Scheme of Examination - I Semester

Sr No	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Continual Assessment	End Sem Examination	Total
1	CSE101T	Mathematical Modelling	4			4	30	70	100
2	CSE102T	Advanced Operating System Design	4			4	30	70	100
3	CSE102P	Advanced Operating System Design Lab			2	1	25	25	50
4	CSE103T	High Performance Computer Architecture	4			4	30	70	100
5	CSE104T	Advanced Database Management Systems	4			4	30	70	100
6	CSE104P	Advanced Database Management Systems Lab			2	1	25	25	50
7	CSE105T	Elective - I	3			3	30	70	100
8	CSE106T	Open Elective	3			3	30	70	100
Total			**22**	**0**	**4**	**24**	**230**	**470**	**700**

CSE105T	Elective - I
CSE105T(i)	Artificial Intelligence & Machine Learning
CSE105T(ii)	Software Architecture
CSE105T(iii)	Natural Language Processing

CSE106T	Open Elective
CSE106T(i)	Soft Computing
CSE106T(ii)	Blockchain Technology
CSE106T(iii)	Business Intelligence

Scheme of Examination - II Semester

Sr No	Course Code	Course Title	Hours per Week			Credits	Maximum Marks		
			L	T	P		Continual Assessment	End Sem Examination	Total
1	CSE201T	Wireless and Mobile Ad Hoc Networks	4			4	30	70	100
2	CSE201P	Wireless and Mobile Ad Hoc Networks Lab			2	1	25	25	50
3	CSE202T	Design of Distributed Systems	4	1		5	30	70	100
4	CSE203T	Advances in Algorithms	4			4	30	70	100
5	CSE203P	Advances in Algorithms Lab			2	1	25	25	50
6	CSE204T	Foundation Course - Research Methodology	3			3	30	70	100
7	CSE205T	Elective - II	3			3	30	70	100
8	CSE206T	Elective - III				3	50		50
Total					**18**	**1**	**4**	**24**	**300**

CSE205T	Elective - II
CSE205T(i)	Big Data Analytics & Knowledge Mining
CSE205T(ii)	Cryptography and Network Security
CSE205T(iii)	Cloud Computing and Virtualization

CSE206T	Elective - III
CSE206T(i)	8 to 10 week Certificate Course

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COMPUTER SCIENCE & ENGINEERING

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE101T	Mathematical Modeling	3			3	30	70	100

Course Objectives	Course Outcomes
Mathematical modeling should typically strive to: ● Introduce students to the elements of the mathematical modeling process. ● Present application driven mathematics motivated by problems from within and outside mathematics. ● Exemplify the value of mathematics in problem solving. ● Demonstrate connections among different mathematical topics.	**Student will be able to** ● Used the principles and methods of mathematical modeling for studies of complex systems in science, engineering, and business ● Learn how to model "real" problems and prepare the mathematical models for analysis using dimensional analysis and scaling. ● Learn how to apply various tools to analyze the models including analytic and computational methods. ● Study how to compare modeling results to observations and how models can be improved. ● Apply the modeling techniques to 3 projects and produce detailed reports.

Unit I **[8Hrs]**

Mathematical Modeling: What Is Mathematical Modeling,Role and Architecture of Mathematical Models,Real-world that can be investigated with Mathematical Models: Simplification, Analysis ,Interpretation,Verification, Typical Relation between Variables, Various Challenges Mathematical Models **Data Collection Methods :** Type of Data, Observation and Collection of data, Method and Technique of Data Collection, Observation Method , Interview Method , Collection of Data through Questionnaires , Collection of Data through Schedules , Difference between Questionnaires and Schedules , Some Other Methods of Data Collection , Primary & Secondary Data used in data collection ,Selection of Appropriate Method for Data Collection,

Unit II **[8Hrs]**

Probability Theory, Reliability & Validity in Research: General Concept of Probability Theory, Discrete and Contentious random variable ,Probability distribution , Discrete time Markova chain , Test-retest reliability, alternative-form reliability,Internal-comparison reliability and scorer reliability,Content validity, criterion-related validity, and construct validity.

Data Analysis and Processing : Processing Operations , Some Problems in Processing , Elements/Types of Analysis ,Statistics in Research , Measures of Central Tendency , Measures of Dispersion , Measures of Asymmetry (Skewness) , Measures of Relationship , Simple Regression Analysis , Multiple Correlation and Regression,Partial Correlation , Association in Case of Attributes ,Other Measures

Unit III **[8Hrs]**

Fundamental Sampling : Need for Sampling , Some Fundamental Definitions , Important Sampling Distributions , Central Limit Theorem , Sampling Theory , Sandler's A-test , Concept of Standard Error , Estimation ,Estimating the Population Mean,Estimating Population Proportion ,Sample Size and its Determination , Determination of Sample Size through the Approach, Based on Precision Rate and Confidence Level, Determination of Sample Size through the Approach,Based on Bayesian Statistics

Testing of hypothesis: What is a Hypothesis, Basic Concepts Concerning Testing of Hypotheses , Procedure for Hypothesis Testing , Flow Diagram for Hypothesis Testing ,Measuring the Power of a Hypothesis Test , Tests of Hypotheses , Important Parametric Tests , Hypothesis Testing of Means , Hypothesis Testing for Differences between Means ,Hypothesis Testing for Comparing Two Related Samples ,Hypothesis Testing of Proportions ,Hypothesis Testing for Difference between Proportions , Hypothesis Testing for Comparing a Variance to, Some Hypothesized Population Variance ,Testing the Equality of Variances of Two Normal Populations ,Hypothesis Testing of Correlation Coefficients , Limitations of the Tests of Hypotheses , Important Nonparametric or Distribution-free Test , Relationship between Spearman's r's and Kendall's W,characteristics of Distribution-free or Non-parametric Tests

Unit IV **[8Hrs]**

Chi-square Test Analysis : Chi-square as a Test for Comparing Variance , Analysis of Variance (ANOVA) , Use of Multivariable Analysis in Business research, Chi-square as a Non-parametric Test ,Conditions for the Application of □2 Test , Steps Involved in Applying Chi-square Test ,Alternative Formula , Yates' Correction , Conversion of □2 into Phi Coefficient, Conversion of □2 into Coefficient by Contingency ,Important Characteristics of □2 Test ,Caution in using □2 Test .**Investigation of Variance and Co-variance:** Analysis of Variance (ANOVA) , What is ANOVA, The Basic Principle of ANOVA , ANOVA Technique , Setting up Analysis of Variance Table , Short-cut Method for One-way ANOVA , Coding Method ,Two-way ANOVA

