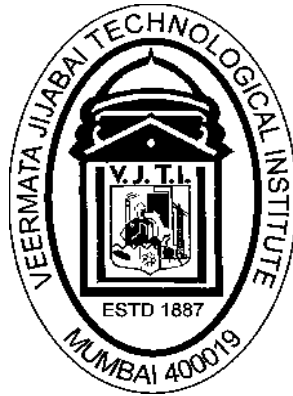


VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)



Curriculum

(Scheme of Instruction & Evaluation and Course contents)

(Revision 2018)

For
Final year of

Four Year Undergraduate Program 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
Final year of

Four Year Undergraduate Program Leading to
Bachelor of Technology (B. Tech.)

In

COMPUTER ENGINEERING

(2021-22)

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 Outcomes (POs)

After the completion of the B.Tech. Computer Engineering Program, 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):

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

1. **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, Cyber Security, and Forensics' applications for efficient design of computer-based system of varying complexity by applying the knowledge of core science, engineering mathematics and engineering fundamentals.
2. **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.
3. **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.

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
B.Tech. (Computer Engineering)
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	ESE
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	00	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

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
B.Tech. (Computer Engineering)
Scheme of Instruction and Evaluation
SEMESTER- IV

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	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			

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VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

B.Tech. (Computer Engineering)

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		40
8	R4CO3003P	Computer Network Lab	0	0	2	1	60		40
9	R4CO3004P	Artificial Intelligence Lab	0	0	2	1	60		40
10	R4CO3007P	Open-Source Computing	1	0	2	2	60		40
		TOTAL	18	1	8	21			

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VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

B.Tech. (Computer Engineering)

Scheme of Instruction and Evaluation

SEMESTER- VI

Scheme of Instruction			Scheme of Evaluation						
S.N.	Course Code	Course Name	L-T-P			Credits	Evaluation Scheme		
			Hours / Week				TA	MST	ESE
			L	T	P				
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			

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	Professional Elective 1		Professional Elective 1 Lab
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

	Open Elective 1
R4CO3601S	Network Security
R4IT3601S	System Administration

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

VEERMATA VIVJBAI TECHNOLOGICAL INSTITUTE
B.Tech. (Computer Engineering)
Scheme of Instruction and Evaluation
SEMESTER-VII

Scheme of Instruction			Scheme of Evaluation						
S.N	Course Code	Course Name	Hours/Week			Credits	Evaluation Scheme		
			L	T	P		TA	MST	ESE
1	R4CO4001T	Data Mining and Data Warehousing	3	0	0	3	20	20	60
2	R4CO4001P	Data Mining and Data Warehousing Lab	0	0	2	1	60	00	40
3	R4CO4002T	Cyber Security	3	0	0	3	20	20	60
4	R4CO4002P	Cyber Security Lab	0	0	2	1	60	00	40
5		Professional Elective 2	3	0	0	3	20	20	60
6		Professional Elective 2 Lab	0	0	2	1	60	00	40
7		Open Elective 2	3	0	0	3	20	20	60
8	R4CO4901D	Project –I	4			2	60	00	40
9	R4CO4003A	Presentation on Internship work	4			2	60	00	40
			12	0	14	19			

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Professional Elective –2		Professional Electives–2 Lab	
Course Code	Course Title	Course Code	Course Title
R4CO4201T	Software Project Management	R4CO4201P	Software Project Management Lab
R4CO4202T	Geospatial Programming and Web Application Development	R4CO4202P	Geospatial Programming and Web Application Development lab
R4CO4203T	Blockchain Technology	R4CO4203P	Blockchain Technology Lab
R4CO4204T	Natural Language Processing	R4CO4204P	Natural Language Processing Lab
R4CO4205T	Software Architecture	R4CO4205P	Software Architecture Lab

Open Electives –II	
Course Code	Course Title
R4CO4601S	Internet of Things
R4CO4602S	Data Structure
R4CO4603S	Cyber Physical System Security

VEERMATA VIVJBAI TECHNOLOGICAL INSTITUTE

B.Tech. (Computer Engineering)

Scheme of Instruction and Evaluation

SEMESTER-VIII

Scheme of Instruction			Scheme of Evaluation						
SN	Course Code	Course Name	Hours / Week			Credits	Evaluation Scheme		
			L	T	P		TA	MST	ESE
1	R4CO4011T	Big Data Analytics	4	0	0	4	20	20	60
	R4CO4011P	Big Data Analytics Lab	0	0	2	1	60	00	40
2	R4CO4012T	Cloud Computing	3	0	0	3	20	20	60
3	R4CO4012P	Cloud Computing Lab	0	0	2	1	60	00	40
4		Professional Elective-3	3	0	0	3	20	20	60
5		Professional Elective 3 Lab	0	0	2	1	60	00	40
6		Professional Elective-4	3	1	0	4	20	20	60
7	R4CO4902D	Project –II	8			4	60	00	40
			13	1	14	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**:

Professional Elective –3		Professional Electives–3 Lab	
Course Code	Course Title	Course Code	Course Title
R4CO4301T	Software Testing	R4CO4301P	Software Testing Lab
R4CO4302T	Soft Computing	R4CO4302P	Soft Computing Lab
R4CO4303T	Digital Forensics	R4CO4303P	Digital Forensics Lab
R4CO4304T	Service Oriented Architecture	R4CO4304P	Service Oriented Architecture Lab
R4CO4305T	Management Information Systems	R4CO4305P	Management Information Systems Lab

Professional Electives –4	
Course Code	Course Title
R4CO4401S	Multicore Technologies
R4CO4402S	Advanced Database Engineering
R4CO4403S	Human Computer Interaction
R4CO4404S	Virtual Reality
R4CO4405S	Distributed Algorithms

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4001T	
Course Title	Data Mining and Data Warehousing	
Prerequisite	Statistics, Database, Data Structures and Algorithms	

COURSE OUTCOMES: Students will be able to	
1.	Perform the preprocessing of data and apply mining and data warehousing techniques on it.
2.	Identify and Implement association rules, classification, and clustering algorithms
3.	Solve real world problems in business and scientific information using data mining
4.	Use data analysis tools for scientific applications

COURSE CONTENTS

	Hrs	CO
1. Introduction to Data Mining: Introduction, Data Mining Techniques, Knowledge Discovery, KDD Process.	2	1
2. Data Warehouse and OLAP Technology for Data Mining: Introduction to Data Warehouse, Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation.	4	1
3. Data Processing: Types of Data, Data Quality, Data Pre-processing, Data Cleaning, Outlier Detection, Missing Value Detection, Data Integration, Data Reduction, Data Transformation and Data Discretization, Similarity and Dissimilarity, Summary Statistics, Visualization,	7	1,2
4. Classification: Decision Tree, Model Overfitting, Evaluating Performance of Classifier, Rule-Based Classifier, Nearest-Neighbor Classifier, Bayesian Classifier, ANN, SVM, Ensemble Methods, Class Imbalance Problems.	7	2,3
5. Association: Frequent Item Generation, Rule Generation, Compact Representation of Frequent Itemsets, FP-Growth Algorithm	4	2,3
6. Clustering: K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering.	4	2,3
7. Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining.	3	2,3
8. Visualization: Data Generalization and Summarization-Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating Between Different Classes, Mining Descriptive Statistical Measures in Large Databases.	4	4
9. Applications: Anomaly Detection, Time Series Prediction, Visual and Audio Data Mining, Recommendation Systems.	2	3,4
10. Advances in Data Mining.	2	3,4

TEXTBOOKS

- 1 Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, ISBN: 978-93-3257-140-2
- 2 Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, ISBN: 978-93-80931-91-3

RECOMMENDED READING

- 1 M. Berry and G. Linoff, "Mastering Data Mining", John Wiley and Sons, 2nd Edition.
- 2 I.H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, 4th Edition.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4001P	
Course Title	Data Mining and Data Warehousing Lab	
Prerequisite	Statistics, Data Structures and Algorithms	

COURSE OUTCOMES: Students will be able to	
1.	Investigate different data mining and data warehouse tasks and evaluate the algorithms with respect to their accuracy.
2.	Compare the results of a data mining exercise and analyze the results.
3.	Design a data mining solution to a practical problem.

LIST OF EXPERIMENTS:

	Hrs	CO
1. To perform a multidimensional data model using SQL queries. e.g., snowflake, star and fact constellation schema.	2	1
2. To perform various OLAP operations such as: slice, dice, roll up, drill up etc.	2	1
3. To perform data cleaning and preparing for operations	2	1,2
4. Study of Decision Trees and other classification Algorithms.	4	2,3
5. To perform association rule mining	4	2, 3
6. Study of predictive algorithms.	2	2, 3
7. Study of clustering and its different techniques.	4	2, 3
8. To perform text mining on the given data warehouse and perform correlation analysis between for the given data sets	2	2, 3

TEXTBOOKS

- 1 Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, ISBN: 978-93-3257-140-2
- 2 Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, ISBN: 978-93-80931-91-3

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- 1 M. Berry and G. Linoff, "Mastering Data Mining", John Wiley and Sons, 2nd Edition.
- 2 I.H. Witten and E. Frantk, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, 4th Edition.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4002T	
Course Title	Cyber Security	
Prerequisite	Computer Network	

COURSE OUTCOMES: Students will be able to

1.	Identify cybercrimes, and respective cyber laws
2.	Build the secure Network infrastructure and reduce the risk of attacks.
3.	Reduce the risk of data theft and web application attacks.
4.	Explore the Security and Forensic Best Practices in Advanced Domain.

COURSE CONTENTS

	Hrs	CO
1. Cyber Threats and Attacks and laws: What is Cyber Security, its needs, Security Parameters, Vulnerabilities, cybercrimes and stalking, Hacking Phases, Investigation of Cyber Crimes And evidential aspects of cyber laws, IT Acts-2000 and cybercrimes, IPR, Media Law, IPC for cyber-crimes, CrPC and IT Act 2000, International cyber laws, Cyber-crime case studies.	4	1,2
2. TCP/IP Stack: Vulnerabilities and attacks on TCP/IP stack- DOS: R2L, U2R, probing, Vulnerabilities and Attack on Application Layer Protocols, Transport Layer (TCP/UDP), Internet Layer. Data communication/ Link Layer Attacks and Defense Mechanisms, Cryptanalysis Techniques and building robust algorithms of cryptography.	7	1,2
3. TCP/IP Routing and security Protocols: Vulnerabilities and Attacks On TCP/IP routing protocols and security protocols and their defense mechanisms.	7	1,2
4. Secure Network Design; Networking Scanning- secure Network Architecture design, Network Security Devices-firewall's, intrusion prevention systems, router attacks and defense mechanism, network analysis Tools-wire shark and NMAP., Case Studies	7	2,3
5. Web Application Attacks and Security- Web program security, OWASP And Defense Mechanism, access control hardening LINUX OS for cyber security- Web Server and data base servers' attacks and security and forensic, digital payments and dangers to credit cards on Net-SET	7	3
6. Advances in domain- Hand Held Devices and cloud attacks, security and forensic. Security and Forensic Best practices, Case Studies	7	3,4

TEXTBOOKS

1. 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
2. William Stallings, “Cryptography and Network Security”, Pearson Education/PHI, 2006.

RECOMMENDED READING

- 1 Digital Forensics, DSCI - Nasscom, 2012.
- 2 Cyber Crime Investigation, DSCI - Nasscom, 2013
- 3 Charles Pfleeger, “Security in Computing”, 4th Edition, Prentice Hall of India, 2006.
- 4 Joakim Kävrestad, “Fundamentals of Digital Forensics: Theory, Methods, and Real-Life Applications”, Springer

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4002P	
Course Title	Cyber Security Lab	
Prerequisite	Computer Network	

COURSE OUTCOMES: Students will be able to

1.	Identify cybercrimes, and respective cyber laws
2.	Build the secure Network infrastructure and reduce the risk of attacks.
3.	Reduce the risk of data theft and web application attacks.
4.	Explore the Security, Defense mechanism And Forensic Best Practices in Advanced domain.

LIST OF EXPERIMENTS:

Hrs CO

1. Cyber Crime

2 1

(i)For a given case study on cyber-crime,

1. Investigate the Cyber Crimes And evidential aspects.

2. identify the security parameters.

