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

COURSE OUTCOMES

Students will be able to

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

COURSE CONTENTS:

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

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

TEXTBOOKS

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

RECOMMENDED READING

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

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS:

Unit No	Topics	Hrs	CO
1.	**Introduction:** Learning Problems , Perspectives and Issues , Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias, Decision Tree learning, Representation, Algorithm, Heuristic Space Search.	5	1
2.	**Instant Based Learning :** K-Nearest Neighbor Learning, Locally weighted Regression, Radial Bases Functions, and Case Based Learning. Association Rule Learning: Apriori, FP Growth ,Clustering: Centroid based , K-means, Distribution based , EM, Density based , DBScan Regression: Linear Regression, Interpolation & Extrapolation, Nonlinear regression	8	2
3.	**Bayesian And Computational Learning :** Bayes Theorem , Concept Learning , Maximum Likelihood , Minimum Description ,Length Principle , Bayes Optimal Classifier , Gibbs Algorithm , Naïve Bayes Classifier , Bayesian Belief Network , EM Algorithm , Probability Learning , Sample Complexity , Finite and Infinite Hypothesis Spaces , Mistake Bound Model.	8	2
4.	**Neural Networks And Genetic Algorithms:** Neural Network Representation , Problems , Perceptron's , Multilayer Networks and Back Propagation Algorithms , Advanced Topics, Genetic Algorithms , Hypothesis Space Search, Genetic Programming, Models of Evaluation and Learning	6	3

| 5. | **Introduction to Deep Learning :** | 7 4 |

Deep L-layer Neural Network, Need of Deep Learning, Practical aspects of Deep Learning, Hyper-parameters, Gradient Descent Algorithms and variants used, Different activation functions, Introduction to types of Deep Learning NN such as Recurrent Neural Network, Convolutional Neural Network, and Applications of Deep Learning.

| 6 | Advances in machine learning | 1 | 4 |

TEXTBOOKS

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill, 1st Edition, 2017

2. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation & Machine Learning)", 2nd Edition, 2009.

3. Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

RECOMMENDED READING

1. Hastie. T, Tibshirani. R, Friedman. J. H, "The Elements of Statistical Learning", Springer, 2nd edition, 2009.

2. William W.Hsieh, "Machine Learning Methods in the Environmental Sciences", Cambridge Publication ,2009.

3. J Han ,J Pei, Han Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers,3rd edition,2011.

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

COURSE OUTCOMES:

Students will be able to

1.	Describe different ways of achieving parallelism and different parallel computer systems.
2.	Design Memory and Input/output subsystems in Uni processor and Multiprocessor environment considering the performance issues influencing its design.
3.	Analyze the organization and operation of different parallel computer architectures such as Pipelined processor, SIMD Array processor, Multiprocessor and Multi-core systems, superscalar processor & GPU based architectures.
4.	Demonstrate the parallel hardware constructs and operating system support for parallel computing.

COURSE CONTENTS

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

4. **Pipeline and Superscalar micro architecture**   7   3

    A. Pipelining: An Overlapped Parallelism, Principles and implementation of Pipelining. Classification of pipelining processors. Study and comparison of processors with and without pipelining. General pipelining reservation table

    B. Instruction and Arithmetic Pipelining: Design aspects.

    C. Issues of designing Pipelined Processors: Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision detection.

    D. Data level parallelism: Vector processing

    E. Superscalar Architecture.

5. **SIMD Computer Organization**   8   3,4

    A. SIMD Array Processors: Masking and Data network mechanism, Inter PE Communication

    B. Communication: SIMD Interconnection networks, Static Vs Dynamic Networks, Cube, hyper cube, Mesh Interconnection Network

    C. Associative Array Processors

    D. Parallel Algorithms for Array Processors: Matrix Multiplication algorithm, Sorting algorithm and their analysis.

    E. Performance Enhancement Methods of SIMD Array Processors

6. **Multiprocessor, Multi-core, GPU Architectures**   8   1,3

    A. Functional Structures: Loosely and tightly coupled multiprocessors, Processor characteristics of multiprocessors, centralized and distributed shared memory architectures.

