship in industry/research Institute after 6<sup>th</sup> Semester**

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3001T</b>	
<b>Course Title</b>	<b>Software Engineering I</b>	
<b>Prerequisite</b>	<b>Computer programming, Data structures.</b>	

### **COURSE OUTCOMES:**

Students will be able to

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

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Introduction</b> 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.	5	1
2.	<b>Software Project Management Concepts</b> Important factors of project management- People, Product, Process, Project.	1	2
3.	<b>Software Process and Project Metrics</b> Measures, Metrics, Indicators. Metrics in the process and project domains, Software measurement. Metrics for Software Quality. Integrating metrics.	2	2
4.	<b>Software Project Planning</b> Software Scope, Resources, Software project estimation - cost/effort estimation, Decomposition techniques, Empirical estimation models.	2	2
5.	<b>Risk Analysis and Management</b> Reactive versus proactive risk strategies, Software risks, Risk identification, Risk projection, Risk mitigation-monitoring-management, RMMM plan.	5	2,3

6.	<b>Project Scheduling and Tracking</b> Defining a task set for the software project, Gantt Chart, Defining a task network, Scheduling.	3	3
7.	<b>Software Quality Assurance</b> Software quality assurance, Software reviews, Formal technical reviews, SQA plan	2	3
8.	<b>Software Configuration Management</b> SCM process, Identification of objects in the software configuration, Version control, Change control, Configuration audit, Status reporting.	3	3,4
9.	<b>Analysis Concepts and Principles</b> Requirement Analysis, Requirement elicitation for software, Analysis principles, Software prototyping, Requirements Specification.	3	2
10.	<b>Analysis Modeling</b> Data modeling, Functional modeling and information flow, Behavioral modeling.	2	2
11.	<b>Design Concepts and Principles</b> Software design process, Design principles, Design concepts, Effective modular design.	2	3
12.	<b>Design Modeling</b> 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.	3	3
13.	<b>Software Testing Techniques &amp; Strategies</b> White-box & Black-box testing techniques. Strategic Approach to Software Testing. UNIT Testing, Integration Testing, System Testing, Validation Testing.	3	4

#### **TEXTBOOKS**

1. Roger Pressman, "Software Engineering", McGraw Hill, 8<sup>th</sup> Edition
2. Ian Sommerville, "Software Engineering", Pearson Education. Sixth Edition

#### **RECOMMENDED READING**

1. W. S. Jawadkar, "Software Engineering", TMH. 1st Edition
2. R. Mall, "Fundamentals of Software Engineering", Prentice Hall of India, 2nd Edition

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3002T</b>	
<b>Course Title</b>	<b>Internet of Things</b>	
<b>Prerequisite</b>		

### COURSE OUTCOMES

Students will be able to

1.	Understand digital transformation.
2.	Understand the IoT infrastructure and its applications.
3.	Analyze the system and use appropriate architecture, and protocols for a given scenario.
4.	Understand the use of cloud platform and its framework for the development of IoT applications.

### COURSE CONTENTS

Unit No	Topics	Hrs	CO
1.	<b>Introduction to Digital Transformation</b> What is digital disruption? Examples of Digital Disruption. Waves of Digital Disruption, Why Digital Disruption, examples, What are the emerging digital technologies? 2016 Top 10 Tech Trends, The Digital Technology Stack, And Digital Innovation. The SMAC (Social, Mobile, Analytics, Cloud) Stack - SMAC , Foundational Technology Stack, SMAC , The Basic Enablers The Innovation Accelerator Stack : The Digital Technology Stack -machine learning/ cognitive, augmented reality, virtual reality, automation/ robotics, 3d printing, bigdata, wearables internet of things - the new design principles the digital technology stack - user experience design, omni channel, design thinking/ dev ops, digital marketing,	7	1
2.	<b>Introduction to IoT</b> Introduction to IoT, Future of IoT, Applications of IoT, Advantages of IoT, Enabling Technologies. Overview of Internet of Things, building blocks of IoT, characteristics of IoT systems and IoT levels. IoT and M2M, IoT design methodology, Technology Considerations- IoT Problem Statement, IoT , Technology Enablers, IoT Technology Stack, IoT, Data Considerations, IoT Projects, Introduction to Complexity, IoT Challenges	7	1

3.	<b>IoT Applications Retail, Healthcare &amp; Agriculture, IoT Architecture:</b> Reference Architecture, Study and usage of various types of sensors and actuators, IoT devices, gateways	7	2,3
4.	<b>IoT Physical Devices &amp; Endpoints:</b> Microprocessor, Microcontroller, Microcomputer hardware and software concepts. Study and usage of Prototyping boards like - Arduino, Intel edison, raspberry pi etc. (from software and hardware perspective) programming using sketches and python. Other programming languages used for IoT. A generic design methodology for Internet of Things.	8	3
5.	<b>Communication:</b> Introduction to communication architecture- Network protocol stack, Different protocols: RF: ZigBee, Blue Tooth, BLE, Zwave, Mesh network. Communication Channels: GSM/GPRS, 2G, 3G, LTE, Wi-Fi , IoT protocols: MQTT/MQTTS, CoAP, 6LoWPAN, like TCP, UDP, HTTP/S., Comparison of the different IoT protocols, advantages and disadvantages (limitations) of these IoT protocols. IPv4 addressing problem for IoT and introduction to IPv6 is required to address more devices. Application issues with RF protocol - power consumption, LOS, reliability. Security aspects. Showcase the GSM module.	7	3
6.	<b>Cloud platform and framework for developing IoT:</b> An introduction to the use of cloud platforms and frameworks for developing IoT applications. Data Analytics for IoT.	4	4

### TEXTBOOKS

1. Arshdeep Bahga, Vijay Madiseti, "Internet of Things: A Hands-on Approach", Universities Press, 2015.

### RECOMMENDED READING

1. Stephanie Moyerman, "Getting Started with Intel Edison", Published by Maker Media, Inc., San Francisco, 2016. CA 94111.
2. AgusKurniawan , "ArduinoUno:A Hands-On Guide for Beginner ,1st
3. John Boxall , "Arduino Workshop A Hands-On Introduction with 65 Projects", No Starch Press, Inc. San Francisco, CA USA, 2013.
4. Internet sources: Arduino site, Intel IoT site, Raspberry pi site.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3003T</b>	
<b>Course Title</b>	<b>Computer Network</b>	
<b>Prerequisite</b>		