3. Identify the cyber laws for the punishment of cybercrimes and stalking.

Run the following commands on your computer and analyze the results.

1 run c:\> ipconfig/all

2 run c:\> NETSTAT [-a] [-b] [-e] [-n] [-o] [-p proto] [-r] [-s] [-v] [interval]

3 ping IP Address

4 tracert type url or IP Address

5. c:\> arp-a

6. Find the open ports using NETWOX tools 67

7. Discuss the following internet address tools

1. Dig

2. Whois

3. Traceroute

8 Enumerate Remote Systems

2. TCP/IP Security Model

2 1,2

(i) The TCP/IP STACK deals with the various protocols at various layers of the TCP/IP stack like TCP/IP protocols, routing protocols and security protocols. Study the various protocols, identify vulnerabilities of these protocols and provide the defense mechanism. Identify the tools to do attack and defense mechanism tools.

OR. Download the open-source Linux operating system from the internet and study the code of TCP/IP Model, modify it and embed it in Linux and execute.

(ii) Perform Attacks on Cryptographic Algorithms and Design Robust RSA, DES, Stream Ciphers-RC4 etc. algorithms and implement and test them.

3. Secure Network Design for Organization

2 1,2,3

Design the campus wide network for the campus of the engineering college. Analyze The location of the core switch, distribution switch and access switch and departmental requirements for connectivity of the computers. Also specify the requirements for setting the data centre and firewall and IPS, Routing Requirements. Identify active and passive components specifications for the design of the network. Identify the vulnerabilities, attacks and defense mechanism for the security of organization's enterprise network. Formulate the organizational guidelines for network and computing infrastructure usage.

4. **Practical Experiment on Firewall** 2 1,3

(i) Each student shall Download and install each type of open-source firewall, perform the experiment and note the results. Write a report of your experimentations; and check with the domain expert

1. SHORELINE, JAY" S, GUARDDOG firewalls are classified as Packet Filtering firewalls
- 2 NETNANNY, CYBERPATROL, DANE GUARDIAN and GAUNTLET firewalls are classified as Data Filtering firewalls.
3. IPCOP and SMOOTHWALL firewalls are both Data Filtering as well as Packet Filtering firewalls.

(ii) Study the commercial software's (firewall and IDS) if you have access from any sources Write a report of your experimentations; and check with the domain.

5. **Implement Intrusion Detection Systems.** 2 2

Use the following steps:

1. Capture packets using windup/TCPDump and storing in packet.txt
2. Preprocess packet.txt to give input to the patterning matching algorithm.
3. Storing the normal and abnormal traffic patterns in pattern.txt file. You can use KDD cup data or create your own data for the experiment.
4. Pattern Matching step: if pattern in the pattern.txt file matches with any of the abnormal attack packet in packet.txt file, then the packet is abnormal packet otherwise it is normal packet
5. Display result as normal or abnormal packet (attack or intrusion).

6. **Protocol Analysis Tools.** 2 1,3

Download and install the following packet capture softwares on your computer(any one by each student)

1. Wireshark
2. TCPDUMP
3. WindowDump
4. NMAP

What are the facilities provided by the softwares? Illustrate the features of each softwares? Study and analyse following protocols or any other protocols of your choice.(any two by each students)

(i)ARP (ii) IP (iii) TCP (iv) DNS packet (v) SMTP protocol (vi) BGP
Show the report to your teacher

7. The Attacks On Web Application and Defense Mechanism 2 1,3

Consider the systems software's and applications software are loaded on web server, application server and database server. Gather the information about the enterprise for making the attacks. How can you do Top 10 OWASP attack. Apply secure software life cycle for the given case study. Write the secure code and provide the defense mechanism against Top 10 OWASP attack. You can use ESAPI Or Any Other Framework.

8. Hardening Linux and Database for Cyber Security 2 2

(i) Harden the Linux operating systems with respect to following

1. Basic security 2. File and directory security 3. Workstation security 4. Server security 5. Network services security

(ii) Perform the experiment for Data base security using RBAC, DAC, MAC and identify the source of unauthorized users accessing the database.

(iii) Identify the organizational Implications for organizational policy, web threats, security and privacy and incident handling

9. Defense Mechanism Against Hackers Methodology. 2 3,4

Illustrate the Hackers methodology with suitable experiment in order to improve the quality of the computing systems services of your organization.

(Hint: Foot printing, Scanning, Enumeration, gaining access, escalating privileges, covering tracks, Creating backdoors, Denial of service)

i) Which techniques and tools are used by the hacker at each phase of hacking of computing assets of your network/laptop/PC?

ii) Perform the experiment for the passive attacks and active attacks on computing systems of your organization's data centre/laptop/PC and show the results to the owner of organization with snapshots.

iii) Suggest the defense mechanism strategy/tools at every phase of hacking in order to protect the computing assets of your data centre.

(iv) Cybercrime: Illustrations and case studies.

10 GROUP PROJECTS 2 3

1. Select any group project on following.

Analyze design, implement and Test project (any one)

Modification Of TCP/IP, Network Security, Web Application Security, Secure Life Cycle, Security. E Testing IPS, Firewall, Computer Hacking and Forensic Investigation, Mobile Security, Mobile Forensic, Cloud Security, Cloud Forensic, Security and forensic of Hand-held devices. OR Any Other Project Assigned by Teacher on Cyber Security.

TEXTBOOKS

1. 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.
2. John Sammons, "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics", Elsevier, 1st Edition, 2012.

RECOMMENDED READING

- 1 Charles Pfleeger, “Security in Computing”, 4th Edition, Prentice Hall of India, 2006.
- 2 Roberta Bragg, M.r. Ousley. Keith Strassberg, “Network Security- The Complete Reference”, Tata McGraw-Hill

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4201T	
Course Title	Software Project Management	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Apply key Project Management concepts to Software Projects.
2.	Use Project Integration Management Techniques for Software Projects.
3.	Manage Scope, Time, Cost and Quality of Software Projects.
4.	Illustrate Human Resource Management, Communications Management, Risk Management & Procurement Management Techniques for Software Projects.

COURSE CONTENTS

	Hrs	CO
1. Introduction to Project Management: Introduction to Project and Project Management, Program and Project Portfolio Management, The Role of the Project Manager, The Project Management Profession.	3	1
2. The Project Management and Information Technology Context: A Systems View of Project Management, Understanding Organizations, Stakeholder Management, Project Phases and the Project Life Cycle, The Context of Information Technology Projects. Recent Trends Affecting Information Technology Project Management.	3	1
3. The Project Management Process Groups: Project Management Process Groups, Mapping the Process Groups to the Knowledge Areas, Developing an IT Project Management Methodology.	3	1
4. Project Integration Management: Introduction to Project Integration Management, Strategic Planning and Project Selection, developing a Project Management Plan, Project Execution, Directing and Managing Project Work, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases, Using Software to Assist in Project Integration Management.	3	2
5. Project Scope Management: Planning Scope Management, Collecting Requirements, Defining Scope, Creating the Work Breakdown Structure, Validating Scope, Controlling Scope, Using Software to Assist in Project Scope Management.	3	3
6. Project Time Management: The Importance of Project Schedules, Planning Schedule Management, Defining Activities, Sequencing Activities, Estimating Activity Resources, Estimating Activity Durations, Developing the Schedule, Controlling the Schedule, Using Software to Assist in Project Time Management.	3	3
7. Project Cost Management: The Importance of Project Cost Management, Basic Principles of Cost Management, Planning Cost Management, Estimating Costs, Determining the Budget, Controlling Costs, Using Project Management Software to Assist in Project Cost Management.	3	3

8.	Project Quality Management: Introduction Project Quality Management, Planning Quality Management, Performing Quality Assurance, Controlling Quality, Tools and Techniques for Quality Control, Modern Quality Management, Improving IT Project Quality, Using Software to Assist in Project Quality Management.	3	3
9.	Project Human Resource Management: Introduction to Project Human Resource Management, The Importance of Human Resource Management, Keys to Managing People, Developing the Human Resource Plan, Acquiring the Project Team, Developing the Project Team, Managing the Project Team, Using Software to Assist in Human Resource Management.	3	4
10	Project Communications Management: Introduction to Project Communications Management, Keys to Good Communications, Planning Communications Management, Managing Communications, Controlling Communications, Information Distribution, Performance Reporting, Managing Stakeholders, Suggestions for Improving Project Communications, Using Software to Assist in Project Communications.	4	4
11	Project Risk Management: The Importance of Project Risk Management, Planning Risk Management, Common Sources of Risk on IT Projects, Identifying Risks, Performing Qualitative Risk Analysis, Performing Quantitative Risk Analysis, Planning Risk Responses, Controlling Risks, Using Software to Assist in Project Risk Management.	4	4
12	Project Procurement Management: The Importance of Project Procurement Management, Planning Procurement Management, Planning Contracting, Conducting Procurements, Controlling Procurements, Closing Procurements, Using Software to Assist in Project Procurement Management.	2	4
13	Advances in the domain	2	4

TEXTBOOKS

1. Kathy Schwalbe, "Information Technology Project Management", Revised, 7th Edition, Cengage Learning.
2. B. Hughes, M. Cotterell, "Software Project Management", Tata McGraw-Hill Education, 5th Edition.

RECOMMENDED READING

- 1 Joseph Phillips, "IT Project Management: On Track from Start to Finish", Mc-Graw Hill Publication, 3rd Edition.
- 2 P. Jalote, "Software Project Management in Practice", Pearson Education.
- 3 John M. Nicholas, Herman Steyn, "Project Management for Business and Technology", PHI, 4th Edition.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4201P	
Course Title	Software Project Management Lab	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate Project Initiation, Analysis & Design of Software Projects.
2.	Develop, Test, prepare end project documents and Assess Software Projects.
3.	Illustrate Scope, Time, Cost, Quality, Human Resources, Communications & Risks management of Software Projects.
4.	Demonstrate effective project execution and control techniques that result in successful Software Projects.

LIST OF EXPERIMENTS:

	Hrs	CO
1. Select a Software Project and Define Project Objectives.	2	1
2. Write a Detailed Problem Statement.	2	1, 2
3. Prepare Project Initiation Documents -	2	2, 3
a. Business Case		
b. Project Charter		
c. Team Contract Scope Statement		
4. Prepare Project Planning Documents-	2	2, 3
a. Estimation Document		
b. Risk Management Plan		
c. Time Management Plan (Schedule)		
d. SQA Plan		
e. SCM Plan Test Plan		
5. Prepare Problem Analysis, Product Design & Testing Documents-	2	3, 4
a. Data modeling- ER diagrams		
b. Functional modeling- Data flow diagrams		
c. Behavioral modeling – State transition diagrams		
d. Database design, File design, Data structures design, Software Architecture design (Modular diagram)		
6. b. Flowcharts, Algorithms/pseudo code design		
b. User interface design Test cases		
7. Develop Software & Carry out testing using different testing methods.	2	1, 2
8. Prepare End Project Documents -	2	3, 4
a. Milestone report		
b. Summary of project results		
c. Lesson Learned report Client acceptance form		

TEXTBOOKS

1. Kathy Schwalbe, “Information Technology Project Management”, Revised, 7th Edition, Cengage Learning.
2. John M. Nicholas, Herman Steyn, “Project Management for Business and Technology”, PHI, 4th Edition.

RECOMMENDED READING

- 1 Joseph Phillips, “IT Project Management: On Track from Start to Finish”, Mc-Graw Hill Publication, Third Edition.
- 2 P. Jalote, “Software Project Management in Practice”, Pearson Education.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4202T	
Course Title	Geospatial Programming and Web Application Development	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

1.	Understand basic concepts of GIS, GIS models and projection systems.
2.	Learn accurate data acquisition and visualization techniques.
3.	Apply spatial analysis techniques.
4.	Learn about webGIS and MobileGIS.