Unit V **[8Hrs]**

Analysis Multivariate Techniques : Growth of Multivariate Techniques,Characteristics and Applications, Classification of Multivariate Techniques , Multiple Regression, Factor Analysis,Discriminant Analysis, Cluster Analysis, Multidimensional scaling, Variables in Multivariate Analysis , Important Multivariate Techniques, Important Methods of Factor Analysis,Rotation in Factor Analysis ,R-type and Q-type Factor Analyses, Path Analysis **The Role Computer and Simulation in Research :** Introduction, The Computer and Computer Technology , The Computer System , Important Characteristics , The Binary Number System , Computer Applications , Computers and Researcher 15.8 What is meaning of Simulation , Need of Simulation, Appropriateness of Simulation,Advantages and Disadvantages,Various Applications in engineering ,Simulation of queuing system

Text Books

S.N	Title	Authors	Edition	Publisher
1	Mathematical Modeling	Sandeep Banerjee		
2	An Introduction to Mathematical Modeling	Edward Bender		Dover Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Reserach Methodology	C. R. Kothari		New Age International Publication

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COMPUTER SCIENCE & ENGINEERING

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE102T	Advanced Operating System	4			4	30	70	100

Course Objectives	Course Outcomes
The aim of this course is ● to study, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems); This course presents hardware and software features that support these systems, presenting advanced design/implementation methods and techniques for modern operating systems. It also provides insights into how the higher performance of modern processors (including implicit and explicit parallelism) impacts operating system design approaches.	**Students will be able to:** ● Analyze the structure of OS and basic architectural components involved in OS design. ● Analyze the various device and resource management and IPC techniques for timesharing and distributed systems. ● Understand the process synchronization, mutual exclusion, deadlock detection and agreement protocols of Distributed operating system.

Unit I **[8Hrs]**

Operating System concepts using Linux kernel as the reference OS. Linux kernel programming: Customizing the Linux kernel, design and implementation of simple kernel modules, and, design of new kernel features with user space interfacing using system call API and character devices.

Unit II **[8Hrs]**

Device Drivers; Message Passing: Interprocess communication, group communication, broadcasting algorithms; Remote Procedure Call: RPC Model, stub generation, server management, parameter passing, call semantics, communication protocols, client-server binding, exception handling, security, optimization;

Unit III **[8Hrs]**

Theory and implementation aspects of distributed operating systems, Process synchronization in multiprocessing/multiprogramming systems, Inter-process communication and co-ordination in large distributed systems, Distributed resource management. Naming in distributed systems, directory services, DNS; Case studies of some distributed OS: Hydra, Mach and Amoeba.

Unit IV **[8Hrs]**

Distributed Shared Memory: General Architecture of DSM Systems, Design and Implementation Issues of DSM, consistency model, replacement strategy, thrashing, coherence, Advantages of DSM ; Synchronization: Clock synchronization, event ordering, mutual exclusion, deadlock, election algorithms; Resource Management: Scheduling algorithm, task assignment, load balancing, load sharing; Process Management: Process migration, threads; File Systems; Protection and Security; Fault Tolerance;

Unit V **[8Hrs]**

Fundamentals of real time operating systems. Case studies. Information management in distributed systems: security, integrity and concurrency problems. Fault tolerance issues.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Modern Operating Systems	A S Tanenbaum	3rd Edition	Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagne,	8th Edition	John Wiley
2	Operating Systems: Internals and Design Principles	William Stallings	6th Edition	Prentice-Hall
3	Operating Systems Design and Implementation	A S Tanenbaum, AS Woodhull	3rd Edition	Prentice Hall

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FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE102P	Advanced Operating System Lab			2	1	25	25	50

Course Objectives	Course Outcomes
The aim of this course is ● To study state-of-the-art operating system in today's world, covering variety of platforms -- cell phones, muti-core, parallel systems, distributed systems, and cloud computing	**Students will be able to** ● understand the key concepts of virtualization, Synchronization, Communication, Scheduling in the context of distributed systems. ● Implement basic services and functionalities of the operating system using system calls.

Expt. No.	Title of the experiment
1	Write a program to implement a multilevel feedback queue CPU scheduling algorithm.
2	Implement a parallel merge sort of an integer array which resides in a shared-memory segment. A tree of processes is created recursively for this purpose.
3	Implement a solution to the dining philosophers' problem which is deadlock free as well as starvation free.
4	Demonstrate the concept of thread synchronization by using Linux system calls. The thread synchronization needs to be achieved using the concept of locks on a computer that has a processor with multiple cores. (Eg: producer-consumer problem, reader-writer problem)
5	Write Shell Script to delete zero sized files from a given directory (and all its sub-directories).
6	Write a shell script to implement the ls command with at least two options. The output of the script should completely match with the output of the ls command when executed on the same system with the same option(s) and argument.
7	Implementation Of SJF (Shortest Job First) preemptive CPU Scheduling algorithm to find average turn around time and average waiting time.
8	Write a C program to simulate Optimal page replacement algorithm.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Modern Operating Systems	A S Tanenbaum	3rd Edition	Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagne,	8th Edition	John Wiley
2	Operating Systems: Internals and Design Principles	William Stallings	6th Edition	Prentice-Hall
3	Operating Systems Design and Implementation	A S Tanenbaum, AS Woodhull	3rd Edition	Prentice Hall

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE103T	High Performance Computing Architecture	4			4	30	70	100

Course Objectives	Course Outcomes
The aim of this course is ● To Provide systematic and comprehensive treatment of the hardware and the software high performance techniques invovled in current day computing. ● To Introduce the fundamentals of high performance computing with the graphics processing units and many integrated cores using their architectures and corresponding programming environments.	**The student will be able to** ● The learner will be able to design, formulate, solve and implement high performance versions of standard single threaded algorithms ● The learner will know and will be able to demonstrate the architectural features in the GPU and MIC hardware accelarators.. ● The learner will be able to design programs to extract maximum performance in a multicore, shared memory execution environment processor. ● The learner will be able to design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.

Unit I **[8Hrs]**

Introduction : Introduction to Heterogeneous Parallel Computing. GPU architecture. Thread hierarchy. GPU Memory Hierarchy .

Unit II **[8Hrs]**

Vector Addition, Matrix Multiplication algorithms. 1D, 2D, and 3D Stencil Operations. Image Processing algorithms – Image Blur, Grayscaling. Histogramming, Convolution, Scan, Reduction techniques.

Unit III **[8Hrs]**

Introduction to Many Integrated Cores. MIC, Xeon Phi architecture. Thread hierarchy. Memory Hierarchy. Memory Bandwidth and performance considerations.