### COURSE OUTCOMES

Students will be able to

1.	Obtain insight about basic network theory and layered communication architectures.
2.	Analyze, design and document computer network specifications to meet client needs, use proper computer system and networking terminology
3.	Implement local area networks using both static and dynamic addressing techniques including sub netting, install and configure domain-based local area networks
4.	Understand conceptual design of MAC, IP, and Transport layer protocols and solve problems in MAC, IP, and Transport layers

### COURSE CONTENTS

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Introduction :</b> 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.	<b>Mac Layer :</b> Media access control, Ethernet (802.3), Wireless LANs 802.11, Bluetooth Switching and bridging Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP )	6	2,3
3.	<b>Network Layer :</b> Design issues, Bridges – Routers , Gateways, Routing algorithms, Congestion control , algorithms, Quality of Service, Internetworking, Address learning bridges, Spanning tree, Source routing, IP datagram, hop by hop routing, ARP/RARP, Subnet addressing , Address, masking, ICMP, RIP/RIPV2, OSPF, DNS	8	2,3
4.	<b>Transport Layer:</b> 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	3,4

5.    **Applications:**  
Traditional Applications (WWW, HTTP, FTP, Email, Telnet, SSH, DNS),       5    4  
Peer-to-Peer Networks, Socket programming.
- 6       Advances in Computer Network

### **TEXTBOOKS**

1.       B. A. Forouzan and Firouz Mosharraf, “Computer Networks, A Top-Down Approach”, McGraw-Hill, 1<sup>st</sup> Edition, 2012.
2.       Andrew S. Tanenbaum, “Computer Networks”, Pearson Education, 4<sup>th</sup> 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



<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3004T</b>	
<b>Course Title</b>	<b>Artificial Intelligence</b>	
<b>Prerequisite</b>	<b>Design and Analysis of Algorithms</b>	

### COURSE OUTCOMES

Students will be able to

1.	Understand artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning.
2.	To solve problems by applying a suitable search method, and AI applications in Natural Language Processing, Vision and Robotics
3.	Compare mini-max search and alpha-beta pruning in game playing.
4.	Differentiate the key aspects of evolutionary computation, including genetic algorithms and genetic programming.

### COURSE CONTENTS

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

7.	<b>Logic and Inferences:</b> Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.	4	2
8.	<b>AI Applications:</b> AI applications in Natural Language Processing, Vision and Robotics	2	4
9	Advances in AI		

### **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, 3<sup>rd</sup> Edition, 2009.

### **RECOMMENDED READING**

1. Stefan Edel Kamp 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, 2<sup>nd</sup> Edition, revised and extended edition, 2013.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3005S</b>	
<b>Course Title</b>	<b>Compiler Construction</b>	
<b>Prerequisite</b>	<b>Automata Theory</b>	

### **COURSE OUTCOMES:**

Students will be able to

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

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Language Processors:</b> Translators – Compilers and Interpreters, The Phases of Compilers, Errors in different phases, Analysis and Synthesis phases, Compiler Construction Tools.	2	1
2.	<b>Lexical Analysis:</b> 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.	<b>Syntax Analysis:</b> 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.	<b>Syntax Directed Translation:</b> 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.	<b>Run Time Environments:</b> Storage Organization, Activation Trees, Activation Records, Stack Allocation of activation records, Parameter passing mechanisms	7	3
6.	<b>Intermediate Code Generation:</b>	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 4

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 ,2<sup>nd</sup> 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, 2<sup>nd</sup> revised edition, 1999.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3006A</b>	
<b>Course Title</b>	<b>Intellectual Property Rights</b>	
<b>Prerequisite</b>		

### **COURSE OUTCOMES:**

Students will be able to

1.	Demonstrate fundamental aspects of Intellectual Property Rights in innovative projects in industries.
2.	Explore all aspects of the IPR Acts.
3.	Demonstrate the application of the legal concepts in Science, Engineering, Technology and Creative Design.
4.	Analyze the importance of copyrights, trademarks and patents.

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Overview of Intellectual Property:</b> Introduction and the need for intellectual property right (IPR) IPR in India – Genesis and Development IPR in abroad. Some important examples of IPR.	4	1
2.	<b>Patents:</b> Macro-economic impact of the patent system, Patent and kind of inventions protected by a patent ,Patent document, protect your inventions, Granting of patent, Rights of a patent ,protect inventions by patents, Searching a patent, Drafting of a patent, Filing of a patent, The different layers of the international patent system (national, regional and international options)	5	2
3.	<b>Copyright:</b> covered by copyright, How long does copyright last?, 4 Why protect copyright? RELATED RIGHTS What are related rights? Distinction between related rights and copyright? Rights covered by copyright?	4	2

4.	<b>Trademarks:</b> What is a trademark? Rights of trademark? What kind of signs can be used as trademarks? Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered? How long is a registered trademark protected for? How extensive is trademark protection? What are well-known marks and how are they protected? Domain name and how does it relate.	5	3
5.	<b>Geographical Indications:</b> What is a geographical indication? How is a geographical indication protected? Why protect geographical indications?	3	3
6.	<b>New Plant Varieties:</b> Why protect new varieties of plants? How can new plants be protected? What protection does the breeder get? How long do the breeder's rights last? How extensive is plant variety protection?	2	4
7.	<b>Unfair Competition:</b> What is unfair competition? Relationship between unfair competition and Intellectual property laws?	2	4
8.	<b>Enforcement of Intellectual Property Rights:</b> Infringement of Intellectual Property Rights, Enforcement Measures, Emerging Issues	3	3,4
9.	<b>Intellectual Property:</b> Overview of Biotechnology and Intellectual Property Biotechnology Research and Intellectual Property Rights, Management Licensing and Enforcing Intellectual Property, Commercializing Biotechnology Invention, Case studies of Biotechnology	3	2,3
10.	<b>Case studies of patents in other areas</b>	3	3,4

#### **TEXTBOOKS**

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI Learning Private Limited.