COURSE CONTENTS

	Hrs	CO
1. Geographic Information Systems, Science and Study: Introduction: Why GIS, Science and Technology of problem solving, GISystems, GIScience, GIS applications, GIS Components, Geographic data representation, Geographic data models: Raster and Vector data models.	5	1
2. Geo referencing and projection system: Early measurements, The Geoid, Measuring the Earth: latitude and Longitude, Map projections and coordinate System, Digitizing: Coordinate capture, coordinate transformation, GNSS basics, GNSS control points, Map Projection vs. Transformation, Geo-referencing, satellite-based positioning,	5	1
3. Data acquisition and assimilation: Data Sources: Aerial images, Satellite images, LiDAR, Digital data, remote sensing, Data acquisition methods: Field survey, Control survey, old records, Integration challenges in geospatial systems	5	2
4. Visualizing spatial data: Introduction to maps, visualization process, cartographic toolbox, Maps types, Map scales, Map Generalization, Map boundaries, maps and cartography, Principles of map design, how to map: qualitative, quantitative, terrain elevation, time series, geo visualization, map stories.	5	2
5. Spatial Analysis: Introduction: what is spatial analysis? Selection and Classification, Proximity Functions and Buffering, Fundamental spatial analysis techniques such as overlay, extraction, and interpolation, Raster analysis: Map Algebra, Local Functions, global Functions, terrain analysis	6	3
6. Web GIS: Introduction to Web GIS, Introduction to Mobile GIS, Scripting Languages for GIS	6	4
7. Advances in GIS: Data Standards, Data Quality, Data Accuracy, Advances and Currents developments in GIS, Challenges in GIS	7	2,4

TEXTBOOKS

1. Paul Bolstad, “GIS Fundamentals - A First Text on Geographic Information Systems” -XanEdu (2016)
2. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, “Geographic information systems and science”, John Wiley & Sons,4th edition 2015.

RECOMMENDED READING

- 1 Michael N. DeMers, “Fundamentals of Geographic Information Systems”, 4th edition. Hoboken, NJ: Wiley, 2009.
- 2 Lo, C. P., Yeung, Albert, “Concepts and techniques of geographic information systems”, 2nd edition. Upper Saddle River, NJ: Pearson Prentice Hall, ,2007.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4202P	
Course Title	Geospatial Programming and Web Application Development Lab	
Prerequisite	NIL	

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.

LIST OF EXPERIMENTS:

	Hrs	CO
1. Understanding QGIS, and other GIS mapping tools	2	1
2. Working with QGIS	2	1
3. Creating digital maps using geospatial objects	2	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 basics of spatial data analysis	2	3
8. Working with multiple layers of digital maps and complex query analysis	2	3
9. Developing web pages for webGIS	2	4
10. Working with scripting languages for dynamic webGIS contents	2	4
11. Working with scripting languages for dynamic MobileGIS contents	2	4

TEXTBOOKS

1. Paul Bolstad, “GIS Fundamentals_ A First Text on Geographic Information Systems” -XanEdu (2016)
2. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, “Geographic information systems and science”, John Wiley & Sons, 4th edition 2015.

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- 1 Michael N. DeMers, “Fundamentals of Geographic Information Systems”, 4th edition. Hoboken, NJ: Wiley, 2009.
- 2 Lo, C. P., Yeung, Albert, “Concepts and techniques of geographic information systems”, 2nd edition. Upper Saddle River, NJ: Pearson Prentice Hall, 2007.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4203T	
Course Title	Blockchain Technology	
Prerequisite	Nil	

COURSE OUTCOMES: Students will be able to

1.	Understand blockchain architecture and requisite crypto foundations and Understand and Resolve security concerns in blockchain
2.	Demonstrate various consensus protocols and their usage for specific applications
3.	Explore blockchain advances and upcoming platforms
4.	Analyze smart contracts and distributed application and design use-case

COURSE CONTENTS

	Hrs	CO
1. Introduction and Crypto foundations: Elliptic curve cryptography, ECDSA, Cryptographic hash functions, SHA-256, Merkle Trees, Cryptocurrencies	4	1
2. Bitcoin: Bitcoin addresses, Bitcoin's blockchain, block header, mining, proof of work (PoW) algorithms, difficulty adjustment algorithm, mining pools, transactions, double spending attacks, the 51% attacker, block format, pre-SegWit transaction formats, Bitcoin script, transaction malleability, SegWit transaction formats, smart contracts (escrow, micropayments, decentralized lotteries), payment channels, Lightning network	8	1,3
3. Ethereum: Overview of differences between Ethereum and Bitcoin, block format, mining algorithm, proof-of-stake (PoS) algorithm, account management, contracts and transactions, Solidity language, decentralized applications using Ethereum	4	1,2
4. Smart Contracts	4	4
5. Different Blockchains and Consensus mechanisms	4	2
6. Blockchain and Security: Attacks and countermeasures	4	1
7. R3, Corda and Hyperledger: System architecture, ledger format, chain code execution, transaction flow and ordering, private channels, membership service providers, case studies	8	3
8. Advances in the domain	3	4

TEXTBOOKS

1. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media, Inc., 2014.
2. Arvind Narayanan, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (July 19, 2016) ISBN-10: 0691171696

RECOMMENDED READING

- 1 <http://hyperledger-fabric.readthedocs.io/en/latest/>
- 2 <http://www.ethdocs.org/en/latest/>
- 3 Arvind Narayanan, Princeton University Press (July 19, 2016) ISBN-10: 0691171696

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4203P	
Course Title	Blockchain Technology Lab	
Prerequisite	Nil	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate the basic concepts of cryptography in Blockchain technology
2.	Implement Ethereum contracts
3.	Analyze distributed applications
4.	Implement consensus algorithms

LIST OF EXPERIMENTS:

	Hrs	CO
1. Understanding ECDSA	2	1
2. Implement a program to chain the message using hash functions	2	1
3. Analyze the bitcoin blockchain and ethereum blockchain	2	1,2
4. Write a program to implement proof-of-work consensus algorithm	2	4
5. Implement a smart contract to creation of Token	3	2,3
6. Implement a smart contract to election	3	2,3
7. Design a Distributed Application	4	3
8. Configure hyperledger Blockchain	3	4

TEXTBOOKS

1. V. Saravanan. “An Introduction to Bitcoin”, Lecture Notes.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media, Inc., 2014.

RECOMMENDED READING

- 1 Arvind Narayanan, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016) ISBN-10: 0691171696
- 2 Antonopoulos, Andreas M. and Wood, “Mastering Ethereum”, O’Reilly Media, Inc., 2018

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4204T	
Course Title	Natural Language Processing	
Prerequisite	Machine Learning	

COURSE OUTCOMES: Students will be able to

1.	Understand the applications and analysis of NLP.
2.	Demonstrate accomplishments of knowledge and comprehension of NLP.
3.	Compare and contrast approaches to NLP.
4.	Discuss the limitations and promise of NLP.

COURSE CONTENTS

	Hrs	CO
1. Introduction to NLP: History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural Language, Stages in NLP, Challenges of NLP. Various Applications of NLP- Machine translation, Named Entity Recognition, question answering system, Information retrieval, Text categorization, text summarization, Sentiment Analysis and so on.	3	1
2. Word Level Analysis: Morphology in natural languages, Morphology analysis, Inflectional morphology & Derivational morphology, Regular expression, finite automata, finite state transducers (FST), Morphological parsing with FST, Lexicon free FST - Porter stemmer.	4	2
3. N-gram Language Models: The role of language models, Simple N-gram models. Estimating parameters and smoothing - Laplace Smoothing, Add-k smoothing, Kneser-Ney Smoothing, Web and Stupid Back-off, Perplexity and Entropy, Evaluating language models.	4	2
4. Part of Speech Tagging: Part of Speech Tagging, Tagset for English, Penn TreeBank Tagset for English, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging, Issues –Multiple tags & words, Unknown words, class-based n-grams, Hidden Markov Models (Forward and Viterbi algorithms and EM training) for sequence labeling task of POS tagging.	4	2
5. Syntactic Analysis: Context Free grammar Constituency, Context free rules & trees, Sentence level construction - Noun Phrase, Verb phrase etc. Need of Parsing, Dependency Parsing, Parsing in case of Ambiguity, Parsing, Different Parsing Algorithms - CFG, V Probabilistic Parsing.	5	2
6. Semantics Analysis: Meaning representation, lexical semantics - sense relations, semantic roles, and primitive decomposition, WordNet - Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy. Ambiguity in Word Senses, Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary-based approaches.	4	3

7.	Distributional Semantics: Distributional hypothesis, vector space models, etc. Distributed Representations: Neural Networks (NN), Backpropagation, Softmax, Hierarchical Softmax. Word Vectors: Feedforward NN, Word2Vec, GloVE, Contextualization (ELMo etc.) etc	4	3
8.	Discourse Analysis: Pragmatics and Discourse, Ambiguity in Discourse Analysis, Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure in brief.	3	4
9.	Text Classification: Preparing Data: Acquiring Text, Text Cleaning, Text Preprocessing with POS tagger, Parsers, Chunkers etc. Statistical analysis of text or sentences. Supervised approach using Classifiers such as Naive Bayes, SVM, Random Forest etc. NN-based Approaches such as LSTM-Based approach using word vectors etc. Dictionary-based or Unsupervised Approaches: Extracting Information using Corpus, evaluating statistical data, Linguistic Properties, WordNet etc.	3	4
10	Advances in the domain and Case Studies from various applications of NLP such as Question answering system, Information retrieval, Text categorization, text summarization, Named Entity Recognition, & Sentiment Analysis	4	4

TEXTBOOKS

1. Dan Jurafsky, James H. Martin, “Speech and Language Processing”, Stanford University, 2017
2. Christopher D.Manning and Hinrich Schuetze, “Foundations of Statistical Natural Language Processing”, MIT press, 1999.

RECOMMENDED READING

- 1 Joseph D. Booth, “Natural Language Processing”, Syncfusion, Inc., 2018
- 2 Shuly Wintner, “Formal Language Theory for Natural Language Processing”, ESSLLI, 2001
- 3 Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O'Reilly Media, 2009

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4204P	
Course Title	Natural Language Processing Lab	
Prerequisite	Machine Learning	

COURSE OUTCOMES: Students will be able to

1.	Perform and understand stages of NLP and their application using NLTK toolkit
2.	Use and processing of corpora, word embeddings in NLP experiments.
3.	Access and analyse data from social platforms and perform text classification.
4.	Implement Different approaches such as Supervised, Unsupervised and Knowledge-based approaches to NLP applications

COURSE CONTENTS

	Hrs	CO
1. Use of Natural Language Toolkit (NLTK): Computing with Language: Texts and Words, Tokenization, Segmentation, Texts as Lists of Words, Simple Statistic Generation	2	1
2. Accept the Sentence as input and display Part of Speech Tags for the same. Also Perform dependency parsing and list out all dependency relations along with their operands/entities.	2	1
3. A word can be simple or complex. For example, the word 'cat' is simple because one cannot further decompose the word into smaller parts. On the other hand, the word 'cats' is complex, because the word is made up of two parts: root 'cat' and plural suffix '-s'. Develop an Analyser/Generator with Simple User Interface to accept lanua as English / Hindi and a word as input. Now generate the following information for the same. Word, Root, PoS tag, Gender and Person (if noun), Case and Tense (if Verb)	2	1
4. Probability of a sentence can be calculated by the probability of sequence of words occurring in it. We can use Markov assumption, that the probability of a word in a sentence depends on the probability of the word occurring just before it. Such a model is called a first order Markov model or the bigram model. Create a Bigram Language Model using given Corpora and generate the best possible word after a word (given as input).	2	1, 2
5. Text Processing at the Lowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions	2	1
6. Develop a Knowledge-based approach for Disambiguating the meaning of an input word from a given sentence.	2	2, 4
7. Experiment to understand and illustrate the word-vectors	2	1, 2
8. Develop a program to extract tweets from twitter platforms, Preprocess the data and store back the cleaned data in a .csv which related to a particular domain or specific hashtag value file.	2	3
9 Case study on Text Classification using supervised models	4	3,4
10 Case study on Text classification using Neural Network approach such as LSTM networks.	4	3, 4

TEXTBOOKS

1. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O'Reilly Media, 2009.
2. Joseph D. Booth, “Natural Language Processing, Syncfusion”, Inc., 2018

RECOMMENDED READING

- 1 Dan Jurafsky, James H. Martin, “Speech and Language Processing, Stanford University”, 2017.
- 2 Shuly Wintner, “Formal Language Theory for Natural Language Processing”, ESSLLI, 2001.
- 3 Nitin Indurkha and Fred J. Damerau, “Handbook of Natural Language Processing”, Second Edition, Chapman and Hall/CRC Press, 2010.
- 4 Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4205T	
Course Title	Software Architecture	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Identify issues in analysis, implementation and deployment in software architecture.
2.	Apply different modeling techniques.
3.	Evaluate different patterns and case study.
4.	Analyze issues in software architecture.