Unit IV **[8Hrs]**

Symmetric and Distributed architectures. OpenMP Introduction. Threadcreation, Parallel regions. Worksharing, Synchronization.

Unit V **[8Hrs]**

MPI Introduction. Collective communication. Data grouping for communication. Lab view : Vector Addition, Matrix Multiplication, Tiled Matrix Multiplication, Picture Scaling, Image Blur, Image Grayscaling. 1D, 2D, and 3D Stencil Operations. Histogramming, Convolution, Scan, Reduction.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Programming Massively Parallel Processors A Hands-on Approach	Wen-Mei W Hwu, David B Kirk	3rd Edition	Morgann Kaufmann
2	Intel Xeon Phi Coprocessor Architecture and Tools	Rezaur Rahman		Apress Open

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Using OpenMP	Barbara Chapman, Gabriele Jost, Ruud van der Pas		MIT Press

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COMPUTER SCIENCE & ENGINEERING

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE104T	Advanced Database management System	4			4	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To learn the modeling and design of databases. ● To acquire knowledge on parallel and distributed databases and their applications. ● To study the usage and applications of Object Oriented and Intelligent databases. ● To understand the usage of advanced data models. ● To learn emerging databases such as XML, Cloud and Big Data. ● To acquire inquisitive attitude towards research topics in databases.	**students will be able to :** ● To develop in-depth understanding of relational databases and skills to optimize database ● performance in practice. ● To understand and critique on each type of databases. ● To design faster algorithms in solving practical database problems. ● To implement intelligent databases and various data models.

Unit I **[7Hrs]**

PARALLEL AND DISTRIBUTED DATABASES : Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies

Unit II **[8Hrs]**

OBJECT AND OBJECT RELATIONAL DATABASES: Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies.

Unit III **[8Hrs]**

Data Warehousing,: Characteristics and functioning and architecture of Data Warehousing, Data marts,Data warehousing Life Cycle,Data modeling (Multidimensional Database) for data warehousing ,Building of data warehouse , OLAP, MOLAP, ROLAP

Data Mining : Introduction to data mining Technology and its relationship to Data warehousing, Association rules, Classification ,Clustering ,Commercial tools of data mining, Knowledge Discovery

Unit IV **[6Hrs]**

NoSQL Database : Overview, and History of NoSQL Databases Definition of the Four Types of NoSQL Database,NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases,NoSQL Key/Value databases using MongoDB, Document databases, Column- oriented NoSQL databases,Graph NoSQL databases

Unit V **[6Hrs]**

EMERGING TECHNOLOGIES: XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Geographic Information Systems- Biological Data Management- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models-Query Languages- Introduction to Big Data-Storage-Analysis.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Database System Concepts	Henry F Korth, Abraham Silberschatz, S. Sudharshan	6th Edition	McGraw Hill
2	Advanced Database Systems	Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari		Morgan Kaufmann publishers

Reference Books

S.N	Title	Authors	Edition	Publisher
1	An Introduction to Database Systems	C.J.Date, A.Kannan, S.Swamynathan	8th Edition	Pearson Education

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation

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CSE104P	Advanced Database management System Lab			2	1	CA	ESE	Total
						25	25	50

Course Objectives	Course Outcomes
This course is intended ● Apply and customize state-of-the-art implementation techniques for single-node database management systems following modern coding practices. ● Identify trade-offs among database systems techniques and contrast alternatives for both on-line transaction processing and on-line analytical workloads. ● Develop and justify design decisions in the context of a high-performance database system.	**Students will be able to** ● Design different types of databases. ● Use query languages. ● Apply indexing techniques.

Expt. No.	Title of the experiment
1	To implement SQL String functions in the DBMS
2	Implement a thread-safe, concurrent data structure.
3	Practical on WEKA tool for classification and Association
4	Practical on MongoDB
5	Practical on Cloud Databases

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Database Systems, A Practical Approach to Design, Implementation and Management	Thomas Cannolly and Carolyn Begg	4th Edition	Pearson Education
2	"Database Management System"	Raghu Ramakrishnan		Mc Graw Hill Publications

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE105T(i)	Elective I :-Artificial Intelligence and Machine Learning	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To cover fundamentals of Artificial Intelligence and understand various knowledge representation techniques and also provides knowledge of AI systems and its variants. ● To Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms. ● To introduce students to the basic concepts and techniques of Machine Learning and to develop skills of using recent machine learning software for solving practical problems.	**Student will be able to:** ● Understand the basics of Artificial Intelligence and to develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents. ● To choose an appropriate problem-solving method and knowledge-representation scheme. ● To develop/demonstrate/ build simple intelligent systems or classical toy problems using different AI techniques. ● Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised. ● Recognize the characteristics of machine learning that make it useful to real-world problems.

Unit I **[8Hrs]**

Introduction to AI: Foundation and history of AI. AI Problems and techniques - AI programming languages – Introduction to LISP and PROLOG – Problem spaces and searches -Blind search strategies; Breadth first - Depth first –Heuristic search techniques Hill climbing - Best first – A* algorithm AO* algorithm – game trees Minimax algorithm – Game playing – Alpha beta pruning.

Unit II **[8Hrs]**

Knowledge representation and Reasoning under uncertainty : Knowledge representation issues – Predicate logic – logic programming – Sematic nets - Frames and inheritance - constraint propagation –Representing Knowledge using rules – Rules based deduction system.Introduction to uncertain knowledge review of probability – Baye's Probabilistic inferences and Dempster Shafer theory –Heuristic methods – Symbolic reasoning under uncertainty- Statistical reasoning – Fuzzy reasoning – Temporal reasoning- Non monotonic reasoning.

Unit III **[8Hrs]**

Planning and learning: Planning - Introduction, Planning in situational calculus - Representation for planning – Partial order planning algorithm- Learning from examples- Discovery as learning – Learning by analogy –Explanation based learning – Introduction to Neural nets – Genetic Algorithms.