#### **RECOMMENDED READING**

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3001P</b>	
<b>Course Title</b>	<b>Software Engineering I Lab</b>	
<b>Prerequisite</b>	<b>Computer programming, Data structures.</b>	

**COURSE OUTCOMES:**

Students will be able to

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

**LIST OF EXPERIMENTS:**

<b>S.N.</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
	For a given case study do the following -		
1.	Give detailed Problem Statement	1	1
2.	Prepare Software scope	1	1
3.	Estimate required Resources	1	1
4.	Perform Software cost and time Estimation	1	1
5.	Perform Risk Analysis and prepare RMMM plan	2	2
6.	Prepare Project Schedule	1	2
7.	Prepare Software Quality Assurance Plan (SQA plan)	2	2
8.	Prepare Project Plan	1	2
9.	Carry out Requirement Analysis Modeling	2	3
10.	Prepare Software Requirements Specification (SRS)	2	3
11.	Carry out Software Design (Data design, Architecture Design, Interface design & Component Level Design)	6	3
12.	Write code and implement the software	2	4
13.	Develop test cases and carry out testing of the software	4	4
14.	Change specifications and make different versions of the software using any SCM tool.	2	4

## **TEXTBOOKS**

1. Roger Pressman, “Software Engineering”, McGraw Hill, 8<sup>th</sup> Edition
2. Ian Sommerville, “Software Engineering”, Pearson Education. Sixth Edition

## **RECOMMENDED READING**

1. W. S. Jawadekar, “Software Engineering”, TMH. 1st Edition
2. R. Mall, “Fundamentals of Software Engineering”, Prentice Hall of India, 2nd Edition



<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3003P</b>	
<b>Course Title</b>	<b>Computer Network Lab</b>	
<b>Prerequisite</b>		

### COURSE OUTCOMES

Students will be able to

1.	Use simulation tools
2.	Implement the various protocols
3.	Analyze the performance of the protocols in different layers
4.	Analyze various routing algorithms

### LIST OF EXPERIMENTS:

S.N	Topics	Hrs	CO
1.	Implementation of Stop and Wait Protocol and Sliding Window Protocol.	2	1
2.	Study of Socket Programming and Client – Server model	2	1
3.	Write a code simulating ARP /RARP protocols.	2	2
4.	Write a code simulating PING and TRACEROUTE commands	2	1,2
5.	Create a socket for HTTP for web page upload and download.	2	2
6.	Write a program to implement RPC (Remote Procedure Call)	2	2
7.	Implementation of Subnetting.	2	3
8.	Applications using TCP Sockets like A. Echo client and echo server B. Chat C. File Transfer	2	2,3
9.	Applications using TCP and UDP Sockets like A. DNS B. SNMP C. File Transfer	2	3
10.	Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS	2	4

11. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer. 2 4
- A. Link State routing
  - B. Flooding
  - C. Distance vector

### **TEXTBOOKS**

1. B. A. Forouzan and Firouz Mosharraf, "Computer Networks, A Top-Down Approach", McGraw-Hill, 1<sup>st</sup> Edition, 2012.
2. Andrew S. Tanenbaum, "Computer Networks", Pearson Education, 4<sup>th</sup> 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

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3004P</b>	
<b>Course Title</b>	<b>Artificial Intelligence Lab</b>	
<b>Prerequisite</b>		

### **COURSE OUTCOMES:**

Students will be able to

1.	To compare different search techniques.
2.	To apply AI technique for a given problem.
3.	To implement AI based search technique based on problem.
4.	To design AI applications in different domain.

### **COURSE CONTENTS:**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	Implement Breadth first and depth first search techniques.	2	1
2.	Implement Hill climbing algorithm.	2	1
3.	Implement Beam Search	2	2
4.	Implement A* algorithm	2	2
5.	Implement MINIMAX algorithm.	2	3
6.	Implement Alpha Beta algorithm.	2	3
7.	Implement AO* algorithm	2	4
8.	Design a smart home application of controlling light using smart speakers such as Amazon Alexa dot ,SIRI Microsoft Cortana etc.	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, 3<sup>rd</sup> Edition, 2009.

### **RECOMMENDED READING**

1. Stefan Edel Kamp 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, 2<sup>nd</sup> Edition, revised and extended edition, 2013

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CO3007P</b>	
<b>Course Title</b>	<b>Open Source Computing</b>	
<b>Prerequisite</b>		

### COURSE OUTCOMES

Students will be able to

1.	Understand the difference between open source software and commercial software
2.	Identify, install and run Linux operating system, manage applications
3.	Identify, install open source web technologies Apache, MySQL, PHP.
4.	Develop web applications using LAMP.

### COURSE CONTENTS

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>OPEN SOURCE:</b> Introduction to Open Source Open Source vs. Commercial Software What is Linux? Free Software Where I can use Linux? Linux Kernel Linux Distributions	6	1
2.	<b>LINUX:</b> Introduction to Linux Essential Commands , File system, Concept Standard Files 1. The Linux Security Model, Vi Editor Partitions, creation, Shell Introduction 2. String Processing, Investigating and Managing Processes	6	1,2
3.	<b>APACHE:</b> Apache Explained Starting, Stopping, and Restarting Apache Modifying the Default Configuration Securing Apache Set User and Group Consider Allowing Access to Local Documentation Don't Allow public html Web sites Apache control with .htaccess	6	2
4.	<b>MYSQL:</b> Introduction to MYSQL The Show Databases and Table The USE command Create Database and Tables Describe Table Select, Insert, Update, and Delete statement Some Administrative detail Table Joins Loading and Dumping a Database.	6	3
5.	<b>PHP:</b> Introduction General Syntactic Characteristics PHP Scripting Commenting your code Primitives, Operations and Expressions PHP Variables Operations and Expressions Control Statement Array	6	4

Functions Basic Form Processing File and Folder Access Cookies  
Sessions Database Access with PHP MySQL MySQL Functions  
Inserting Records Selecting Records Deleting Records Update Records.  
6 Advances in the domain