COURSE CONTENTS

Hrs CO

- | | | | |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|
| 1. | Basic Concepts, Designing Architectures: Concepts of Software Architecture, Models, Processes, Stakeholders, The Design Process, Architectural Conception, Refined Experience in Action: Styles and Architectural Patterns, Architectural Conception in Absence of Experience. | 6 | 1 |
| 2. | Connectors, Modeling: Connectors in Action: A Motivating Example, Connector, Foundations, Connector Roles, Connector Types and Their Variation Dimensions, Example Connectors, Modeling Concepts, Ambiguity, Accuracy, and Precision, Complex Modeling: Mixed Content and Multiple Views, Evaluating Modeling Techniques, Specific Modeling Techniques. | 6 | 1 |
| 3. | Analysis, Implementation and Deployment: Concepts, Existing Frameworks, Software Architecture and Deployment, Software Architecture and Mobility, Pipes and Filters, Event- based, Implicit Invocation, Layered systems, Repositories Interpreters, Process control. MVC, Peer to peer architecture, 3 tier architecture. | 5 | 2 |
| 4. | Applied Architectures and Styles, Designing for Non-Functional Properties:
Distributed and Networked Architectures, Architectures for Network-Based Applications, Decentralized Architectures, Service-Oriented Architectures and Web Services, Efficiency, Complexity, Scalability and Heterogeneity, Adaptability, Dependability. | 5 | 2 |
| 5. | Domain-Specific Software Engineering: Domain-Specific Software Engineering in a Nutshell, Domain-Specific Software Architecture, DSSAs, Product Lines, Micro services, and Architectural Styles, Evaluation of architectures. | 6 | 3 |
| 6. | Introduction to Pattern:
a) Interface Pattern: Interfaces, Adapter, Façade, Composite, Bridge.
b) Responsibility Pattern: Responsibility, Singleton, Observer, Mediator, Proxy, Chain of Responsibility, Flyweight.
c) Construction Pattern: Construction, Builder, Factory Method, Abstract Factory, Prototype, Memento.
d) Operational Pattern: Operations, Template Method, State, Strategy, Command, | 8 | 4 |

Interpreter.

e) **Extension Pattern:** Extension, Decorator, Iterator, Visitor.

7. **Advances in the domain and Case Studies**

3 4

TEXTBOOKS

- 1 Richard N. Taylor, Nenad Medvidovic and Eric Dashofy, “Software Architecture: Foundations, Theory, and Practice”, Willey India Publication. 3rd Edition, 2008.
- 2 Erich Gamma, John Vlissides, Richard Helm and Ralph Johnson, “Design Patterns: Elements of Reusable Object-Oriented Software”, Addison-Wesley, 1994.

RECOMMENDED READING

- 1 Stephen T Albin, “The Art of Software Architecture: Design Methods and Techniques”, Wiley Publication, 2nd Edition.
- 2 Len Bass, Paul Clements and Rick Kazman, “Software Architecture in Practice,” Addison Wesley, 3rd Edition, 2012.
- 3 Mark Richards and Neal Ford, “Fundamentals of Software Architecture”, O'Reilly Media, Inc., January 2020.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4205P	
Course Title	Software Architecture Lab	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Draw different UML diagrams using software tool.
2.	Analyze the different views of software architecture.
3.	Identify and integrate various architecture and design patterns.
4.	Implement mini project using principles of software architectures.

LIST OF EXPERIMENTS:

Hrs CO

- | | | | | | | | | | | | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|-----|---|---|---|-----|---|---|---|---|
| <ol style="list-style-type: none"> 1. Consider an e-commerce application where goods orders are received from customers. Initially these orders are in pending state, after that orders are prepared and dispatched to the appropriate warehouse, simultaneously customer credit limits are checked and orders are confirmed and dispatched. A courier service collects dispatch and transport it to customers during which order status is in-transit. On receipt of goods by order orders is complete. Subsequently, a customer bonus is calculated, which will be offered to him/her as a discount coupon for a specific time period, after which coupon expires. Identify different components and connectors for the above system. Suggest and design an architecture for this system (use UML notations). 2. Extend calculator program to implement MVC architecture. Design JFrame to create views, use basic calculator as model and create appropriate controllers. 3. Design of the Logical View of the Mini project. 4. System needs to log the messages of the progress of the task in the system for various purposes such as debugging and monitoring progress. The log can be created in different formats like .txt, .html, database, xml, etc. User needs to select the type of the log mechanism required for him at the time of configuring the system.
Design the system and draw class diagrams to use factory method pattern.
Implement a system in the language of your preference. 5. Design of the implementation, process and deployment views for the Mini project 6. Mini Project Implementation: Implementation of the Mini project with emphasis on the inter-process communication mechanism and the software components identified. | <table border="0"> <tr> <td style="text-align: right;">2</td> <td style="text-align: right;">1</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: right;">1,2</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: right;">2</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: right;">2,3</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: right;">3</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: right;">4</td> </tr> </table> | 2 | 1 | 2 | 1,2 | 2 | 2 | 2 | 2,3 | 2 | 3 | 2 | 4 |
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| 2 | 2,3 | | | | | | | | | | | | |
| 2 | 3 | | | | | | | | | | | | |
| 2 | 4 | | | | | | | | | | | | |

TEXTBOOKS

1. Richard N. Taylor, Nenad Medvidovic and Eric Dashofy, “Software Architecture: Foundations, Theory, and Practice”, Willey India Publication. 3rd Edition, 2008.
2. Erich Gamma, John Vlissides, Richard Helm and Ralph Johnson, “Design Patterns: Elements of Reusable Object-Oriented Software”, Addison-Wesley, 1994.

RECOMMENDED READING

- 1 Stephen T Albin, “The Art of Software Architecture: Design Methods and Techniques”, Wiley Publication, 2nd Edition.
- 2 Len Bass, Paul Clements and Rick Kazman, “Software Architecture in Practice,” Addison Wesley, 3rd Edition, 2012.
- 3 Mark Richards and Neal Ford, “Fundamentals of Software Architecture”, O’Reilly Media, Inc., January 2020.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4601S	
Course Title	Internet of Things	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

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

COURSE CONTENTS

	Hrs	CO
1. Introduction to Digital Transformation: 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, Digital Innovation. The SMAC (Social, Mobile, Analytics, Cloud) Stack	6	1
2. Introduction to IoT Future of IoT, Some Interesting IoT Projects, IoT Applications Retail, Healthcare & Agriculture, IoT Challenges, IoT Reference Architecture.	5	1
3. IoT Physical Devices & Endpoints: Hardware and software concepts of Microcontrollers and Microprocessors. Study and usage of Prototyping boards like - Arduino, Intel Edison, Raspberry pi etc (from software and hardware perspective). Study and usage of various types of sensors and actuators such as temperatures sensor, light sensor, Rotary angle sensor, buzzer, LED etc, IoT devices, IoT gateways.	8	3
4. Programming of IoT Devices: Basic study of programming languages like C & Python used for programming IoT devices. Other programming languages used for IoT.	5	3
5. Different aspects of IoT system: Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, Logical Design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT levels, IoT and M2M, A generic design methodology for Internet of Things.	7	4
6. IoT Servers and Cloud: An introduction to the use of cloud platforms and frameworks for developing IoT applications, Data Analytics for IoT.	4	4
7. Advances in the domain	4	4

TEXTBOOKS

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2015.
2. John Boxall, “Arduino Workshop A Hands-On Introduction with 65 Projects”, No Starch Press, Inc. San Francisco, CA USA, 2013.

RECOMMENDED READING

- 1 Stephanie Moyerman, “Getting Started with Intel Edison”, Published by Maker Media, Inc., San Francisco, 2016. CA 94111.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4602S	
Course Title	Data Structure	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

1.	Analyze the problem while organizing data.
2.	Design a suitable structure for organization of data and Analysis of Algorithms to access it..
3.	Apply the appropriate data structure for the given application.
4.	Implement efficient data structure and different Searching and Sorting Methods.

COURSE CONTENTS

	Hrs	CO
1. Introduction to data structures: Need of data structures, Types of data structures, recursion, ADT (Abstract Data Types). Basics of algorithm and Analysis of Algorithms	7	1
2. Stack and Queue: Stack: The stack as an ADT, Representation, Stack operation, Application: Expression Evaluation, Conversion of Infix expression to Postfix expression. Queue: The Queue as an ADT, Representation, Queue operation, Circular and Priority queue, Applications: Implementing stacks using queue.	7	1, 2
3. Linked list: Linked list as an ADT, Operation on linked list, Linked stacks and Queues, Array implementation of Linked List, Linked list using Dynamic Variable, Doubly, circular linked list. Applications for searching and sorting in a linked list.	7	2
4. Binary Tree: Basic tree concept, Binary tree operations, Binary tree representation, Binary tree traversals, Binary search tree and operations on it, balanced tree: AVL trees and operations, applications of these binary trees and exercises on it. Implementing priority queue using binary heap data Structure.	7	3
5. Graphs: Basics concepts of graphs, representation of graphs, graph traversals BFS and DFS, minimum spanning tree algorithms: Kruskal's algorithm and Prim's algorithm, application and related exercises in brief.	6	4
6. Searching and Sorting Techniques: Various sorting methods and their time complexity analysis: Insertion sort, Selection sort, Merge sort, Quick sort, Heap sort Linear Search and Binary Search, Hashing: Direct-address tables, Hash tables, open addressing, Perfect Hashing	5	3

TEXTBOOKS

1. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: Pseudocode Approach with C”, Second Edition, Cengage Learning Publication.
2. Ellis Horowitz, SartajSahni and Dinesh Mehta, “Fundamental of Data Structure using C++”, Galgotia Publication.

RECOMMENDED READING

- 1 Goodrich and Tamassia, “Data Structures and Algorithm in Java”, John Wiley and Sons.
- 2 Y. Langsam, M. J. Augenstein and A. M. Tanenbaum “Data structures using C++”, Pearson Education.