Unit IV **[8Hrs]**

Introduction to Machine learning: Introduction – History of Machine Learning, Programs vs learning algorithms, Machine Learning definition, Components of a learning, Different Types of Learning.Concept Learning Task, Concept learning as search, Inductive Learning Bias, FIND-S and Candidate-Elimination algorithm,Decision Trees, Basic decision trees learning algorithm, inductive bias in decision tree learning, overfitting Artificial Neural Networks, Perceptron, Multilayer networks and Backpropagation algorithm, Introduction to Deep Neural networks, Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs)

Unit V **[8Hrs]**

Evaluating Hypotheses: Evaluating Hypotheses, Basics of sampling theory, comparing learning algorithms,Bayesian learning and Bayesian networks, Gibbs algorithm, EM algorithm, Naive Bayes classifier,Instance based learning, K-Nearest-Neighbor, Locally weighted linear Regression, Logistic Regression, SVM , SVM, Multiclass & Ordinal Classification , Kernel Methods,Clustering, Generative Models, Mixture Models , Hidden Markov Model, Genetic Algorithms,Introduction to Analytical Learning, Combining Inductive and Analytical learning, Reinforcement learning, adaptive hierarchical clustering, Gaussian mixture model.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	2nd Edition	Pearson Education
2	Artificial Intelligence	Elaine Rich, Kevin Knight, Shivshankar B Nair	3rd Edition	McGraw Hill
3	Machine Learning	Mitchell Tom		McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	AI-Structures and Strategies for Complex Problem Solving,	George Lugar,	4th Edition	Pearson Edu.
2	Principles of Artificial Intelligence	Nils J. Nilsson		Narosa Publication
3	Artificial Intelligence	Patrick H. Winston	3rd Edition	Pearson Education.

FIRST SEMESTER

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE105T(ii)	Elective I :- Software Architecture	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To provide ways to develop different architectural views addressing specific concerns of stakeholders. ● To learn how to use design patterns to keep code quality high without over design. ● To learn how to add functionality to designs while minimizing complexity.	**Student will be able to** ● Design and understand software architecture for large scale software systems. ● Recognize major software architectural styles, design patterns, and frameworks. ● Describe a software architecture using various documentation approaches and architectural description languages. ● Develop architectural alternatives for a problem and select among them. ● Use well-understood paradigms for designing new systems.

Unit I **[8Hrs]**
Software process and the role of modeling and analysis, software architecture, and software design. Software Modeling and Analysis: Analysis modeling and best practices, traditional best practice diagrams such as DFDs and ERDs.

Unit II **[8Hrs]**
Software Architecture: architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, Architectural description languages and tools.

Unit III **[8Hrs]**
Software Design: design best practices, design patterns, design case studies, component technology, object oriented frameworks, distributed objects, inter-operability standards, case studies, software quality.

Unit IV **[6Hrs]**
UML diagrams and UML analysis modeling, analysis case studies, analysis tools, analysis patterns, documenting software architecture, reconstructing software architecture. Middleware components, programming models, implementation, systems qualities.

Unit V **[6Hrs]**
Moving from qualities to architecture and views Components and COTS, Economics Driven Architecture, Software product line, Software architecture future. Issues in Software Architecture: Scalability and interoperability issues, web application architectures, case studies.

Text Books

S.N	Title	Authors	Edition	Publisher
1	"Software Architecture Perspectives on an Emerging Discipline"	M. Shaw		PHI
2	"Software Architecture in Practice",	Len Bass, Paul Clements, Rick Kazman		Pearson Education, Asia
3	"Software Architecture –Foundations, Theory, and Practice"	R. Taylor, N. Medvidovic, E. Dashofy		Wiley India

Reference Books

S.N	Title	Authors	Edition	Publisher
1	"Design and Use of Software Architectures"	Jan Bosch		Addision-Wesley-Pearson Education
2	"Aoolied Software Architecture"	Christine Hofmeister, Robert Nord, Dilip Soni		
3	"Software Architecture: Organizational Principles and Pattern"	Addision-Wesley Pearson Education, Dikel, D.Met Al		Prentice Hall

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE105T(iii)	Elective I:- Natural Language Processing	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● to provides an introduction to the field of computational linguistics. ● To provide the creation of computer programs that can understand and generate natural languages	**Student will be able to** ● Students will be understand that How key concepts from NLP are used to describe and analyze language. ● POS tagging and context free grammar for English language ● Understanding semantics and pragmatics of English language for processing

Unit I **[8Hrs]**

Introduction

NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

Unit II **[8Hrs]**

N-gram Language Models

The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

Unit III **[8Hrs]**

Part Of Speech Tagging and Sequence Labeling

Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training).

Unit IV **[8Hrs]**

Semantic Analysis

Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

Unit V **[8Hrs]**

Information Extraction (IE) & Machine Translation (MT)

Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Natural Language understanding	James Allen	2nd Edition	Pearson
2	Natural Language Processing	Akshar Bharti,Vineet Chaitanya		

Reference Books

S.N	Title	Authors	Edition	Publisher
1	An Introduction to Natural Language Processing,Computational Linguistics, and Speech Recognition	Daniel Jurafsky and James H. Martin	2nd Edition	

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COMPUTER SCIENCE & ENGINEERING

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE106T(i)	Open Elective :-Soft Computing	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To cater the knowledge of Neural Networks,Fuzzy Logic and Genetic Algorithms and use these for controlling real time systems. ● To provide adequate knowledge about supervised and unsupervised learning and introduce neural network design concepts. ● To teach about the concept of fuzziness involved in various systems and provide adequate knowledge about fuzzy set theory, and fuzzy logic. ● To expose neural networks and fuzzy logic based methods to solve real world complex problems.	**Student will be able to** Analyze the feed-forward and feedback neural networks and their learning algorithms. Comprehend the neural network training and design concepts to solve real world complex problems. Comprehend the concept of fuzziness involved in various systems, fuzzy set theory and fuzzy logic Explain the of the principles underlying Evolutionary Computation in general and Genetic Algorithms in particular. To provide adequate knowledge of application of fuzzy logic control and genetic algorithms to solve real world complex problems.

Unit I **[8Hrs]**

Introduction to Neural Networks and their basic concepts: History of Development in neural networks, Neural Networks Characteristics:,Artificial neural network terminology,,Biological neurons and Artificial neuron, Topology, McCulloch-Pitts models of neuron, Types of activation functions and Neural Network architectures, Pre-requisites for training of neural networks. Linearly separable and linearly non-separable systems with examples.

Unit II **[8Hrs]**

Neural Network Learning: Types of learning. Supervised, Unsupervised learning.Basic Learning rules, Hebb's rule, Delta rule, Perceptron Learning rule, Back propagation learning Learning factors.ART networks, Associative memory. Application of NN in pattern recognition

Unit III **[8Hrs]**

Introduction to Fuzzy logic: Introduction to fuzzy logic, Basic Fuzzy logic theory, Fuzzy sets - properties & operations, Fuzzy relation - Operations on fuzzy relations, Fuzzy Membership functions,Fuzzy Rules and Fuzzy Reasoning, Fuzzification and Defuzzification methods, Fuzzy Inference Systems,basic Fuzzy interference algorithm ,Knowledge base Decision Fuzzy system design implementation

Unit IV **[8Hrs]**

Introduction to Evolutionary Computation: Different historical branches of EC, a simple genetic algorithm. Search Operators: Crossover,mutation, crossover and mutation rates, Crossover for real-valued representations, mutation for real-valued representations, combinatorial GA, Selection Schemes: Fitness proportional selection and fitness scaling, ranking, tournament selection, selection pressure and its impact on evolutionary search. Theoretical Analysis of Evolutionary Algorithms: Schema theorems, convergence of the algorithms, computational time complexity of the algorithms.