    B. Interconnection Networks: Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency

    C. Exploiting Concurrency for Multiprocessing: Implementation issues of a program on multiprocessor system.

    D. Parallel Algorithms for Multiprocessors, Multiprocessor operating systems

    E. Multi-core systems: Structure, performance.

    F. GPU based Architecture, CPU-GPU integration.

TEXTBOOKS

1. Computer Architecture: A Quantitative Approach (Third Edition), John Hennessy and David Patterson, Morgan Kaufmann Publishers, 2003.

2. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw-Hill international Edition.

3. D. E. Culler and J. P. Singh with A. Gupta, "Parallel Computer Architecture", Morgan Cuffman 1st Edition ,1998

RECOMMENDED READING

1.   V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.

2.   Harrold Stone, High performance computer Architecture.

3.   Richard Y. Kain, Advanced Computer Architecture

4..   Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS

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

Assignments:

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

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

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

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

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

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

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

TEXTBOOKS

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

RECOMMENDED READING

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

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS:

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

TEXTBOOKS

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

RECOMMENDED READING

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

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS

Unit No	Topics	Hrs	CO
1.	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	2	1
2.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the algorithms operating on it.	2	1
3.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	2	1,2
4.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets	2	2
5.	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	2	2
6.	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/Python can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	2	2,3
7.	Write a program to construct a Bayesian network considering medical/other data. You can use Java/Python ML library classes/API.	2	3
8.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the	2	3

program.

9.	Write a program to implement k-Nearest neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	2	4
10.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	2	4

TEXTBOOKS

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill, 1st Edition, 2017

2. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation & Machine Learning)", 2nd Edition, 2009.

3. Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning",Addison Wesley, N.Y., 1989.

RECOMMENDED READING

1. Hastie. T, Tibshirani. R, Friedman. J. H, "The Elements of Statistical Learning", Springer, 1st edition, 2001.

2. William W.Hsieh, "Machine Learning Methods in the Environmental Sciences", Cambridge Publication.

3. Han Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers.

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

COURSE OUTCOMES:

Students will be able to

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

LIST OF EXPERIMENTS

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

TEXTBOOKS

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

RECOMMENDED READING

1. V.Rajaraman, L Sivaram Murthy, "Parallel Computers", PHI.

2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition.

3. Kai Hwang, Scalable Parallel Computing.

4. Harrold Stone, High performance computer Architecture.

5. Richard Y. Kain, Advanced Computer Architecture

6. J. L. Hennessy and D. A. Patterson. Computer Architecture: A Quantitative Approach. Morgan-Kaufmann publishers.

7. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill

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

COURSE OUTCOMES

Students will be able to

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

COURSE CONTENTS

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

7.	**Spatial modelling:**	4	4

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

TEXTBOOKS

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

RECOMMENDED READING

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

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

COURSE OUTCOMES:

Students will be able to

1.	Demonstrate the fundamentals of wireless technology.
2.	Apply the layered protocols and fundamentals for the design of wireless
3.	Analyse and apply resource optimization techniques for better performance
4.	Apply the working of different wireless networks.

COURSE CONTENTS

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

Sync

| 6 | Advances in the wireless network | 4 | 4 |

TEXTBOOKS

1. Jochen Schiller, "Mobile Communications", 2ndEdition, Pearson Education, 2003.

2. William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Education, 2002.

RECOMMENDED READING

1. Kaveh Pahlavan, Prashanth Krishnamoorthy, "Principles of Wireless Networks", Pearson Education, 1st Edition, 2003.

2. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.3.C. K. Toh, "AdHoc Mobile Wireless Networks", Pearson Education, 1st Edition, 2002.