Program Name	B. Tech. (Computer Engineering)	Semester – VII
Course Code	R4CO4603S	
Course Title	Cyber Physical System Security	
Prerequisite	Nil	

COURSE OUTCOMES: Students will be able to

1.	Understand cyber-physical systems components
2.	Apply interaction with cyber-physical systems protocols
3.	Analyze attacks on cyber-physical systems protocols and Systems
4.	Demonstrate cyber-physical systems and architectures that are resilient to attack

COURSE CONTENTS

	Hrs	CO
1. Cyber Physical Systems (CPSs): Definition, CPS Concept Map, High Level Examples, Challenges	4	1
2. CPS: Predictable Comp. Architecture, Predictable OS Abstractions, Timing and Performance Analysis Intro to Models of Computation and Verification	4	1
3. Overview: Computer Security, Cyber Physical Security Introduction and History,	4	2
4. Attack: Detailed CPS Attack Examples, Industrial Controls, Detailed CPS Attack Examples, Power Grid	4	2
5. Security Policies: Trust, Confidentiality, Integrity	4	2,3
6. CPS Threat Modeling: Data Flow Diagrams, examples, CPS Threat Metrics & Identification (STRIDE), Threat Trees	4	3
7. CPS Threat: Threat, Vulnerability Assessment, Risk Tables and Mitigation Strategy, SDL Threat Modeling Tool	4	3
8. Protection Mechanisms: Intrusion Detection, Secure Design Principles, Untrusted Computing – Malicious Logic,	4	4
9. Detailed CPS Attack Examples – Automotive Systems, Physical-Cyber Attacks, Best Practices in Designing Secure CPSs	4	4
10 Advances in the domain	3	4

TEXTBOOKS

1. George Loukas, “Cyber-Physical Attacks: A Growing Invisible Threat”, Elsevier 2015
2. Matt Bishop, “Introduction to Computer Security”, Addison-Wesley,

RECOMMENDED READING

- 1 2005Glossary of Terms CPS Security – available on class Blackboard portal
- 2 Adam Shostack, “Threat Modeling – Designing for Security”, Wiley, 2014
- 3 The Three Tenets of Secure Cyber-Physical System Design and Assessment
- 4 Guide to Industrial Control Systems Security by NIST
- 5 Sajal K. Das, Krishna Kant and Nan Zhang, “Securing Cyber-Physical Critical Infrastructure”, Elsevier, 2012.
- 6 Edward A. Lee, Sanjit A. Seshia, “Introduction to Embedded Systems – A Cyber-Physical Systems Approach”, LuLu, 2014
- 7 Special Issue of Politico - The Cyber Issue
<http://www.politico.com/agenda/issue/the-cyber-issue-December-2015>

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4011T	
Course Title	Big Data Analytics	
Prerequisite	Data Mining and Warehousing	

COURSE OUTCOMES: Students will be able to

1.	Identify different types of data and to select required big data technologies.
2.	Understanding importance of NoSQL databases, and analytics tools and technologies.
3.	Build and maintain reliable, scalable, distributed systems with Hadoop, Spark.
4.	Apply Big Data Analysis ecosystem to solve real world problems.

COURSE CONTENTS

	Hrs	CO
1. Introduction to Big Data: Data, Characteristics of data and Types of digital data: Unstructured, Semi-structured and Structured, Sources of data, working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data, Data environment versus big data environment, Big Data Analysis Life Cycle.	4	1
2. Big data analytics tools and Technologies: Overview of business intelligence, Characteristics and need of big data analytics, Classification of analytics, Challenges to big data analytics. Analytical operations: Associations rules, classifications, clustering, Mahout ML, etc.	10	2
3. Hadoop foundation for analytics: Features, Hadoop ecosystems, Evolution of Hadoop architectures Hadoop 1.0, Hadoop 2.0, Hadoop3.0, Key aspects and Components of Hadoop 3.0. Hadoop Technology Stack: Hive, Pig, Zookeeper, Swoop, oozie, flume, etc.	12	2,3
4. MapReduce and YARN framework: Introduction to MapReduce, Processing data with MapReduce, Introduction to YARN, Components YARN, Data serialization and Working with common serialization formats, Big data serialization formats.	8	3
5. NoSQL Databases: Schema-less Models, Increasing Flexibility for Data Manipulation- Key Value Stores- Document Stores – Tabular Stores – Object Data Stores Hive – Sharding –Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs. NoSQL Database Architectures, Case Studies MongoDB and Cassandra, Graph Databases.	8	3,4
6. Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform (RTAP) applications. Case Studies as Spark, Kafka: Features, Components, Architecture, streaming functionalities, Spark QL,	10	4

TEXTBOOKS

1. Seema Acharya, “Subhashini Chellappan, Big Data and Analytics”, Wiley, 2016.
2. Alex Holmes, “Big Data Black Book”, Dreamtech, 1st Edition, 2015

RECOMMENDED READING

- 1 Minelli, Chambers, Dhiray, “Big Data Big Analytics”, Wiley, Illustrated Edition, 2013.
- 2 Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw-Hill Osborne Media; 1st edition, 2011.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4011P	
Course Title	Big Data Analytics Lab	
Prerequisite	Data Mining and Warehousing	

COURSE OUTCOMES: Students will be able to

1.	Build and maintain reliable, scalable, distributed systems with Apache Hadoop.
2.	Apply Hadoop ecosystem components to solve real world problems.
3.	Apply machine learning algorithm for big data analysis.
4.	Design recommended system using Hadoop.

LIST OF EXPERIMENTS:

	Hrs	CO
1. Understanding Big Data in real world examples, real time analytics, and design Analysis life cycle for the big data case study.	2	1
2. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop distributed file system, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves). MapReduce application for word counting on Hadoop cluster.	2	2,3
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.	2	2,3
4. Apply ML algorithms using map reduce.	2	4
5. Page Rank Computation.	2	4
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.	2	3
7. Recommendation system using Graph Analytics for Big Data on Graph Databases.	2	3
8. Real Time Sentiment Analysis using Apache Spark for Stock Market Predictions or any similar real time requirement case study.	2	4

TEXTBOOKS

1. Seema Acharya, “Subhashini Chellappan, Big Data and Analytics”, Wiley, 2016.
2. Alex Holmes, “Big Data Black Book”, Dreamtech, 1st Edition, 2015

RECOMMENDED READING

- 1 Minelli, Chambers, Dhiray, “Big Data Big Analytics”, Wiley, Illustrated Edition, 2013.
- 2 Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw-Hill Osborne Media; 1st edition, 2011.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4012T	
Course Title	Cloud Computing	
Prerequisite	Nil	

COURSE OUTCOMES: Students will be able to

1.	Understand and formulate the basics of cloud computing with its benefits, architecture and measure its value.
2.	Explore the services offered by cloud computing like IAAS, PAAS, SAAS, storage using various application frameworks like MapReduce, HADOOP etc.
3.	Analyze the underlying virtualization technology for cloud and implement the same using Open-source cloud environment tool.
4.	Evaluate cloud administration, management, and various cloud service providers and explore the security aspects concerning the cloud.

COURSE CONTENTS

	Hrs	CO
1. Introduction to Cloud Computing: Roots of Cloud Computing: From mainframe to Cloud, Benefits of Cloud Computing SOA, Web services, Web 2.0, Mashups, Grid computing, Utility computing, Hardware virtualization, Essentials of Cloud characteristics, Challenges, Cloud economics, Role of Networks in Cloud Computing: Cloud types and service models, Cloud computing platforms : Openstack, Open nimbus, Eucalyptus Primary Cloud Service models, Cloud Services brokerage, Primary cloud deployment models, cloud Computing reference model, The greenfield and brownfield deployment options.	4	1,2
2. Virtualization Concepts and Architecture: Introduction, Characteristics of virtualized environments, Taxonomy of Virtualization techniques, Pros and Cons of Virtualization, Technology examples: Xen, KVM, VMware, Microsoft Hyper-V.	6	3
3. Cloud Computing Platforms: Exploring cloud computing stack – Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Defining Infrastructure as a Service (IaaS), Defining Software as a Service (SaaS), Defining Platform as a Service (PaaS), Defining Identity as a Service (IDaaS), Defining Compliance as a Service (CaaS). Software as a Service – Overview, advantages, limits, Platform as a Service – overview, advantages and functionalities, PaaS application frameworks.	8	2,3
4. Accessing the Cloud: Platforms, WEB applications, WEB APIS, WB Browsers, Google Cloud platform (GCP) Cloud Storage: Overview, Storage providers, Cloud Standards: and cloud storage techniques like MAPREDUCE, HDFS, GFS	4	1,2
5. Cloud Computing at work/Deploying of Cloud: Deployment of cloud. Introduction to cloud environment deployment, Concept of Datacenter, Cloud Datacenter, Deployment of private/public cloud Datacenter using opensource tools like Open stack, Open Nebula. Deployment of various cloud services using open-source tools, Amazon Web Services (AWS), Google Cloud platform (GCP) and various others., Exploring SaaS, PaaS, IaaS, Company offerings, Industries, Software + services: Overview,	7	2,3

Mobile Device Integration, Providers, Microsoft Online Application development: Google, Microsoft, Development Platforms: Google, Sales Force, Azure, Trouble shooting, Application management.

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| 6. | Cloud Administration: Performance prediction for HPC on Cloud. SLA management: Types of SLA, Life cycle of SLA, Traditional approaches of SLA. service catalog, service ordering process, management and functional interfaces of services, cloud portal and its functions, Management responsibilities, lifecycle management, cloud management products, Cloud management standards. | 4 | 4 |
| 7. | Security in Cloud Computing: Technologies for Data security, Data security risk, Cloud computing and identity, Digital identity and access management, Content level security, Security-As-A-Cloud Service, Cloud security, Identity and presence protocol standards, Availability management in SaaS, IaaS, PaaS, Access Control, Security Vulnerability, Patch and Configuration Management, Security as a Service of cloud, Future of Security in Cloud computing. | 4 | 4 |
| 8. | Advances in the domain | 2 | 4 |

TEXTBOOKS

1. Rajkumar Buyya, T. Selvi Mc-graw Hill, “Mastering cloud computing”, 1st edition, 2017.
2. Gautam Shroff, “Enterprise Cloud Computing: Technology, Architecture, Applications”, Cambridge University press, 2010.

RECOMMENDED READING

1. Barrie Sosinsky, “Cloud Computing Bible”, Wiley & Sons, Illustrated Edition, 2010.
2. Anthony T. Velte, “Cloud Computing: A Practical Approach”, Tata McGraw Hill, 2009.
3. Tim Mather, Subra Kumarswamy, Shahed latif, “Cloud Security and Privacy –An Enterprise Perspective on Risks and Compliance”, O’Reily.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4012P	
Course Title	Cloud Computing Lab	
Prerequisite	Nil	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate use of virtual machine on virtual machine manager.
2.	Simulate resource allocation in the virtual environment in cloud computing.
3.	Implement private/public cloud data center using openstack, google cloud platform or Amazon web service (AWS).
4.	Demonstrate SaaS and Paas programs in cloud computing for the end users by developing applications in the distributed and cloud environment.

LIST OF EXPERIMENTS:

	Hrs	CO
1. To create virtual machines using virtual box or Vmware on windows or Linux platform and know its various features (Virtualization Concept).	2	1
2. To study and implement logical volumes in physical disk via lvm utility. (allocation of resource)	2	1,2
3. To create x datacenter with x hosts (x per data center) Set storage capacity, ram and cost using Cloud Reports.	2	2
4. To study and perform Closest Data Center Service Broker Policy in Cloud Analyst.	2	3
5. To study and perform Dynamically Reconfiguring Service Broker Policy in Cloud Analyst.	2	3
6. To study and perform Round Robin Load Balancing 1st Policy in Cloud Analyst.	2	4
7. Implement the service model of "Infrastructure as a Service" or private cloud datacenter. Use devstack (Openstack) or Open Nebula or any other open-source framework for IaaS.	2	3
8. Implement "Software as a Service" (SaaS) model using Google Cloud Platform (GCP) or any other.	2	4
9. Implement the service model of "Platform as a Service". Deploy and application on Google App Engine or any other platform providers like AWS	2	4
10. Study and Analysis of Hadoop Distributed File system framework by implementing Similarity Search program or word count program using MapReduce on HADOOP framework	2	3.4

TEXTBOOKS

1. Rajkumar Buyya, James Broberg, "A. Goscinski, Mastering cloud computing", 1st edition, 2017
2. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University press, 2010.

RECOMMENDED READING

- 1 Barrie Sosinsky, “Cloud Computing Bible”, Wiley & Sons, Illustrated Edition, 2010.
- 2 Anthony T. Velte, “Cloud Computing: A Practical Approach”, Tata McGraw Hill, 2009.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4301T	
Course Title	Software Testing	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate and describe fundamental concepts in software testing such as process, criteria, strategies, methods, and quality parameters.
2.	Evaluate and summarize various software testing issues and their solutions in software for unit, integration, regression, and system testing.
3.	Design and develop project test plan, design test cases, test data, and conduct test operations.
4.	Analyze and report test results for testing defects and quality.