Unit V **[8Hrs]**

Applications of Neural network, Fuzzy Systems Genetic Algorithms: Applications of Neural networks in pattern classification, Character Recognition, Face recognition. Applications of fuzzy logic in Fuzzy pattern recognition, fuzzy image processing, Simple applications of Fuzzy knowledge based controllers like washing machines, Air conditioners. Applications of GA in engineering problems, job-shop scheduling and routing problems.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Neural Networks, Fuzzy Logic, and Genetic Algorithms	S. Rajasekaran & G. A. Vijayalakshmi Pai		PHI India Pvt. Ltd
2	Introduction to Soft computing	S. N. Sivanandam and S. N. Deepa		Wiley India Publications
3	Introduction to Artificial Neural Systems	J. M. Zurada		Jaico publishers
4	Fuzzy Logic with Engineering Applications	Thimothy J. Ross		Wiley India Publications

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Neural networks and Fuzzy Systems	Bart Kosko		Pearson Education
2	Neural Networks: A classroom Approach	Satish Kumar		Tata McGraw-Hill.
3	Neural Network- A Comprehensive Foundation	Simon Haykin		Pearson Education
4	Fuzzy sets, Uncertainty and Information	Klir G.J. & Folger T.A.		PHI

FIRST SEMESTER

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COMPUTER SCIENCE & ENGINEERING

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE106T(ii)	Open Elective :- Blockchain Technology	3			3	30	70	100

Course Objectives	Course Outcomes
● The objective of this course is to provide conceptual understanding of how block chain technology can be used to innovate and improve business processes. ● The course covers the technological underpinning of block Chain operations in both	**Students will be able to:** ● Understand block chain technology. ● Develop block chain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks. ● Build and deploy block chain application for on premise and cloud based architecture. ● Integrate ideas from various domains and implement them using block chain technology in different perspectives

Unit I	**[8Hrs]**
Blockchain Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	
Unit II	**[8Hrs]**
Basic Crypto primitives and Distributed Computing: Introduction, advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public Blockchain.	
Unit III	**[8Hrs]**
Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Side chain, Namecoin	
Unit IV	**[8Hrs]**
Privacy, Security Issues in Blockchain: Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these attacks.	
Unit V	**[8Hrs]**
Block chain application development :Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda	

Text Books

S.N	Title	Authors	Edition	Publisher
1	"Block Chain: Blueprint for a New Economy"	Melanie Swan		O'Reilly
2	"Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming"	Josh Thompsons		
3	"Block Chain Basics"	Daniel Drescher	1st Edition	Apress

Reference Books

S.N	Title	Authors	Edition	Publisher
1	"Block Chain and Crypto Currencies"	Anshul Kaushik		Khanna Publishing House, Delhi
2	Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained	Imran Bashir		Packt Publishing
3	"Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain"	Ritesh Modi		Packt Publishing
4	Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer	Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman		Import

FIRST SEMESTER

		October 2022	1	Applicable for 2022-23
Chairman - BoS	Dean – Academics	Date of Release	Version	

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE106T(iii)	Open Elective :-Business Intelligence	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To enhance the ability of a student for examining Business Intelligence (BI) as a broad category of applications and technologies for gathering, storing, analyzing, sharing and providing access to data to help enterprise users make better managerial decisions.	**students will be able to** ● Explain the fundamentals of business intelligence Link data mining with business intelligence. ● Articulate modern BI concepts and practices, including knowledge integration, sourcing and managing BI solutions. ● Realize the crucial role that Business Intelligence plays in careers as well as in business and society in the 21st century

Unit I **[7Hrs]**

Introduction : Data Definitions and Analysis Techniques:Elements, Variables, and Data categorization,Levels of Measurement,Data management and indexing,Introduction to statistical learning and R-Programming

Descriptive Statistics : Measures of central tendency,Measures of location of dispersion, Practice and analysis with R

Unit II **[8Hrs]**

Basic Analysis Techniques: Statistical hypothesis generation and testing,Chi-Square test,t-Test,Analysis of variance,Correlation analysis,Maximum likelihood test

Data analysis techniques: Regression analysis,Classification techniques,Clustering,Association rules analysis

Unit III **[8Hrs]**

Case studies and projects: Understanding business scenarios,Feature engineering and visualization,Scalable and parallel computing with Hadoop and Map-Reduce,Sensitivity Analysis

Business Intelligence Essentials: Introduction & Overview of BI ,Types of Business Intelligence, Business Intelligence Platform, Dynamic roles in Business Intelligence, Roles of Business Intelligence in Modern Business- Challenges of BI, Creating Business Intelligence Environment, Business Intelligence Landscape

Unit IV **[6Hrs]**

Decision Making and Decision Support Systems : A BI perspective, Foundation and Technologies for decision Making,Information gathering ,Managing BI,BI User Segmentation,Gathering BI Requirements, Introduction to Tableau

Unit V **[6Hrs]**

Modeling and Analysis,Knowledge Management and Collaborative Systems,Strategic Approach to BI Social media, big data and data mining,Business Analytics: Emerging Trends and Future Impacts

Text Books

S.N	Title	Authors	Edition	Publisher
1	Business Intelligence: The Savvy Manager's Guide	David Loshin,Newnes		
2	Business Intelligence: Practices, Technologies, and Management	Rajiv Sabherwal, Irma Becerra-Fernandez		John Wiley & Sons.

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Business Intelligence: Making Decisions Through Data Analytics	Jerzy Surma		Business Expert Press

SECOND SEMESTER

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE201T	WIRELESS & MOBILE AD HOC NETWORK	4			4	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To explore the advance and recent development in mobile ad hoc networks. ● To guide to the fundamental concepts, design issues, and solutions to the issues, architectures & protocols and the state-of-the-art research developments in ad hoc wireless networking.	**Students will be able to** ● Compare the differences between cellular and ad hoc networks and the analyze the challenges at various layers and applications ● Summarize the protocols used at the MAC layer and scheduling mechanisms ● Understand the Mobile Ad hoc Network in view with 4G technologies.

Unit I **[8Hrs]**

Fundamental of Wireless Communication Technologies

Electromagnetic spectrum, radio propagation mechanisms, characteristics of wireless channel, modulation and multiple access techniques, voice coding, error coding, IEEE 802.11 standard.