### **TEXTBOOKS**

1. James Lee and Brent Ware ,”Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP”, , Dorling Kindersley(India) Pvt. Ltd, 2008

### **RECOMMENDED READING**

1. Eric Rosebrock, Eric Filson ,”Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together”, Published by John Wiley and Sons, 2004

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3011T</b>	
<b>Course Title</b>	<b>Software Engineering II</b>	
<b>Prerequisite</b>	<b>Software Engineering</b>	

### COURSE OUTCOMES

Students will be able to

1.	Comprehend software development life cycle.
2.	Prepare SRS document for a project.
3.	Apply software design and development techniques.
4.	Identify verification and validation methods in a software engineering project.
5.	Analyze and apply object modeling for the problem.
6.	Identify verification and validation methods in a software engineering project

### COURSE CONTENTS:

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

7.	<b>Design:</b> Architectural Design. Refining The Model. Refactoring. Coupling And Cohesion. Who Should Own The Attribute? Who Should Own The Operations? Process And Threads.	4	4
8.	<b>Design Classes:</b> Classes Visibility; User Interface. Subsystem Interface.	3	5
9.	<b>Deployment Diagram:</b> Deployment Diagram basics, design	3	6
10	Advances in the domain		

### **TEXTBOOKS**

1. Ali Bahrami, "Object Oriented System Development ", McGraw Hill International Edition, 1999.
2. Grady Booch, J. Rumbaugh, Ivar Jacobson, "The UML Users guide", Pearson education
3. Ivar Jacobson, "Object Oriented Software Engineering", Seventh Impression , Pearson, 2009.

### **RECOMMENDED READING**

1. Simon Benett, Steve McRobb, Ray Farmer, "Object Oriented System Analysis and Design Using UML", McGraw Hill. 2002
2. Timothy C. Lethbridge, Robert Laganriere, "Object Oriented Software Engineering", McGraw Hill 2001

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3012T</b>	
<b>Course Title</b>	<b>Machine Learning</b>	
<b>Prerequisite</b>	<b>Linear Algebra, Probability, Statistics</b>	

### **COURSE OUTCOMES:**

Students will be able to

1.	Analyze and appreciate the applications which can use Machine Learning Techniques, Data and Dimensionality reduction techniques.
2.	Understand regression, classification, clustering methods.
3.	Understand the difference between supervised and unsupervised learning methods.
4.	Understand the working of Reinforcement learning.

### **COURSE CONTENTS:**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Introduction:</b> 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.	<b>Instant Based Learning :</b> K-Nearest Neighbor Learning, Locally weighted Regression, Radial Bases Functions, and 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	8	2
3.	<b>Bayesian And Computational Learning :</b> 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.	<b>Neural Networks And Genetic Algorithms:</b> Neural Network Representation , Problems , Perceptron's , Multilayer Networks and Back Propagation Algorithms , Advanced Topics, Genetic Algorithms , Hypothesis Space Search, Genetic Programming, Models of Evaluation and Learning	6	3



- |    |   |     |
|----|---|-----|
| 5. | <b>Introduction to Deep Learning :</b><br>Deep L-layer Neural Network, Need of Deep Learning, Practical aspects of Deep Learning, Hyper-parameters, Gradient Descent Algorithms and variants used, Different activation functions, Introduction to types of Deep Learning NN such as Recurrent Neural Network, Convolutional Neural Network, and Applications of Deep Learning. | 7 4 |
| 6  | Advances in machine learning  | 1 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, 2<sup>nd</sup> edition, 2009.
2. William W.Hsieh, "Machine Learning Methods in the Environmental Sciences", Cambridge Publication ,2009.
3. J Han ,J Pei, Han Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers,3<sup>rd</sup> edition,2011.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3013T</b>	
<b>Course Title</b>	<b>Parallel Computing</b>	
<b>Prerequisite</b>	<b>Computer Organization and Architecture , Operating Systems, C/C++ programming</b>	

### **COURSE OUTCOMES:**

Students will be able to

1.	Describe different ways of achieving parallelism and different parallel computer systems.
2.	Design Memory and Input/output subsystems in Uni processor and Multiprocessor environment considering the performance issues influencing its design.
3.	Analyze the organization 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.	Demonstrate the parallel hardware constructs and operating system support for parallel computing.

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Introduction to Parallel Processing</b> A. Evolution of Computer Systems, Necessity of high performance, Constraints of conventional architecture B. Parallelism in Uni-processor Systems, Instruction and Thread Level Parallelism. C. Evolution of Parallel processors, Parallel Computer Structures, Future Trends D. Instruction Set Architectures-classification, instruction formats, operations. E. Processor - Architectural Classification Schemes	4	1,4
2.	<b>Memory subsystems in parallel environment</b> A. Hierarchical Memory Structure: Interleaved memory - structure, performance B. Virtual Memory - utilization, locality of reference, performance C. Cache Memory - structure, performance, implementation, optimization	5	2,3
3.	<b>I/O subsystems in parallel environment</b> A. I/O techniques- polling, interrupts, direct memory access B. I/O channels, I/O processors - structures, bandwidth issues	4	2

4.	<b>Pipeline and Superscalar micro architecture</b>	7	3
	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		
	B. Instruction and Arithmetic Pipelining: Design aspects.		
	C. Issues 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.	<b>SIMD Computer Organization</b>	8	3,4
	A. SIMD Array Processors: Masking and Data network mechanism, Inter PE Communication		
	B. Communication: SIMD Interconnection networks, Static Vs Dynamic Networks, 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.	<b>Multiprocessor, Multi-core, GPU Architectures</b>	8	1,3
	A. Functional Structures: Loosely and tightly coupled multiprocessors, Processor characteristics of multiprocessors, centralized and distributed shared memory architectures.		
	B. Interconnection Networks: Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency		
	C. Exploiting Concurrency for Multiprocessing: Implementation issues of a program on multiprocessor system.		
	D. Parallel Algorithms for Multiprocessors, Multiprocessor operating systems		
	E. Multi-core systems: Structure, performance.		
	F. GPU based Architecture, CPU-GPU integration.		