COURSE CONTENTS

	Hrs	CO
1. Fundamentals of Testing: Human and errors, Testing and Debugging, Software Quality, Requirement Behavior and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, Test Metrics. A framework for Test and Analysis: Validation and Verification, Degree of Freedom, Varieties of Software	6	1
2. Role of Testing in SDLC: Review of software development models& testing (W Model, V Model) Agile Methodology and its Impact on testing, Levels of Testing: unit testing (JUnit); integration testing; system testing; performance, stress, and configuration testing; regression testing; acceptance testing Object-oriented testing: Problems specific to OO testing adapting classic testing techniques to OO.	6	1
3. Approaches to Testing – I: Static Testing, Structured Group Examinations, Static Analysis, Control flow & Data flow, Determining Metrics.	4	2
4. Approaches to Testing – II: Dynamic Testing, Black Box Testing: Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing, Decision Table Technique, Use Case Testing. White Box Testing: Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage, Gray Box Testing, Intuitive and Experience Based Testing.	6	3
5. Specialized Testing: Performance Testing: Load, Stress, and Volume. Security Testing, Compatibility Testing, GUI Testing, Control Testing, Smoke Testing, Sanity Testing, Adhoc Testing: Monkey, Exploratory and Random Testing.	6	4
6. Test Metrics & Management: Test Planning, Test Plan, Prioritization Plan, Test Exit Criteria, Cost and economy aspects, Test Activity Management, Incident management, Configuration Management, Test Progress Monitoring and Control.	4	3

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| 7. | Software Quality Assurance and Standards: The Software Quality challenge, what is Software Quality, Software Quality factors, The components of Software Quality Assurance system, Quality Assurance Plan, Quality management standards: The scope of quality management standards, ISO 9001 and ISO 9000-3, Capability Maturity Models – CMM and CMMI assessment methodology. | 6 | 1 |
| 8. | Advances in the domain | 1 | 4 |

TEXTBOOKS

1. Daniel Galin, Software Quality Assurance. “From theory to implementation”, Pearson Education Limited, 1st edition, 2004.
2. Dorothy Graham, Erik Van Veenendaal, Isabel Evans, Rex Black., “Foundations of Software Testing”, Cengage Learning India Edition, 3rd edition 2015.

RECOMMENDED READING

- 1 William Perry, “Effective Methods for Software Testing”, Willy India Edition, 3rd edition, 2012,
- 2 Michal Young, “Software Testing and Analysis, Process, Principles and Techniques”, University of Oregon ISBN 978-0-471 45593-6.
3. Daniel Galin, “Software Quality Assurance: From theory to implementation”, Pearson Education Limited, 1st edition, 2004

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4301P	
Course Title	Software Testing Lab	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Design and formulate a software test process for a software testing project.
2.	Implement identify various software testing problems and solve these problems by designing and selecting software test models, criteria, strategies, and methods.
3.	Implement a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
4.	Analyze and report test results for testing defects and quality.

COURSE CONTENTS

	Hrs	CO
1. Perform Verification and Validation and associated umbrella activities related to testing. (Write the test cases for User Authentication for any application. The requirement is username should not be less than or equal to 7 characters. Valid password should be considered as combination of special characters, numbers, capital and small letters.)	2	1
2. Write Master Test Plan for the system with sufficient complexity.	2	2
3. Unit testing of Java Programs using Junit. (Install unit testing framework for java programs, write a simple program and test that program.)	2	2
4. Test suite generation (Apply test suite generation technique to a simple program and write test suites and update them for new test cases.) Hint: Create environment to run multiple test cases, generate test suite with more than one test case, run test suite, and update test suite with more test cases.	2	3
5. Selenium IDE for Web-based testing.	2	3
6. Performance testing using Apache JMeter. (Performance Testing: Load & Stress testing)	2	4
7. Code Coverage of Java Programs. (Tool for Code coverage of Java programs: EclEmma)	2	4

TEXTBOOKS

1. Daniel Galin, "Software Quality Assurance: From theory to implementation, Pearson Education Limited", 1st edition, 2004.
2. Dorothy Graham, Erik Van Veenendaal, Isabel Evans, Rex Black,, "Foundations of Software Testing", Cengage Learning India Edition, 3rd edition 2015.

RECOMMENDED READING

- 1 William Perry, “Effective Methods for Software Testing”, Willy India Edition, 3rdedition, 2012

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4302T	
Course Title	Soft Computing	
Prerequisite	Artificial Intelligence	

COURSE OUTCOMES: Students will be able to

1.	Analyze various neural network algorithms.
2.	Design artificial neural networks of the Backpropagation, Hopfield, RBF and SOM for particular applications.
3.	Justify the applicability of fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
4.	Apply genetic algorithms for solving problems.

COURSE CONTENTS

	Hrs	CO
1. Artificial Neural Network: Fundamental Concept, Evolution of Neural Networks, McCulloch-Pitts Neuron, Basic Models of Artificial Neural Network, Important Terminologies of ANNs, Learning and Adaptation, Learning rules.	3	1
2. Supervised Learning Network: Single layer perceptron classifiers: Models, features, discriminant functions, non-parametric training, Discrete perceptron algorithm, continuous perceptron algorithm, Perception Networks. Multilayer Feedforward Network: Linearly non separable pattern classification, delta learning rule, error back propagation training and learning factors.	6	1,2
3. Single Layer Feedback Networks, Associative Memory Networks: Training Algorithm of Pattern Association, Auto associative Memory Network, Heteroassociative Memory Network, Bidirectional Associative Memory, Hopfield Networks, and Interactive Auto associative Memory Network.	5	1,2
4. Unsupervised Learning Network: Fixed Weight Competitive Nets, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter propagation Networks, Adaptive Resonance Theory Network	4	1,2
5. Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Classical Sets (Crisp Sets), Fuzzy Sets, Cartesian Product of Relation, Classical relation, Fuzzy Relations, Tolerance and Equivalence Relations, Non-interactive Fuzzy Sets, Features of the Membership Functions. Defuzzification, Fuzzy Arithmetic and Fuzzy Measures: Lambda-Cuts for Fuzzy Sets (Alpha-cuts), Lambda Cuts for Fuzzy Relations, Defuzzification Methods, Fuzzy Arithmetic, Extension principles, Fuzzy Measures, Measures of Fuzziness, Fuzzy Integrals, Truth Values and Tables in Fuzzy Logic Fuzzy Propositions, Formation of Rules, Decomposition of Rules, Aggregation of Fuzzy Rules, Fuzzy Reasoning, Fuzzy Inference Systems.	7	3

6.	Systems, Overview of Fuzzy Expert Systems. Fuzzy Decision Making and Fuzzy Logic Control Systems: Individual Decision Making, multiperson decision making, multiobjective decision making, Multiattribute decision making, Fuzzy Bayesian decision making, Control System Design, Architecture and operation of FLC system, FLC System Models, Application of FLC Systems.	4	3
7.	Genetic Algorithm: Biological Background, Traditional Optimization & Search Techniques, Genetic Algorithm and Search Space, Genetic Algorithm vs Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA, General Genetic Algorithm, Operators in Genetic Algorithm, Stopping Condition for Genetic Algorithm flow, constraints in Genetic Algorithm, Problem Solving	4	4
8.	Applications of Soft Computing: Optimization of Travelling Salesman Problem and Genetic Algorithm Approach, Soft computing Based Hybrid Fuzzy Controllers, Soft Computing Based Rocket Engine Control, Applications in the field of Audio, Image, Video and Big Data.	4	2,3,4
9	Advances in the domain	2	2,3,4

TEXTBOOKS

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", A John Wiley and Sons, Ltd., Publication, 3rd Edition, 2010.

RECOMMENDED READING

- 1 Fakhreddine O. Karray And Clarence De Silva, "Soft Computing and Intelligent Systems Design (Theory, Tools and Applications)", Pearson Education, 1st Edition, 2009.
- 3 J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing Company, 1st Edition, ISBN: 81-7224-650-1

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4302P	
Course Title	Soft Computing Lab	
Prerequisite	Artificial Intelligence	

COURSE OUTCOMES: Students will be able to

1.	Design various neural network algorithms.
2.	Develop artificial neural networks of the Back-prop, Hopfield, RBF and SOM for particular applications.
3.	Implement the applicability of fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
4.	Apply genetic algorithms for solving problems.

COURSE CONTENTS

	Hrs	CO
1. To perform classification of logic functions using single layer perceptron algorithm.	2	1
2. To perform Hebbian learning rule and understand neural network learning process.	2	1
3. To perform clustering on data set using competitive learning rule	2	1
4. To solve classification problem with the help of Radial Basis Function.	2	1
5. To perform classification / recognition using any error back-propagation algorithm.	2	2
6. To perform character recognition using Hopfield network.	2	2
7. To implement a hetro-associator using binary associative memory.	2	2
8. To study various membership functions used in fuzzy logic and calculate degree of membership for particular element in set.	2	3
9. To implement FKBC for calculating	2	3
1. Wash time of washing machine if dirt and grease values are known		
2. Break power for locomotive if speed and distance values are known		
10. To implement Genetic Algorithm to minimize $(x) = x^2$.	2	4
11. To implement Fuzzy ANN Solution.	2	4

TEXTBOOKS

1. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, A John Wiley and Sons, Ltd., Publication, 3rd Edition, 2010.

RECOMMENDED READING

- 1 Fakhreddine O. Karray and Clarence De Silva, “Soft Computing and Intelligent Systems Design (Theory, Tools and Applications)”, Pearson Education, 1st Edition, 2009.
- 2 J. M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing Company, 1st Edition, 1994.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4303T	
Course Title	Digital Forensics	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate and formulate the digital forensic model.
2.	Perform digital forensics analysis upon Windows and LINUX operating systems.
3.	Demonstrate an awareness of current methods of reducing the effectiveness of anti-forensics.
4.	Apply the principles and procedures of network forensics.

COURSE CONTENTS

	Hrs	CO
1. 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.	4	1
2. Computer Forensics Evidence Capture: Data recovery defined, data backup and recovery, Evidence Collection and Data Seizure: evidence, collection options, obstacles, types of evidence, the rules of evidence, volatile evidence, general procedure, collection and archiving, methods of collection, artifacts, collection steps controlling contamination: the chain of custody.	6	1,2
3. Duplication and Preservation of Digital Evidence: Preserving the digital crime scene computer evidence processing steps, legal aspects of collecting and preserving computer forensic evidence, Computer Forensics Analysis and Validation: Determining what data to collect and analyze, validating forensic data, addressing data, hiding techniques, and performing remote acquisitions. Processing Crime and Incident Scenes	6	2,3
4. 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	2,3
5. Windows Registry Basics: Windows Registry Structure, Registry Hives and Keys, Registry Data Types, Structural Representation of Registry in Memory, Importance of Analyzing Registry in Memory, Registry Keys with forensic Importance, Collecting Evidence 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.	8	3,4

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| 6. | Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools. Internet forensic, E-mail Investigations: Exploring the role of e-mail in investigations, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools. | 6 | 4 |
| 7. | Advance topics in the domain | 3 | 4 |

TEXTBOOKS

1. John Sammons, “The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics”, Elsevier, 1st Edition, 2012.
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 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 Jerry Honey Cutt, “Microsoft Windows Registry Guide”, Microsoft Press, 2nd Edition, 2005

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4303P	
Course Title	Digital Forensics Lab	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

1.	Apply passive attack, Active Attack AND Hackers Methodology.
2.	Demonstrate Digital Forensic process on case studies.
3.	Analyze Windows Registry and file system of Digital Forensic.
4.	Determine Network and Email Forensic process for the network and Email attacks.

COURSE CONTENTS

	Hrs	CO
1. Perform the experiment for the passive attacks and active attacks on computing systems of your organization's data center (your PC/LAPTOP) and show the results to the owner of organization with snapshots.	2	1
2. Suggest the defense mechanism strategy/tools at every phase of hacking in order to protect the computing assets of your data Center.	2	1
3. Illustrate the Hackers methodology with suitable experiment in order to improve the quality of the computing systems services of your organization. For conduction of this experiment perform the following and check the results from your instructors: 1. Foot printing, 2. Scanning, 3. Enumeration, 4. Gaining access, (escalating privileges, covering tracks, creating backdoors, Denial of service) Trace the symptoms of attack with evidence to be submitted in the court of law.	2	2
4. Which techniques and tools are used by the hacker at each phase of hacking of computing assets of your network Perform the hacking experiment using tools and trace the symptoms of hacking?	2	2
5. Create the hacking data / attacking data on window or use the available data sets and Perform the digital forensic analysis for Windows Registry from window registry hives. Use the steps: Computer Forensics Evidence Capture, Duplication and Preservation of Digital Evidence, Processing Crime and Incident Scenes. Prepare the forensic report to produce in the court of law.	2	2,3
6. Create the hacking data / attacking data on Linux systems or use the available data sets and Perform the digital forensic analysis for Linux file systems and Collect Evidences against criminal. Use the steps: Computer Forensics Evidence Capture, Duplication and Preservation of Digital Evidence, Processing Crime and Incident Scenes. Prepare the	2	3

forensic report to produce in the court of law.