Unit II **[8Hrs]**

Fundamentals of WLAN, WAN, MAN

Network architecture, CSMA/CA mechanism, HIPERLAN1, HIPERLAN2, Bluetooth, The Cellular concept,cellular architecture, Wireless in Local Loop, Wireless ATM, HIPERACCESS,MobileIP, TCP in Wireless domain, WAP.

Unit III **[8Hrs]**

Fundamentals of Adhoc Wireless Networks and in depth MAC protocol

Issues in Adhoc Network, Application of Ad hoc Networks, issues in designing MAC protocol for Ad hoc Network, Classification of AMAC protocols, Contention based protocols, contention based protocols with reservation mechanisms, Contention based MAC protocols with scheduling mechanisms, MAC protocols using Directional Antenna

Unit IV **[8Hrs]**

Mobile Ad Hoc Networking with a View of 4G Wireless: Imperatives and Challenges, IEEE 802.11 in Ad Hoc Networks: Protocols, Performance and Open Issues, Scatternet Formation in Bluetooth Networks, Topology Control in Wireless Ad Hoc Networks, Broadcasting and Activity Scheduling in Ad Hoc Networks

Unit V **[8Hrs]**

Mobile Ad Hoc Networks (MANET): Routing Technology for Dynamic, Wireless Networking, Routing Approaches in Mobile Ad Hoc Networks, Energy-Efficient Communication in Ad Hoc Wireless Networks, Ad Hoc Networks Security, Simulation and Modeling of Wireless, Mobile, and Ad Hoc Networks, Modeling Cross-Layering Interaction Using Inverse Optimization, Algorithmic Challenges in Ad Hoc Networks

Text Books

S.N	Title	Authors	Edition	Publisher
1	Ad hoc Wireless Network Architectural and Protocol	C.Siva Ram Murthy and B.S. Manoj	3rd Edition	Prentice Hall
2	Mobile Adhoc Networking	Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic		

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Mobile Ad Hoc Networking : The Cutting Edge Directions	Stefano Basagni	2nd Edition	Wiley Publication
2	Guide to the Wireless Adhoc Networks	Sudip Misra, Issac Woungang, Subhash Chandra Misra		Spinger

SECOND SEMESTER

		October 2022	1	Applicable for 2022-23
Chairman - BoS	Dean – Academics	Date of Release	Version	

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE202T	Design of Distributed Systems	4			4	30	70	100

Course Objectives	Course Outcomes
The student should be made to: ● Know the evolution of Distributed Computing Systems(DCS) from hardware and software infrastructure point of view. ● Understand design goals,transparencies, fundamental issues in cloud systems such as parallel processing in the cloud, distributed storage systems, virtualization, cloud security etc. ● Introduce the idea of peer to peer services and file system. ● Understand the issues involved in studying process and resource management in distributed environments.	**Students will be able to:** ● Design and understand software architecture for large scale software systems. ● Discuss trends in Distributed Systems. ● Analyze the performance, scalability, and availability of the underlying cloud technologies as well as identify the security and privacy issues in cloud computing. ● Examine the design of task and data parallel distributed algorithms for Clouds and use them to construct Cloud applications.

Unit I **[8Hrs]**

Overview of distributed computing, Cloud introduction and overview, Different types of cloud services, cloud deployment models, Advantages and Disadvantages of Cloud Computing, and Companies in the Cloud today; infrastructure as a Service (IaaS): Introduction to Infrastructure as a Service (IaaS), CPU Virtualization – Hypervisors, Storage Virtualization - SAN, ISCSI, Network Virtualization – VLAN; Cloud design issues and challanges.

Unit II **[8Hrs]**

Platform/ Software as a Service (PaaS/ SaaS): From IaaS to PaaS, What is PaaS, PaaS properties and characteristics, PaaS Techniques: File System - GFS, HDFS, Programming Model -MapReduce, Storage System for Structured Data - BigTable, Hbase, SaaS: Virtualization, clustering and resource management, HPC in cloud computing, Security in Cloud computing environments: Cloud Computing threats, Security for Cloud Computing;

Unit III **[8Hrs]**

Distributed Algorithms: models and complexity measures, safety, liveness, termination, logical time and event ordering, global state and snapshot algorithms, distributed mutual exclusion, clock synchronization, leader election, Message ordering and group communication, termination detection, distributed deadlock detection, routing, authentication & self stabilization, Challanges in designing distributed graph algorithms; Applications of Distributed algorithms.

Unit IV **[8Hrs]**

Parallel and Distributed Databases: Distributed Data Storage, Fragmentation & Replication, Location and Fragment Transparency, Distributed Query Processing and Optimization, Distributed Transaction Modeling and Concurrency Control, Distributed Deadlock, Commit Protocols, Checkpointing and Rollback recovery, Design of Parallel Databases, Parallel Query Evaluation; Advanced Transaction Processing: Nested and Multilevel Transactions, Distributed objects, directory services, web services.

Unit V **[8Hrs]**

Distributed File Systems: File Models, File-Accessing Models, File-Sharing Semantics, File-Caching Schemes, File Replication; Security: Potential Attacks to Computer Systems, Cryptography, Authentication, Access Control, Digital Signatures. Simple Distributed Security Infrastructure (SDSI); Access Control Mechanisms including Role based access control; Issues of revocation, Anonymity and Privacy issues; Smartcard integration with PKIs, Trust Management Systems; Risks; Impact on E-Commerce and E-Business.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Distributed Computing: Principles, Algorithms, and Systems	Ajay Kshemkalyani and Mukesh Singhal		
2	Cloud Computing: Principles and Paradigms	Rajkumar Buyya and James Broberg		Wiley publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to Distributed and Parallel Computing	Crichlow		PHI.
2	Designing Efficient Algorithms for Parallel Computers	M.J.Quinn		McGraw-Hill
3	Principles of Distributed Database Systems	Özsu, M. Tamer, Valduriez, Patrick		

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE203T	Advances in Algorithms	4			4	30	70	100

Course Objectives	Course Outcomes
The aim of this course is ● To develop sophisticated computer application programs based on the various programming paradigms such as divide-and-conquer, greedy, backtracking, and dynamic programming. ● To learn new techniques for designing more efficient solutions to known complex problems and for analyzing space and time requirements of the algorithms.	**Students will be able to,** ● use different algorithmic techniques such as brute force, greedy, divide and conquer etc. To solve real world problems. ● develop applications using advanced data structures in solving real world problems. ● classify problems into different complexity classes. ● analyse randomized algorithms, approximation algorithms (expected running time, probability of error).