## 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 Cuffman 1<sup>st</sup> Edition, 1998

## **RECOMMENDED READING**

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

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4HM3002L</b>	
<b>Course Title</b>	<b>Professional Communication Skills</b>	
<b>Prerequisite</b>		

### COURSE OUTCOMES:

Students 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.	<b>Communication in an organization:</b> process, types, barriers	2	1
2.	<b>Speaking Skills:</b> Voice modulation, pronunciation, speaking with confidence, prepared and extempore speeches, video-conferencing	4	2
3.	<b>Listening:</b> Note-making and Minutes of Meeting	4	3,4
4.	<b>Technical Writing:</b> Vocabulary building, effective sentences and paragraph, organizational pattern, and summarizing	4	4
5.	<b>Special Types of Technical writing:</b> Business Letter, Email, Brochure, Report, Memo, Proposal, Research paper, Conference Paper	4	4
6.	<b>Interview skills:</b> Resume and job application, preparation for interviews, Interview questions and answers, Group Discussion	5	4,5
7.	<b>Presentation Skills:</b> Planning, preparing, organizing and delivering an oral presentation	5	2,4

### 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 students 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.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3011P</b>	
<b>Course Title</b>	<b>Software Engineering II Lab</b>	
<b>Prerequisite</b>		

### **COURSE OUTCOMES:**

Students will be able to

1.	Comprehend software development life cycle.
2.	Prepare SRS document for a project.
3.	Analyze and apply object modeling over the problem.
4.	Apply different design over the problem.

### **COURSE CONTENTS:**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
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	4
8.	Class design	02	4
9	Component Diagram	02	4

### **TEXTBOOKS**

1. Ali Bahrami, "Object Oriented System Development ", McGraw Hill International Edition, 1999.
2. Grady Booch, J. Rumbaugh, Ivar Jacobson, "The UML Users guide", Pearson education
3. Ivar Jacobson, "Object Oriented Software Engineering", Seventh Impression , Pearson, 2009.

### **RECOMMENDED READING**

1. Simon Benett, Steve McRobb, Ray Farmer, "Object Oriented System Analysis and Design Using UML", McGraw Hill. 2002
2. Timothy C. Lethbridge, Robert Laganieri, "Object Oriented Software Engineering", McGraw Hill 2001

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3012P</b>	
<b>Course Title</b>	<b>Machine Learning Lab</b>	
<b>Prerequisite</b>		

### **COURSE OUTCOMES:**

Students will be able to

1.	Understand the implementation procedures for the machine learning algorithms.
2.	Design Java/Python programs for various Learning algorithms
3.	Apply appropriate data sets to the Machine Learning algorithms
4.	Identify and apply Machine Learning algorithms to solve real world problems.

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
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 algorithms operating on it.	2	1
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 Backpropagation algorithm and test the same using appropriate data sets	2	2
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
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/Python can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	2	2,3
7.	Write a program to construct a Bayesian network considering medical/other data. You can use Java/Python ML library classes/API.	2	3
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	2	3



program.

- |     |   |   |   |
|-----|---|---|---|
| 9.  | Write a program to implement k-Nearest neighbor 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 | 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 | 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.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3013P</b>	
<b>Course Title</b>	<b>Parallel Computing Lab</b>	
<b>Prerequisite</b>	<b>Computer Organization and Architecture , Operating Systems, C/C++ programming</b>	

### **COURSE OUTCOMES:**

Students will be able to

1.	Demonstrate computer system organization and functioning of its components such as CPU, Memory I/O.
2.	Demonstrate Computer System Architecture including various Parallel Architectures.
3.	Evaluate efficiency of different parallel construct programs.
4.	Analyze the organization and operation of different parallel computer architectures.

### **LIST OF EXPERIMENTS**

<b>S.N.</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	Simulation of virtual memory systems	2	1
2.	Simulation of cache memory systems	2	1
3.	To learn basics of MPI (Message Passing Interface)	2	1
4.	To learn Communication between MPI processes	2	2
5.	To get familiarized with advance communication between MPI processes	2	2
6.	To learn basics of OpenMP API (Open Multi-Processor API)	2	2
7.	To get familiarized with OpenMP Directives	2	1, 2
8.	Implementation of Convex hull algorithm	2	3
9.	Implementation of z-buffer algorithm	2	3
10.	Implementation of a shared linked list	2	3
11.	Parallel algorithm for carrying out different matrix operations	2	4
12.	Implementation of Telephone directory using RMI	2	4
13.	Implementation of parallel search algorithm	2	4

## **TEXTBOOKS**

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill international Edition
2. D. E. Culler and J. P. Singh with A. Gupta. Parallel Computer Architecture, Morgan Cuffman 1<sup>st</sup> Edition ,1998

## **RECOMMENDED READING**

1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.
3. Kai Hwang, Scalable Parallel Computing.
4. Harrold Stone, High performance computer Architecture.
5. Richard Y. Kain, Advanced Computer Architecture
6. J. L. Hennessy and D. A. Patterson. Computer Architecture: A Quantitative Approach. Morgan-Kaufmann publishers.
7. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3101T</b>	
<b>Course Title</b>	<b>Spatial Data Analysis and Visualisation</b>	
<b>Prerequisite</b>		

### COURSE OUTCOMES

Students will be able to

1.	Students will be able to apply the knowledge of spatial analysis.
2.	Students will be able to analyze network and point pattern analysis.
3.	Students will be able to learn the surface analysis
4.	Students will be able to analyze spatial modeling