- | | | | |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|
| 7. | Perform the digital forensic analysis for Memory forensic and Collecting Evidences against criminal. Use the steps: Computer Forensics Evidence Capture, Duplication and Preservation of Digital Evidence, Processing Crime and Incident Scenes. Prepare the forensic report to produce in the court of law. | 2 | 3,4 |
| 8. | Perform backup and recovery with the help of computer forensic software Tools and computer forensic hardware tools. Validate and test the forensic software tools by Collecting Evidences against criminal as mentioned in experiment no 1 and 3. Use the steps: Computer Forensics Evidence Capture, Duplication and Preservation of Digital Evidence, Processing Crime and Incident Scenes. Prepare the forensic report to produce in the court of law. | 2 | 4 |
| 9 | Perform the experiments for Network Forensics. Use the steps: Computer Forensics Evidence Capture, Duplication and Preservation of Digital Evidence, Processing Crime and Incident Scenes. Prepare the forensic report to produce in the court of law. | 2 | 2,3 |
| 10 | Perform the experiments for investigating, e-mail crimes and violations, understanding e-mail servers using specialized e-mail forensic tools,. Prepare the forensic report to produce in the court of law. | 2 | 2,4 |

TEXTBOOKS

1. John Sammons, “The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics”, Elsevier, 1st Edition, 2012.
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 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 Jerry Honey Cutt, “Microsoft Windows Registry Guide”, Microsoft Press, 2nd Edition, 2005

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4304T	
Course Title	Service Oriented Architecture	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Identify key issues service-oriented architecture and apply BPM to industry applications.
2.	Design XML Schema for various components of web services for applications.
3.	Design services with emphasis on security at different levels.
4.	Apply Architecture governance and management to case studies.

COURSE CONTENTS

	Hrs	CO
1. Service –Oriented Architecture (SOA) Overview: Introduction to Service oriented computing, Goals and Service-oriented Computing, Goals and Benefits of Service oriented computing, Service orientation challenges, effects and solutions.	5	1
2. Architectural details of SOA: SOA Reference Architecture, Business Architecture, Business Process Models, Business Process Management and Modeling, Conditional Business Process Models, Organizing Services.	6	1
3. Service Definition in SOA: Service Identification, Service Specification, Services Realization, Service Life Cycle, The Service Design Process, and Service Inventory.	4	2
4. Web Service Components and Protocols: XML-RPC, SOAP, WSDL, and UDDI.	6	3
5. Designing and implementing services: Designing service interfaces, implementing interface, business and resource layers, Service Composition implementation.	6	4
6. SOA Security: SOA Security Goals and Fundamentals, Web Service Security Standards and Specifications, Securing the Communications Layer, Message-Level Security, and Data-Level Security.	6	3
7. SOA Governance: SOA Management and Governance, Service Life Cycle and SOA governance, Practical SOA Governance.	4	4
8. Advances in the domain	2	4

TEXTBOOKS

1. Thomas Erl, “Service-Oriented Architecture: Analysis and Design for Services and Microservices” Prentice Hall, 2017
2. Marc J. Balcer, Kevin T. Smith, Boris Lublinsky, Michael Rosen, “Applied SOA: Service-Oriented Architecture and Design Strategies”, Wiley India, 2008.

RECOMMENDED READING

- 1 Thomas Erl, “SOA with REST: Principles, Patterns & Constraints for Building Enterprise Solutions with REST”, Prentice Hall, 1st Edition, 2013
- 2 Ramarao Kanneganti, Prasad Chodavarapu, “SOA Security”, Dream Tech Press, 2008.
- 3 Thomas Erl, “SOA Principles of Service Design”, Pearson Education, 1st Edition, 2008.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4304P	
Course Title	Service Oriented Architecture Lab	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate and map the XML Parser into & create web services.
2.	Design web services.
3.	Implement and integrate web Services.
4.	Design and analyze SOAP parsers.

LIST OF EXPERIMENTS:

	Hrs	CO
1. Write an XML Parser that can read an XML file with the given XML schema and display the data.	2	1
2. Develop a web service for finding factorial of three numbers.	2	2
3. Develop a web service client which uses a division web service from a different project.	2	2
4. To create a web service client which uses a factorial web service from a different project.	2	3
5. Composition of two Web services.	2	3
6. Composition of three Web services.	2	4
7. Write a program to retrieve the data from SOAP request.	2	4
8. Write a program to retrieve the data from SOAP response.	2	1
9. Write a program for parsing WSDL.	2	1
10. Write a program using JSON, REST	2	2

TEXTBOOKS

1. Thomas Erl “Service-Oriented Architecture: Analysis and Design for Services and Microservices” Prentice Hall , 2017
2. Marc J. Balcer, Kevin T. Smith, Boris Lublinsky, Michael Rosen.” Applied SOA: Service-Oriented Architecture and Design Strategies”, Wiley India, 2008.

RECOMMENDED READING

1. Thomas Erl, “SOA with REST: Principles, Patterns & Constraints for Building Enterprise Solutions with REST”, Prentice Hall, 1st Edition, 2013.
2. Ramarao kanneganti, Prasad Chodavarapu, “SOA Security”, Dream Tech Press, 2008.
3. Thomas Erl, “SOA Principles of Service Design”, Pearson Education, 1st Edition, 2008.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4305T	
Course Title	Management Information Systems	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

1.	Identify Information Systems in an organization
2.	Manage IT infrastructure for Electronic Business and Electronic Commerce in an organization
3.	Use Enterprise systems in an organization.
4.	Develop Information Systems & Manage change in an organization.

COURSE CONTENTS

	Hrs	CO
1. Introduction to Information Systems: Perspectives on Information Systems, Contemporary Approaches to Information Systems, Learning to Use Information Systems	3	1
2. Information Systems in the Enterprise: Major Types of Systems in Organizations, Systems from a Functional Perspective, Integrating Functions and Business Processes: Introduction to Enterprise Applications	4	1
3. Information Systems, Organizations, Management, and Strategy: Organizations and Information Systems, How Information Systems Impact, Organizations and Business Firms, The Impact of IT on Management Decision Making, Information Systems and Business Strategy	3	1
4. The Digital Firm: Electronic Business and Electronic Commerce: Electronic Business, Electronic Commerce, and the Emerging Digital Firm Electronic Commerce, Electronic Business and the Digital Firm	4	2
5. IT Infrastructure and Platforms: IT Infrastructure, Infrastructure Components, Contemporary Hardware & Software Platform Trends, Database Trends	3	2
6. Telecommunications, Networks, the Internet & the Wireless Revolution: Technologies and Tools for Communication and E-Business Wireless Computer Networks and Internet Access, M-Commerce, Wireless Technology in the Enterprise	4	2
7. Enterprise Applications and Business Process Integration: Enterprise Systems, Supply Chain Management Systems, Customer Relationship Management Systems, Enterprise Integration Trends	4	3
8. Managing Knowledge in the Digital Firm: The Knowledge Management Landscape, Enterprise-Wide Knowledge Management Systems, Knowledge Work Systems, Intelligent Techniques	4	3
9. Enhancing Decision Making for the Digital Firm: Decision Making and Decision-Support Systems, Systems for Decision Support	3	3

10	Redesigning the Organization with Information Systems: Systems as Planned Organizational Change, Overview of Systems Development Alternative Systems-Building Approaches	3	4
11	Understanding the Business Value of Systems and Managing Change: Information Technology Investments and Productivity, Importance of Change Management in Information Systems Success and Failure, Managing Implementation	3	4
12	Advances in the domain	1	4

TEXTBOOKS

1. Laudon K. C., Laudon J. P, “Management information systems: Managing the digital firm”, Pearson Education Global Edition 2019
2. James O'Brien, George Marakas, “Management information systems”, McGraw-Hill Education

RECOMMENDED READING

- 1 J. Sousa, Effy Oz, “Management information systems”, Cengage Learning

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4305P	
Course Title	Management Information Systems Lab	
Prerequisite	Software Engineering	

COURSE OUTCOMES: Students will be able to

1.	Carry out cost & effort estimation, risk management, project scheduling, software quality assurance and software configuration management for an Information Systems development project.
2.	Carry out requirements analysis, software design, coding & testing for an Information Systems development project

Every student will be assigned an Information System development project. Information System can be a Supply Chain Management System (SCMS), Customer Relationship Management System (CRMS), Knowledge Management System (KMS), Enterprise Resource Planning System (ERPS), Marketing Information System, Accounting Information System, Human Resource Management System, Office Automation System, College Information Management System, Sales and Marketing System, Inventory Control System, Accounting and Finance System, Management Reporting System, Payroll System, Order Processing System, Stock Control System or other similar system. Student has to perform the following assignments for the project assigned. Finally, he has to prepare a project Report as per the format given below for the assigned project.

LIST OF EXPERIMENTS:

	Hrs	CO
1. Give detailed Problem Statement for the Information System (I S) being designed	1	1
2. Perform Software Scoping activity for the I S	1	1
3. Estimate required Resources for the I S	1	1
4. Perform Cost and effort Estimation for the I S	2	1
5. Perform Risk Analysis for the I S	2	1
6. Prepare the Project Schedule	2	1
7. Prepare the Project Plan	2	1
8. Prepare Software Quality Assurance Plan	2	2
9. Carry out Requirement Analysis Modelling using structured or object-oriented analysis	3	2
10. Carry out Software Design using structured or object-oriented design	3	2
11. Develop the MIS & Test it.	4	2

TEXTBOOKS

1. Laudon K. C., Laudon J. P, “Management information systems: Managing the digital firm”, Pearson Education Global Edition 2019.
2. James O'Brien, George Marakas, “Management information systems”, McGraw-Hill Education

RECOMMENDED READING

- 1 Ken J. Sousa, Effy Oz, “Management information systems”, Cengage Learning

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4401S	
Course Title	Multicore Technologies	
Prerequisite	Parallel Computing	

COURSE OUTCOMES: Students will be able to

1.	Understanding in multicore, many core architectures
2.	Analyze parallel programming environments using threads and alternative solutions.
3.	Design and apply algorithms perspective for multicore and many architectures.
4.	Exploring supercomputing architecture.

COURSE CONTENTS

	Hrs	CO
1. Introduction to Multi-Core and Many core Architecture: Parallel Computing Platforms, Parallel Computing in Microprocessors, Single-Core Processor Architecture Fundamentals, Evolution of Multi-core CPUs, Recent Evolution of NVIDIA GPUs, Fermi Streaming Multiprocessor Architecture, ATI Radeon 5000 Series Architecture, VLIW Stream Core (SC), Processor Generation / Cores Per Socket, Evolution of Intel Multicore Processors series.	6+2	1
2. System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Application Programming Models and Threading. Threading on Multi- Core Processors Hardware-based Threading, Threading from Intel, Hyper-Threading Technology, Difference between Multiprocessor and Hyper-Threading Technology, Hyper-Threading Technology Architecture. Virtualization.	6+2	1
3. File System Architectures: Introduction to Grid, Cluster, Job Management Systems, File Systems: Shared File Systems (e.g. NFS), Parallel File Systems (e.g. GPFS, PVFS, Lustre).	4+2	3
4. High Performance Interconnect: Topology: Fat-Tree, Dragonfly, Torus, Hypercube, HyperX, etc. High speed Interconnect: Infiniband, high speed ethernet, etc. Protocol etc.	4+2	3
5. Concepts of Multicore Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Characteristics of Tasks and Interactions, Parallel Algorithm Models,	6+2	2
Combining OpenMP and MPI: Steps for building a hybrid cluster, MPI routines, differences in OpenMP and MPI, Examples like Searching, Sorting, and Linear System Equations, Dense Matrix Algorithms, Graph Algorithms, Search Algorithms for Discrete Optimization Problems, Dynamic Programming.		