Unit I **[8Hrs]**
Review of order rotation & growth of functions, recurrences, probability distributions, Average case analysis of algorithms, Advanced Structures: Binary search trees, B + -trees, AVL trees, Red black trees, splay trees, randomly built binary search trees, Heaps, Binomial heaps, Fibonacci heaps, Strongly connected components, Bi-connected components.

Unit II **[8Hrs]**
Algorithm design techniques: divide-and-conquer, dynamic programming, greedy algorithms, amortized analysis, randomization. Algorithms for fundamental graph problems: minimum-cost spanning tree, connected components, topological sort, and shortest paths. Introduction to network flows and graph matchings.

Unit III **[8Hrs]**
Network Flow: Flow networks, The Ford- Fulkerson method, Maximum bipartite matching.String Matching: Naive string-matching algorithm, Rabin - Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm.

Unit IV **[8Hrs]**
Approximation algorithms: NP completeness, Reductions, coping with NP completeness, Approximation algorithms: The vertex cover problem, The travelling salesman problem, The set covering problem, The Subset-sum problem. Graph colouring problem.

Unit V **[8Hrs]**
Randomized algorithms: Las Vegas and Monte Carlo algorithm, Random variables and their expectations. probabilistic analysis and uses of indicator random variables: Birthday paradox, coupon collector's problem, The online hiring problem.Randomized version of quick sort, Miller Rabin randomized primality Test.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Data Structures and Algorithms	Alfred V Aho, Jeffrey D Ullman, John E Hopcroft		Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to Algorithms	T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford stein	2nd Edition	Prentice Hall India
2	Data Structures, algorithms & applications In C++	Sartaj Sahni		university press

SECOND SEMESTER

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE203P	Advanced Algorithms Lab			2	2	25	25	50

Course Objectives	Course Outcomes
The aim of this course is ● To design and implement various algorithms in Java using various programming paradigms for problem solving. Measure and compare the performance of different algorithms in terms of worst case and average case time complexity.	**Students will be able to** ● Ability to write programs in Java to solve problems using algorithm design techniques such as Divide and Conquer, Greedy, Dynamic programming, and Backtracking.

Expt. No.	Title of the experiment
1	Consider all strings of length n and with symbols coming from the set {a,b,c}. We are interested in only those of these strings, which contain the pattern (substring) abc once and only once. Let T(n) denote the count of these strings. Your task is to compute T(n), given n as input.
2	Design and implement a divide and conquer algorithm for Maximum sub array sum problem. Also find it's time complexity.
3	Design and implement a divide and conquer algorithm running in O(log 2 n) time for finding closest pair of points among a collection of n points.
4	Given a sequence of n numbers a_1 , . . . , a_n , design an algorithm to determine a contiguous subsequence a_i , . . . , a_j for which the sum of elements in the subsequence is maximized.
5	Write a java program to implement greedy algorithm for job sequencing with deadlines.
6	Write a java program to implement Dynamic Programming algorithm for the Optimal Binary Search Tree Problem.
7	Design and develop a Dynamic Programming algorithm to determine a minimum vertex cover of a tree. Also do its run-time analysis.
8	Write a program to implement backtracking algorithm for the N-queens problem.
9	WAP and analyze it for finding the total number of possible minimum cost spanning trees in a given undirected graph.
10	Design and develop a solution for graph coloring problem. Analyze it's time complexity.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Data Structures and Algorithms	Alfred V Aho, Jeffrey D Ullman, John E Hopcroft		Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Introduction to Algorithms	T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford stein	2nd Edition	Prentice Hall India
2	Data Structures, algorithms & applications In C++	Sartaj Sahni		university press

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE204T	Foundation Course – Research Methodology	3			3	30	70	100

Course Objectives	Course Outcomes
● This course will enable scholars to identify and apply appropriate research methodology in order to plan, conduct and evaluate basic research. ● The course will furthermore enable scholars to distinguish between the scientific method and common sense knowledge while laying the foundation for research skills at higher levels	● Demonstrate knowledge of research processes (reading, evaluating, and developing); ● Develop basic framework of research process ● Develop various research designs and techniques. ● Identify various sources of information for literature review and data collection. ● Prepare Technical Research report

Unit I **[8Hrs]**

Introduction to Research Methodology : Objective of Research , motivation, Types of research, research approaches, significance of research, research methods versus methodology, research and scientific methods, defining the research problem, selecting the research problem, Necessity of defining problem, Techniques involved in defining the problem, Problem validation, writing objectives

Unit II **[8Hrs]**

Research Design : Need for research design, concepts & different research design, explanatory, descriptive diagnostic research, basic principles of experimental design, and design of experiment

Unit III **[8Hrs]**

Sampling Data collection : Sampling design steps and types of sampling design scaling of data, types of data ,method and techniques of data collection, primary and secondary data used in data collection.

Unit IV **[8Hrs]**

Data Analysis and interpretation: Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of result

Unit V **[8Hrs]**

Technical Writing and reporting of research: Types of research report, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals,Intellectual property, Plagiarism

Text Books

S.N	Title	Authors	Edition	Publisher
1	Research Methodology: Methods and Techniques	C.R. Kothari	Second Revised Edition	New Age International Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Research Methodology	R. Panneerselvam		PHI
2	Research Methodology: a step –by step guide for beginners	Ranjit Kumar		SAGE Publication Ltd
3	Research Methodology; Integration of Principles, methods and Techniques			Person Education, New Delhi

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
CSE205T(i)	Elective II - Big Data Analytics & Knowledge Mining	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To cover fundamental algorithms and techniques used in Data Analytics ● To provide realization of Technological aspects like data management (Hadoop), scalable computation (MapReduce) and visualization ● To develop skillset through implementation of hands-on projects.	**Students will be able to** ● Find a meaningful pattern in data and interpret data Graphically ● Implement the analytic algorithms and Handle large scale analytics projects from various domains ● Understand the basics of Multimedia semantics

Unit I **[7Hrs]**

Introduction : Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, AnalysingData with Hadoop, Hadoop Streaming, Hadoop Echo System,

HDFS(Hadoop Distributed File System) : The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures

Unit II **[8Hrs]**

Map Reduce : Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features

Hadoop Eco System : Pig :Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.Hive :Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions

Unit III **[8Hrs]**

Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering.Big Data Analytics with BigR

Unit IV **[6Hrs]**

Overview of Big-Data Analytics and Knowledge Mining from Heterogeneous Datasets,Ontologies, Operations on Ontologies,Knowledge Mining as a new paradigm for Big-Data Analytics

Unit V **[6Hrs]**

Knowledge Graph Construction, Reasoning, and Querying,,Knowledge Representation,Knowledge Graph Refinement ,Big Multimedia-Data (Search Engines, Multimedia Information Retrieval, Hazard Applications, etc.) and Challenges (Security, Performance, Privacy, etc.)