### COURSE CONTENTS

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Introduction to Spatial analysis:</b> Significance of spatial analysis. Overview of tools for Analysis	4	1
2.	<b>Spatial analysis:</b> Vector based Overlay operations: Point-in-polygon, Linein-polygon, polygon-in-polygon, Single layer operations: Feature identification, extraction, classification manipulation. Multilayer operation: Union, intersection, symmetrical difference, update, merge, append and dissolve	5	1
3.	<b>Spatial analysis:</b> Raster based Map algebra, grid based operations, local, focal, zonal and global functions, cost surface analysis, optimal path and proximity search	5	2
4.	<b>Network analysis:</b> Concepts, evaluation of network complexity using Alpha-gamma indices. C-matrices for evaluating connectivity of the network. Network data model. Path analysis. Linear referencing and segmentation. Types of network analysis: Optimum cyclic path, vehicle routing, path determination and cost-path analysis. Geocoding	6	2
5.	<b>Methods for evaluating point patterns:</b> Clustered and random Distribution, Point pattern analysis	5	3
6.	<b>Interpolation methods:</b> Trend surface analysis, IDW, kriging, measures of arrangement and dispersion, autocorrelation, semi variogram, DEM, TIN, slope, aspect, hillshade and viewshed Surface analysis	6	3

- |    |   |   |   |
|----|---|---|---|
| 7. | <b>Spatial modelling:</b>   | 4 | 4 |
|    | Role of spatial model, explanative, predictive and normative Models.<br>Correlation-regression analysis in model building. Handling complex<br>spatial query and case studies |   |   |
| 8  | Advances in the domain  |   |   |

### **TEXTBOOKS**

1. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
2. Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York
3. Makrewski, J. (1999): GIS Multi-criteria Analysis, John Wiley and Sons, New York

### **RECOMMENDED READING**

1. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
2. Longley, P. A., Goodchild, M. F., Maguire, D. J. Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester
3. Lo, C. P. Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3102T</b>	
<b>Course Title</b>	<b>Wireless Networks</b>	
<b>Prerequisite</b>	<b>Computer Networks</b>	

### **COURSE OUTCOMES:**

Students 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**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Wireless Communication Cellular systems:</b> Frequency Management and Channel Assignment- types of handoff and their characteristics, dropped call rates & their evaluation - MAC , SDMA, FDMA , TDMA , CDMA , Cellular Wireless Networks	5	1
2.	<b>Wireless Lan:</b> IEEE 802.11 Standards , Architecture , Services , Mobile Ad hoc Networks- Wi-Fi and WiMAX - Wireless Local Loop	5	2
3.	<b>Mobile Communication Systems:</b> GSM-architecture-Location tracking and call setup Mobility management Handover Security GSM SMS ,International roaming for GSM call recording functions subscriber and service data management, Mobile Number portability VoIP service for Mobile Networks, GPRS, Architecture GPRS procedures attach and detach procedures PDP context procedure combined RA/LA update procedures Billing	7	2
4.	<b>Mobile Network and Transport Layers:</b> Mobile IP , Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols, Multicast routing-TCP over Wireless Networks , Indirect TCP , Snooping TCP , Mobile TCP , Fast Retransmit / Fast Recovery , Transmission/Timeout Freezing-Selective Retransmission , Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks	7	3
5.	<b>Application Layer:</b> WAP Model Mobile Location based services WAP Gateway, WAP protocols , WAP user agent profile caching model wireless bearers for WAP WML , WMLScripts WTA iMode	5	4

Sync

6 Advances in the wireless network 4 4

### **TEXTBOOKS**

1. Jochen Schiller, "Mobile Communications", 2<sup>nd</sup> Edition, Pearson Education, 2003.
2. William Stallings, "Wireless Communications and Networks", 2<sup>nd</sup> Edition, Pearson Education, 2002.

### **RECOMMENDED READING**

1. Kaveh Pahlavan, Prashanth Krishnamoorthy, "Principles of Wireless Networks", Pearson Education, 1<sup>st</sup> Edition, 2003.
2. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.3.C. K. Toh, "AdHoc Mobile Wireless Networks", Pearson Education, 1<sup>st</sup> Edition, 2002.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3103T</b>	
<b>Course Title</b>	<b>Digital Image Processing</b>	
<b>Prerequisite</b>	<b>Software Architecture &amp; Design Patterns, Web technology</b>	

### COURSE OUTCOMES:

Students will be able to

1.	Understand the concept of Digital Image Processing.
2.	Design Image Enhancement and Segmentation Techniques.
3.	Design the Image Compression and Decompression Techniques.
4.	Design the Image Degradation and Restoration Techniques.

### COURSE CONTENTS

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Digital Image Processing (DIP) Overview:</b> Introduction to Digital Image Processing, Origins of Digital Image Processing, Fields that uses Digital Image Processing: Gamma-Ray Image, X-Ray Image, Imaging in the Ultraviolet Band, Visible & Infrared Band, Microwave Band and Radio Band	4	1
2.	<b>Digital Image Fundamentals:</b> Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels	4	1
3.	<b>Image Enhancement in the Spatial Domain:</b> Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic / Logical Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharping Spatial Filters, Combining Spatial Enhancement Methods	7	2
4.	<b>Image Enhancement in the Frequency Domain:</b> Introduction to the Fourier Transform and Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering, Implementation	7	2
5.	<b>Image Restoration:</b> Models of Image Degradation / Restoration Process, Noise Models, Restoration in the Presence of Noise Only – Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Positional-Invariant Degradations, Estimating the Degradation	3	3



- Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformation
6. **Color Image Processing:** 3 3  
 Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images, Color Image Compression
7. **Image Compression:** 3 4  
 Fundamentals, Image Compression Models, Elements of Information
8. **Image Segmentation:** Detection of Discontinuities, Edge Linking and 3 4  
 Boundary Detection, Thresholding, Region-Base Segmentation, Split and Merge Technique, Segmentation by Morphological Watersheds, Use of Motion in Segmentation
- 9 Advances in the domain

#### **TEXTBOOKS**

1. Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing, Prentice Hall, Third Edition, 2007
2. William K. Pratt: Digital Image Processing, PIKS Inside, Third Edition, 2002

#### **RECOMMENDED READING**

1. Anil K Jain: Fundamentals of Digital Image Processing, Prentice Hall of India, First Edition, 1998
2. Jayaraman S, Veerakumar T and Esakkirajan S: Digital Image Processing, 2017
3. Milan Sonka and Vaclav Hlavac and Roger Boyle: Image Processing, Analysis and Machine Vision, 2017

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3104T</b>	
<b>Course Title</b>	<b>Information Storage Management</b>	
<b>Prerequisite</b>	<b>Digital systems, Computer Organization and Architecture, Computer Networks</b>	

**COURSE OUTCOMES:**

Students will be able to

1.	Estimate today's storage needs, type of data, and its value and key management requirements of storage systems.
2.	Classify data, information, and storage infrastructure.
3.	Analyze and Justify different data protection techniques and disaster recovery techniques.
4.	Investigate and design data center infrastructure through network storage architecture like DAS, NAS, CAS, and SAN through modern tools.

**COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Overview of Storage Technology:</b> Concepts of storage networking, business applications defined for storage, sources of data and states of data creation, data center requirements and evolution, managing complexity, I/O and the five pillars of technology, storage infrastructure, evolution of storage, information lifecycle management.	7	1
2.	<b>Storage System Architectures:</b> Storage architectures, device overviews, peripheral connectivity, components and concepts, magnetic disk storage, disk systems, disk arrays, RAID storage arrays, magnetic tape storage, physical vs. logical disk organization, caching properties and algorithms connectivity options, differences in bus and network architectures.	7	1
3.	<b>Network Storage Architectures (NAS):</b> Hardware, software architecture, network connectivity, NAS as a storage system, NAS connectivity options, connectivity protocols, management principles.	4	2

**Storage Area Networks (SAN):**

Architecture, hardware devices, host bus adaptors, connectivity.

**Content Addressable Storage (CAS):**

Elements, connectivity options, standards and management principles, hybrid storage solutions.

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|----|---|-----|
| 4. | <b>Storage Area Networks:</b><br>SAN components and cabling, interconnect devices, and storage Arrays, SAN management Software, Fiber Channel architecture, Zoning, Login Types and topologies, IP SAN.   | 4 2 |
| 5. | <b>Information Availability:</b><br>Business continuity and disaster recovery basics, Local business continuity techniques, Remote business continuity techniques, Storage design and implementations of the Business continuity plan, Managing availability, Disaster recovery principles & techniques.  | 6 3 |
| 6. | <b>Managing and Storage Virtualization:</b><br>Managing Availability, Availability metrics, Implementing the plan, Finding the holes, maintaining serviceability capacity planning, Management tools, Overview information security virtualization, Different virtualization, Technologies and processes including file and block level virtualization. | 7 4 |

7 Advances in the domain

**TEXTBOOKS**

1. G. Somasundaram, Alok Shrivastava, Information Storage and Management, Wiley Publishing, Inc., 2<sup>nd</sup> Edition, 2012.
2. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, 2003.

**RECOMMENDED READING**

1. J Gerald Kowalski and T.Mark Mayburk, Information Storage and Retrieval Systems, Springer International, 2<sup>nd</sup> Edition, 2009.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3101P</b>	
<b>Course Title</b>	<b>Spatial Data Analysis and Visualization Lab</b>	
<b>Prerequisite</b>		

### **COURSE OUTCOMES:**

Students will be able to

1.	Understand basic properties of QGIS tool.
2.	Learn to create maps, data acquisition in different formats.
3.	Run spatial data analysis techniques.
4.	Develop and Publish web pages for WebGIS and MobileGIS using scripting languages.

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	Understanding QGIS, and other GIS mapping tools	2	1
2.	Working with QGIS	2	1
3.	Creating digital maps using geospatial objects	2	1,2
4.	Understanding digital data, data collection techniques, and various data formats	2	2
5.	Importing various data formats to QGIS to build map and features	2	2
6.	Working with basics of spatial data analysis	2	3
7.	Working with multiple layers of digital maps and complex query analysis	2	3
8.	Developing web pages for webGIS	2	3,4
9.	Working with scripting languages for dynamic webGIS contents	2	4
10.	Accessing webGIS/Mobile through private/public hosting infrastructure using GeoNode server.	2	4

### **TEXTBOOKS**

1. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
2. Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York
3. Makrewski, J. (1999): GIS Multi-criteria Analysis, John Wiley and Sons, New York

### **RECOMMENDED READING**

1. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
2. Longley, P. A., Goodchild, M. F., Maguire, D. J. Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester
3. Rao, C. P. Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3102P</b>	
<b>Course Title</b>	<b>Wireless Networks Lab</b>	
<b>Prerequisite</b>	<b>Computer Networks</b>	

### **COURSE OUTCOMES:**

Students 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

### **LIST OF EXPERIMENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	Study of Simulators for wireless networks.	2	1
2.	Build and configure Ad-hoc networks for various topologies.	2	1
3.	Study of working Physical MAC, Network, Transport Layer parameters.	2	2
4.	Study and Analysis of protocols at different layers.	2	2
5.	To Build and Study Star topology for wireless sensor network.	2	3
6.	To Build and Study Multi-hop topology for wireless sensor network.	2	3
7.	Study and analysis of protocols for wireless sensor network	2	4
8.	To study and Implementation Cellular Network.	2	4

### **TEXTBOOKS**

1. Jochen Schiller, "Mobile Communications", 2<sup>nd</sup> Edition, Pearson Education, 2003.
2. William Stallings, "Wireless Communications and Networks", 2<sup>nd</sup> Edition, Pearson Education, 2002.

### **RECOMMENDED READING**

1. Kaveh Pahlavan, Prashanth Krishnamoorthy, "Principles of Wireless Networks", Pearson Education, 1<sup>st</sup> Edition, 2003.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.3.C. K. Toh, "AdHoc Mobile Wireless Networks", Pearson Education, 1<sup>st</sup> Edition, 2002.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3103P</b>	
<b>Course Title</b>	<b>Digital Image Processing Lab</b>	
<b>Prerequisite</b>		

### **COURSE OUTCOMES:**

Students will be able to

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

### **COURSE CONTENTS**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	Write Programme for Implementation of Arithmetic Coding for Image.	2	1
2.	Write Programme for Histogram Display and Histogram Equalization.	2	1
3.	Write Programme to design of Non-linear Filtering.	2	1
4.	Write Programme for determination of Edge detection using Operators.	2	2
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	2	3
	a) Using Histogram Processing Technique.		
	b) using Spatial Filtering ( Smoothing Filters / Sharpening Filters )		
8.	Write Programme for Image Segmentation	2	3
	a) Using Split and Merge Technique.		
	b) Using Watershed Transform.		
9.	Write Programme for Image Compression and De-compression	2	3
	a) Using Huffman Coding and Decoding.		
	b) Using Arithmetic Coding and Decoding.		
10.	Write Programme for Color Image Manipulations, Reading and Writing of Color Image.	2	4

11. Write Programme for Color Image Enhancement and Histogram 2 4  
Manipulation

**RECOMMENDED READING**

1. Rafael 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
4. Milan Sonka and Vaclav Hlavac and Roger Boyle: Image Processing, Analysis and Machine Vision.