6. **Concepts of Manycore Programming:** Data Parallelism, Data-Parallel Execution Mode , CUDA Memories , Data Parallelism, CUDA Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading, Cuda Thread Organization, Mapping Threads to Multidimensional Data, Matrix-Matrix Multiplication—A More Complex Kernel, Synchronization and Transparent Scalability, Assigning Resources to Blocks, Querying Device Properties, Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic, A Tiled Matrix Matrix Multiplication Kernel, Memory as a Limiting Factor to Parallelism, Warps and Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of Execution Resources, Instruction Mix and Thread Granularity. Example: Matrix algorithm. Hybrid computing, Pitfalls and issues of Many-core Programming, 6+2 2
7. **Case Study: Supercomputing Architectures:** Interconnect Family, Operating System Family, INDIA@TOP500, Green500, performance benchmarks: Graph500. 6+2 4
Research Recommendations: Rethinking programming models, System Software, Rethinking architecture, Power efficiency, Energy Constraints, Future Computational Challenges.

TEXTBOOKS

1. Shameem Akhter, Jason Roberts, “Multi-Core Programming: Increasing Performance through Software Multi-threading”, Intel Press, April 2006.
2. Ananth Grama, “An Introduction to Parallel Computing: Design and Analysis of Algorithms”, Pearson publication, 2009.

RECOMMENDED READING

- 1 Michael J Quinn, “Parallel Programming in C with MPI and OpenMP”, Tata McGraw-Hill 2011.
- 2 Barbara Chapman, “Using OpenMP. Portable Shared Memory Parallel Programming”, The MIT Press Cambridge, Massachusetts London, England 2008.
- 3 David B. Kirk and Wen-mei W. Hwu, “Programming Massively Parallel Processors A Hands-on Approach Second Edition”, Elsevier 2013.
- 4 Peter S. Pacheco, “An Introduction to Parallel Programming, Morgan Kaufmann”, Elsevier Series, 1st Edition, 2011.
- 5 Bhujade Moreswar R., “Parallel Computing”, New Age International Pvt. Ltd., 2008.
- 6 Hawang Kai and Briggs F. A., “Computer Architecture and Parallel Processing”, Tata McGraw Hill, 1984.
- 7 John L Hennessy, David A Patterson, “Computer Architecture: A Quantitative Approach, Morgan Kaufmann”, 6th Edition, 2017.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4402S	
Course Title	Advanced Database Engineering	
Prerequisite	Database Management Systems	

COURSE OUTCOMES: Students will be able to

1.	Summarize and illustrate concepts and working of parallel database system and Distributed database systems.
2.	Analyze key characteristics of data warehouse and apply design methodologies of data warehouse for OLTP.
3.	Design XML database and query data from semi-structured data models.
4.	Discuss advance databases such as Cloud databases, Hadoop databases, and NoSQL processing, and application of modern tools for cloud computing environment.

COURSE CONTENTS

	Hrs	CO
1. Parallel Databases: Introduction, I/O Parallelism, Inter-query and Intra-query Parallelism, Inter-operational and Intra-operational Parallelism, Design of Parallel systems.	6+2	1
2. Distributed Databases: Homogeneous and Heterogeneous databases, Storing data in distributed DBMS, Distributed catalog management.	8+2	1
3. Distributed Transactions: Distributed Transactions and Query processing, Distributed Concurrency and recovery.	6+2	2
4. Data Warehouse and OLAP: Decision support, Data warehousing, Creating and maintaining a warehouse. OLAP: Multidimensional data model, OLAP queries, Database design for OLAP, Implementation techniques for OLAP bitmap indexes, Join indexes, Views and decision support, Top N Queries, Online aggregation.	8+2	3
5. XML: Structure of XML data, XML document schema, Querying and transformation, API to XML, Storage of XML data, XML applications.	6+2	4
6. Advanced Topics: Hadoop / Map Reduce, No SQL databases.	6+2	3

TEXTBOOKS

1. R. Elmasri, and S. Navathe, “Fundamentals of Database Systems, Benjamin Cummings”, Pearson, 7th Edition, 2016.
2. Abraham Silberschatz, Henry F. Korth, S. “Sudarshan, Database system concepts”, McGraw Hill International Edition, 7th Edition, 2019.

RECOMMENDED READING

- 1 Rob Coronel, “Database systems: Design Implementation and Management”, Thomson Learning Press, 5th Edition, 2006.
- 2 J. D. Ullman, “Principles of Database Systems”, Galgotia Publication, 2nd Edition, 1999.
3. Raghu Ramkrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill International Editions, 3rd Edition, 2014.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4403S	
Course Title	Human Computer Interaction	
Prerequisite	Nil	

COURSE OUTCOMES: Students will be able to

1.	Apply concepts and guidelines of HCI.
2.	Design and examine interfaces and the interactions among them.
3.	Estimate and apply models and empirical data for system development.
4.	Develop and evaluate interactive systems.

COURSE CONTENTS

	Hrs	CO
1. Introduction: Objective, Overview and historical evolution of HCI, Guidelines for HCI: Shneiderman’s eight golden rules, Norman’s seven principles, Norman’s model of interaction, Nielsen’s ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry, Cognitive walkthrough.	6+2	1
2. Interactive System Design: Concept of usability: definition and elaboration, HCI and software engineering, GUI design and aesthetics, Prototyping techniques.	7+2	2
3. Model based design and evaluation: Fundamental concepts, basic idea, different types of models, GOMS family of models (KLM and CMN- GOMS), Fitts’ law and Hick-Hyman’s law, Model-based design case studies.	7+2	2
4. Empirical research methods in HCI: Motivation, issues, research question formulation techniques, experiment design and data analysis.	7+2	3
5. Task modeling and analysis: Hierarchical Task Analysis (HTA), Engineering task models and Concur Task Tree (CTT).	6+2	3
6. Dialog Design: Introduction to formalism in dialog design, design using FSM (finite state machines), State charts and (classical) Petri Nets in dialog design.	5+2	4
7. Advances in the domain	3	4

TEXTBOOKS

1. Dix A., Finlay J., Abowd G. D., “Beale R. Human Computer Interaction”, Pearson Education, 3rd Edition, 2005.
2. Preece J., Rogers Y., Sharp H., Benyon D., Holland S., Carey T. “Human Computer Interaction: Concepts and Design”, Addison-Wesley, 1994.

RECOMMENDED READING

- 1 B. Shneiderman, P. Catherine, “Designing the User Interface”, Addison Wesley, 6th Edition, 2017.

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4404S	
Course Title	Virtual Reality	
Prerequisite	NIL	

COURSE OUTCOMES: Students will be able to

1.	Apply knowledge of Geometry in VR.
2.	Understand life perception in VR.
3.	Interpret lights and optics.
4.	Explore tracking systems.

COURSE CONTENTS

	Hrs	CO
1. Introduction: Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view (general), Birds-eye view (general), Birds-eye view (hardware), Birds-eye view (software), Birds-eye view (sensation and perception).	4+1	1
2. Geometry of Virtual Worlds: Geometric modeling, transforming models, Matrix algebra and 2D rotations, 3D rotations and yaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, Axis-angle representations Quaternions Converting and multiplying rotations, Converting and multiplying rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Eye transforms, Canonical view transform, Viewport transform, Viewport transform.	6+2	2
3. Light and Optics: Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lens, Lens aberrations, Optical system of eyes.	4+1	3
4. Visual Physiology: Photoreceptors, Sufficient resolution for VR, Light intensity, Eye movements, Eye movements, Eye movement issues for VR, Neuroscience of vision.	5+2	3
5. Visual Perception: Depth perception, Depth perception, Motion perception, Frame rates and displays, Frame rates and displays.	4+1	3
6. Tracking Systems: Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach.	4+1	4
7. Visual Rendering: Visual Rendering-Overview, Visual Rendering-overview, Shading models, Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post- rendering image warp.	4+1	4
8. Audio: Physics and physiology, Auditory perception, Auditory localization, Rendering, Spatialization and display, Combining other senses.	4+1	4
9. Interfaces: Interfaces –overview, Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.	4+1	4
10 Advances in the domain	2	4

TEXTBOOKS

1. George Mather, “Foundations of Sensation and Perception: Psychology Press”, 3rd edition, 2016.
2. Peter Shirley, Michael Ashikhmin, Steve Marschner, “Fundamentals of Computer Graphics”, A K Peters/CRC Press, 3rd Edition, 2009.

RECOMMENDED READING

- 1 Jason Jerald, “The VR Book Human-Centered Design for Virtual Reality” NextGen Interactions

Program Name	B. Tech. (Computer Engineering)	Semester – VIII
Course Code	R4CO4405S	
Course Title	Distributed Algorithms	
Prerequisite	Algorithms and Operating Systems	

COURSE OUTCOMES: Students will be able to

1.	Demonstrate the knowledge of various aspects of distributed paradigms.
2.	Apply the synchronization for distributed applications
3.	Design and apply distributed algorithms for the distributed systems.
4.	Utilize fault tolerance techniques for optimization of system performance.

COURSE CONTENTS

	Hrs	CO
1. Theoretical foundations: introduction, limitations of a distributed system, Lamport's logical clocks, vector clocks, causal ordering of messages, Global state reordering algorithm, Cuts of a distributed computation, Termination detection: Computation trees and forests, web-based solutions. Other solutions.	4+1	1
2. Distributed mutual exclusion: Lamport's algorithm, Ricart-Agrawala Algorithm, Maekawa algorithm, Suzuki-Kasami algorithm, Raymond's tree-based algorithm.	4+1	1
3. Routing Algorithms and Deadlock-free packet switching: Destination-based routing, All-pairs shortest path algorithm, Net change algorithm, Routing with compact routing tables, Hierarchical routing, and introduction to packet-switching and deadlock in packet-switching network, structured solution, and unstructured solutions. Distributed deadlock detection: centralized algorithms, distributed algorithms.	8+2	2
4. Election Algorithm: Introduction, Ring Networks, Arbitrary network, The Karachi-Kuttan-Moran Algorithm, Introduction to anonymous networks, A probabilistic election algorithm, two snapshot algorithms, preliminaries of sense of direction and orientation, Election in rings and choral rings, computing in hypercube and complexity related issues	7+2	2,3
5. Synchrony in Networks: Leader Election in synchronous networks, Synchronizer algorithm, Application: Breadth-First Search, Shortest Paths, Minimum Spanning Tree.	5+1	2,3
6. Failure recovery and fault tolerance: Classification of failures, Checkpoints, Synchronous checkpointing and recovery, Asynchronous checkpointing and recovery, commit protocols, Voting protocols, Dynamic voting protocols, robust algorithms, stabilizing algorithms, The Coordinated Attack Problem, Algorithms for Byzantine Failures	7+2	4
7. Asynchronous Shared Memory Model: Shared Memory Systems, Environment Model. Mutual Exclusion: Asynchronous Shared Memory Model, The Problem, Dijkstra's Mutual Exclusion Algorithm, The Bakery Algorithm. Resource Allocation: The Problem, Nonexistence of Symmetric Dining Philosophers Algorithms, Right-Left Dining Philosophers Algorithm	4+2	4
8. Advances in the domain	2	4

TEXTBOOKS

1. Ajay D. Kshemkalyani and Mukesh Singhal, “Distributed Computing: Principles, Algorithms, and Systems”, Cambridge, 2010.
2. Mukesh Singhal , Niranjan Shivaratri, “Advanced concepts in operating systems”, Indian Edition, 2017.

RECOMMENDED READING

- 1 Lynch, Nancy A. Lynch, “Distributed Algorithms, The Morgan Kaufmann Series”, MIT Press, 1996.
- 2 Gerard Tel, “Introduction to Distributed Algorithms”. Cambridge University Press, 2nd edition, 2000.
- 3 George F. Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems: Concepts and Design”, Pearson Education, 5th Edition, 2011.
- 4 Wan J. Fokkink, “Distributed Algorithms: An Intuitive Approach”, MIT Press, 2019.