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS

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

Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformation

6. **Color Image Processing:**   3 3
   Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images, Color Image Compression

7. **Image Compression:**   3 4
   Fundamentals, Image Compression Models, Elements of Information

8. **Image Segmentation:** Detection of Discontinuities, Edge Linking and 3 4 Boundary Detection, Thresholding, Region-Base Segmentation, Split and Merge Technique, Segmentation by Morphological Watersheds, Use of Motion in Segmentation

9 Advances in the domain

TEXTBOOKS

1. Rafel C. Gonzalez and Richard E. Woods: Digital Image Processing, Prentice Hall, Third Edition,2007

2. William K. Pratt: Digital Image Processing, PIKS Inside, Third Edition,2002

RECOMMENDED READING

1. Anil K Jain: Fundamentals of Digital Image Processing, Prentice Hall of India, First Edition,1998

2. Jayaraman S, Veerakumar T and Esakkirajan S: Digital Image Processing,2017

3. Milan Sonka and Vaclav Hlavac and Roger Boyle: Image Processing, Analysis and Machine Vision,2017

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS

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

Storage Area Networks (SAN):

Architecture, hardware devices, host bus adaptors, connectivity.

Content Addressable Storage (CAS):

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

4. **Storage Area Networks**: 4 2

SAN components and cabling, interconnect devices, and storage Arrays, SAN management Software, Fiber Channel architecture, Zoning, Login Types and topologies, IP SAN.

5. **Information Availability:** 6 3

Business continuity and disaster recovery basics, Local business continuity techniques, Remote business continuity techniques, Storage design and implementations of the Business continuity plan, Managing availability, Disaster recovery principles &techniques.

6. **Managing and Storage Virtualization:** 7 4

Managing Availability, Availability metrics, Implementing the plan, Finding the holes, maintaining serviceability capacity planning, Management tools, Overview information security virtualization, Different virtualization, Technologies and processes including file and block level virtualization.

7 Advances in the domain

TEXTBOOKS

1. G. Somasundaram, Alok Shrivastava, Information Storage and Management, Wiley Publishing, Inc., 2nd Edition, 2012.

2. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, 2003.

RECOMMENDED READING

1. J Gerald Kowalski and T.Mark Mayburk, Information Storage and RetrievalSystems, Springer International, 2nd Edition, 2009.

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS

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

TEXTBOOKS

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

RECOMMENDED READING

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

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

COURSE OUTCOMES:

Students will be able to

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

LIST OF EXPERIMENTS

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

TEXTBOOKS

1. Jochen Schiller, "Mobile Communications", 2ndEdition, Pearson Education, 2003.

2. William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Education, 2002.

RECOMMENDED READING

1. KavehPahlavan, PrashanthKrishnamoorthy, "Principles of Wireless Networks", Pearson Education, 1st Edition, 2003.

2. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.3.C. K. Toh, "AdHoc Mobile Wireless Networks", Pearson Education, 1st Edition, 2002.

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS

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

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

RECOMMENDED READING

1. Rafel C. Gonzalez and Richard E. Woods: Digital Image Processing, Prentice Hall, Third Edition

2. William K. Pratt: Digital Image Processing, PIKS Inside, Third Edition

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

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

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

COURSE OUTCOMES:

Students will be able to

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

LIST OF EXPERIMENTS:

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

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

TEXTBOOKS

1. G. Somasundaram, Alok Shrivastava, Information Storage and Management, Wiley Publishing, Inc., 2nd Edition, 2012.

2. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, 2003.

RECOMMENDED READING

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

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

COURSE OUTCOMES:

Students will be able to

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

COURSE CONTENTS:

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

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

TEXTBOOKS

1. Charles P. Pfleeger, Security in Computing, Prentice Hall India, 5th edition, 2015.

2. Dr. B.B. Meshram, Ms K.A. Shirsath, TCP/IP and Network Security: Attacks and Defence Mechanisms With Open Source Tools, Shroff Publishers & Distributors PVT. LTD, 1st edition, 2017.

RECOMMENDED READING

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

2. ISECOM, Hacking Exposed Linux: Linux Security Secret and Solutions, McGraw Hill Education, 3rd edition, 2008.

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

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

COURSE CONTENTS

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

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	nmap, SE Linux, Authentication Mechanisms, LDAP, Firewall, Firewall policies, Proxy Servers, SOCKS Proxy server.		
6	**Advance Technologies:**	5	4
	Cluster Administration: setup & configuration, parallel process management		
7	Advances in the domain	5	4

TEXT BOOKS

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

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

RECOMMENDED READING

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

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

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