<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3104P</b>	
<b>Course Title</b>	<b>Information Storage Management Lab</b>	
<b>Prerequisite</b>	<b>Digital systems, Computer Organization and Architecture, Computer Networks</b>	

**COURSE OUTCOMES:**

Students will be able to

1.	Estimate today's storage needs, type of data, and its value and key management requirements of storage systems.
2.	Classify data, information, and storage infrastructure.
3.	Analyze and Justify different data protection techniques and disaster recovery techniques.
4.	Investigate and design data center infrastructure through network storage architecture like DAS, NAS, CAS, and SAN through modern tools.

**LIST OF EXPERIMENTS:**

<b>S.N.</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
<b>1.</b>	<b>Data Centre Environment:</b> Review and understand the components and systems in a data center.	2	1
<b>2.</b>	<b>Intelligent Storage System:</b> To explore the management interface and general tasks to be performed within an intelligent storage system.	2	1,2
<b>3.</b>	<b>FC San:</b> To explore the management interface and general tasks to be performed within a Fibre Channel SAN.	2	2
<b>4.</b>	<b>IP San:</b> To configure the interface and provision storage within an iSCSI SAN.	2	2,3
<b>5.</b>	<b>Host – based business continuity:</b> To explore the benefits and configuration of multipath protection and host level business continuity.	2	3
<b>6.</b>	<b>Managing protection services:</b> To review the use of local protection systems to provide highly available resources within a storage network.	2	3,4

- |    |   |   |   |
|----|---|---|---|
| 7. | <b>Managing storage infrastructure:</b>   | 2 | 4 |
|    | Review reports and data collections in order to determine operational status and health of the infrastructure |   |   |
| 8  | Advances in the domain  |   |   |

### **TEXTBOOKS**

1. G. Somasundaram, Alok Shrivastava, Information Storage and Management, Wiley Publishing, Inc., 2<sup>nd</sup> Edition, 2012.
2. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, 2003.

### **RECOMMENDED READING**

1. J Gerald Kowalski and T.Mark Mayburk, Information Storage and Retrieval Systems, Springer International, 2<sup>nd</sup> Edition, 2009.

<b>Programme Name</b>	<b>B. Tech. (Computer Engineering)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CO3601S</b>	
<b>Course Title</b>	<b>Network Security</b>	
<b>Prerequisite</b>	<b>Computer Network, Operating System</b>	

**COURSE OUTCOMES:**

Students 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:**

<b>Unit No</b>	<b>Topics</b>	<b>Hrs</b>	<b>CO</b>
1.	<b>Mathematical Foundations:</b> Basic Number Theory, Congruences , Chinese Remainder theorem, Modular exponentiation, Fermat and Euler's theorem , Finite fields, Discrete Logarithms	5	1
2.	<b>Symmetric key Ciphers:</b> Modern Block Ciphers - DES, AES, Modes of Operation of Block Ciphers, Differential Cryptanalysis ,Triple DES , Stream Ciphers ,Pseudorandom Functions	5	1
3.	<b>Asymmetric key Cryptography:</b> 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.	<b>Program Security:</b> 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 code, Control against threats.	4	2

5.	<b>System Security:</b> 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.	<b>Database Security:</b> Databases Security requirements – Reliability and Integrity – Sensitive data – Inference – Multilevel database – Proposal for multilevel security, RBAC, MAC and DAC using ORACLE database	3 2
7.	<b>Network Security:</b>  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.	<b>OWASP: Web Application Security and the OWASP top 10:</b> 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, 5<sup>th</sup> edition, 2015.
2. 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, 1<sup>st</sup> 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, 1<sup>st</sup> edition, 2008.
2. ISECOM, Hacking Exposed Linux: Linux Security Secret and Solutions, McGraw Hill Education, 3<sup>rd</sup> edition, 2008.

<b>Programme Name</b>	<b>B. Tech. (Information Technology)</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4IT3601S</b>	
<b>Course Title</b>	<b>System Administration</b>	
<b>Prerequisites</b>		

### COURSE OUTCOMES:

Students will be able to

1.	Apply GNU/Linux based systems commands
2.	Apply the fundamentals of security in programs, operating systems and databases Demonstrate various Linux distributions File system administration.
3.	Identify various issues in Network Administration, Server administration
4.	Implement and configure a server with security administration policy

### COURSE CONTENTS

<b>S. No.</b>	<b>Contents</b>	<b>HRS</b>	<b>CO</b>
1	<b>Basic System Administration:</b> 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.	4	1
2	<b>File system Administration:</b> 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	4	2
3	<b>Network Administration:</b> 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	<b>Devices/server Administration, Backup and Restore:</b> 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	1,3
5	<b>Security Administration:</b> GNU/Linux security architecture, Access control, PAM, Security Tools –	5	4

nmap, SE Linux, Authentication Mechanisms, LDAP, Firewall, Firewall policies, Proxy Servers, SOCKS Proxy server.

6	<b>Advance Technologies:</b> Cluster Administration: setup & configuration, parallel process management	5	4
7	Advances in the domain	5	4

#### **TEXT BOOKS**

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, 6<sup>th</sup> 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, 1<sup>st</sup> edition, 1999.
3. Richard Blum and Christine Bresnahan, Linux Command Line and Shell Scripting Bible, Wiley India Pvt. Ltd.; 2<sup>nd</sup> edition, 2011.