Text Books

S.N	Title	Authors	Edition	Publisher
1	Hadoop: The Definitive Guide	Tom White	3rd Edition	O'reily Media
2	Big Data Analytics,Subhasini Chellappan	Seema Acharya		Wiley 2015

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Big Data Analytics with R	Simon Walkowiak		Packt Publishing Ltd
2	Multimedia Computing	Gerald Friedland, Ramesh Jain		

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
CSE205T(ii)	CRYPTOGRAPHY AND NETWORK SECURITY	3			3	CA	ESE	Total
						30	70	100

Course Objectives	Course Outcomes
This course is intended ● Introduce range of cartographic algorithms, schemes and protocols. ● Provide principles and guidelines for the design, analysis and implementation of cartographic systems and protocols with a focus on standards.	**Students will be able to** ● Understand the classification of computer security techniques. ● Identify the security weaknesses in different networking environment. ● Implement appropriate cryptography scheme & security mechanism for different computing environment and information system.

Unit I **[8Hrs]**

Number theory & Cryptography : **concepts & Techniques Number Theory:** Introduction, Congruence's and Residue Classes, Euler's Phi Function, The Theorems of Fermat, Euler and Lagrange, Quadratic Residues, Square Roots Modulo Integer, Blum Integers, Cryptography: The shift cipher, The Substitution Cipher, The Affine Cipher, Crypt analysis of the Affine Cipher, Crypt analysis of the substitution cipher

Unit II **[8Hrs]**

Block Cipher and the Advanced Encryption Standard-Substitution : Permutation Networks, Linear Cryptanalysis, Differential Cryptanalysis, The Data Encryption Standard, The Advanced Encryption Standard, Simplified AES, Modes of Operation ,Cryptography Hash Function- Hash Function and Data Integrity, Security of Hash Function ,Iterated Hash Functions, Message Authentication Codes.

Unit III **[8Hrs]**

RSA and factoring system : Introduction to number theory, Fermat's and Euler's theorem's, Public Key cryptography and RSA, ELGamal Cryptosystem, Shanks' Algorithm, Finite Fields, Elliptic Curves over the Reals, Elliptical Curves Modulo a Prime, Signature Scheme -Digital Signature Algorithm.

Unit IV **[8Hrs]**

Authentication Protocols — Principles : Introduction, Authentication and Refined Notions, Convention, Basic Authentication Techniques Password-based Authentication ,Authenticated Key Exchange Based on Asymmetric Cryptography, Typical Attacks on Authentication Protocols, The Secure Shell (SSH), Kerberos Protocol

Unit V **[8Hrs]**

Secret Sharing Schemes : The Shamir Threshold Scheme, Access Structure and General Secret key sharing, Information Rate and Construction of Efficient Schemes, Multicast Security and Copyright production Multicast Security, Broadcast Encryption, Multicast Re-keying, Copyright Protection, Tracing Illegally Redistribution keys.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Cryptography Theory and Practice	Douglas R. Stinson	3rd Edition	Chapman & Hall/CRC
2	Handbollk of Applied Cryptography	Menzes A. J., Oorschot P, Vanstone S		ACRC Press
3	Cryptography and Network Security: Principles and Practices	William Stallings	3rd Edition	Pearson Education
4	Modern Cryptography-Theory and Practice	Wenbo Mao	1st Edition	Pearson Education

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Security in Computing	Charles B. Pfleeger, Shari Lawrence Pfleeger	4th Edition	Pearson Education
2	Cryptography and network security	Behrouz A. Forouzan, DebdeepMukhopadhyay	2nd Edition	
3	Introduction to Cryptography with Coding Theory	Wade Trappe and Lawrence C. Washington	2nd Edition	Pearson Education

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SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
CSE205T(iii)	Elective II - CLOUD COMPUTING & VIRTUALIZATION	3			4	CA	ESE	Total
						30	70	100

Course Objectives	Course Outcomes
This course is intended ● To provide students the skills and knowledge to understand how Cloud Computing can enable transformation, business development and agility in an organization ● To present a top-down view of cloud computing, from applications and administration to programming and infrastructure.	**Students will be able to** ● Understand of Cloud Computing and Related Technologies ● Analyze the performance, scalability, and availability of the underlying cloud technologies and software. ● Identify security and privacy issues in cloud computing. ● Use IaaS,PaaS SaaS and BPaaS solutions to build comprehensive end-to-end business solutions on the Cloud.

Unit I **[7Hrs]**

Introduction : Recent trends in Computing : Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing

Cloud Computing : ,Cloud Computing Architecture, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services, Deployment Model :(Public Cloud, Private cloud, Hybrid cloud, Community cloud), Service Model: (IAAS, SAAS, PAAS.)

Unit II **[6Hrs]**

Infrastructure as a Service (IaaS) : IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM),· Resource Virtualization (Server,Storage ,Network), Distributed resource management, distributed resource monitoring, and distributed scheduling in clouds, Virtual Machine(resource) provisioning and manageability, Data storage in cloud computing(storage as a service), Examples :Amazon EC2,Eucalyptus

Unit III **[8Hrs]**

Platform as a Service(PaaS): What is PaaS, Service Oriented Architecture (SOA),Cloud Platform and Management(Computation Storage) Cloud platform services (monitoring and management, application servers, messaging, data management, development and testing, integration, business intelligence, etc. Example: Google App Engine, Microsoft Azure , SalesForce.

Software as a Service(PaaS) : Web services, Web 2.0, Web OS,

Unit IV **[6Hrs]**

Service Management in Cloud Computing : Service Level Agreement, Billing & Accounting , Comparing Scaling Hardware: Traditional vs. Cloud , Economics of scaling: Benefitting enormously

Managing Data : Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud Large Scale Data Processing

Unit V **[9Hrs]**

Cloud Security : I nfrastructure Security,Network level security, Host level security, Application level security,Data security and Storage,Data privacy and security Issues, Jurisdictional issues raised by Data location,Identity & Access Management,Access Control,Trust, Reputation, Risk Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations **Case Study on Open Source & Commercial Clouds** : Eucalyptus, Microsoft Azure, Amazon EC2

Text Books

S.N	Title	Authors	Edition	Publisher
1	Cloud Computing Bible	Barrie Sosinsky		Wiley-India
2	Cloud Computing: Principles and Paradigms, Editors	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski		Wiley

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Cloud Computing: Principles, Systems and Applications	Nikos Antonopoulos, Lee Gillam		Springer
2	Cloud Security: A Comprehensive Guide to Secure Cloud Computing	Ronald L. Krutz, Russell Dean Vines		Wiley-India