DAYANANDA SAGAR UNIVERSITY

Main Campus, Devarakaggalahalli, Harohalli,
Kanakapura Road, Ramanagara District, 562112

SCHOOL OF ENGINEERING

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS FOR
MASTER OF TECHNOLOGY
(M. Tech) – 2023-2024

COMPUTER SCIENCE & ENGINEERING

(With Effect from 2023-24)

I SEMESTER													
#	Program Code	Course Code	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	202	23CSE5101	Mathematics For Computer Science	CSE	3	2	-	-	3	60	40	100	5
2		23CSE5102	Advances in Algorithm	CSE	3	-	4	-	3	60	40	100	5
3		23CSE5103	Advances in Data Base Management System	CSE	3	-	4	-	3	60	40	100	5
4		23CSE51XX	Professional Elective – I	CSE	3	-	2	-	3	60	40	100	4
5		23CSE51XX	Professional Elective – II	CSE	3	-	2	-	3	60	40	100	4
6		23CSE5104	Soft Skills and Personality Development	CSE	1	-	-	-	2	60	-	60	1
			Total		**16**	**2**	**12**	**-**	**17**	**360**	**200**	**560**	**24**

II SEMESTER													
#	Program Code	Course Code	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	202	23CSE5201	Artificial Intelligence	CSE	3	-	4	-	3	60	40	100	5
2		23CSE5202	Agile Project Management & DevOps	CSE	3	1	2	-	3	60	40	100	5
3		23CSE5203	Advances in Operating Systems	CSE	3	-	4	-	3	60	40	100	5
4		23CSE52XX	Professional Elective – III	CSE	3	-	2	-	3	60	40	100	4
5		23CSE52XX	Professional Elective – IV	CSE	3	-	2	-	3	60	40	100	4
6		23CSE5204	Research Methodology	CSE	1	-	-	-	2	60	-	60	1
			Total		**16**	**1**	**14**	**-**	**17**	**360**	**200**	**560**	**24**

III SEMESTER													
#	Program Code	Course Code	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	202	23CSE63XX	Professional Elective – V	CSE	3	-	2	-	3	60	40	100	4
2		23CSE6301	Internship	-	-	-	-	24	3	100	-	100	12
			Total		**3**	**-**	**2**	**24**	**6**	**160**	**40**	**100**	**16**

IV SEMESTER													
#	Program Code	Course Code	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	202	23CSE64XX	Professional Elective – VI	CSE	3	-	2	-	3	60	40	100	4
2		23CSE6401	Dissertation / Research Project	-	-	-	-	24	3	60	40	100	12
			Total		**3**	**-**	**2**	**24**	**6**	**120**	**80**	**200**	**16**

S. N	Domain Clusters	PROFESSIONAL ELECTIVE COURSES											
		PEC-I		PEC-II		PEC-III		PEC-IV		PEC-V		PEC-VI	
		Semester 1				Semester 2				Semester 3		Semester 4	
		Course Code	Course Name	Course Code	Course Name	Course Code	Course Name	Course Code	Course Name	Course Code	Course Name	Course Code	Course Name
1	Core CSE	23CSE5105	Data Structures	23CSE5106	Computer Networks	23CSE5205	Digital Image Processing and Forensics Science	23CSE5206	Social Network Analysis	23CSE6302	Machine Learning	23CSE6402	Deep Learning
										23CSE6303	MOOC	23CSE6403	MOOC
2	Computational & Data Science	23CSE5107	Data Science	23CSE5108	Data Warehouse & Data Mining	23CSE5207	Big Data Analytics	23CSE5208	Business intelligence	23CSE6304	Natural Language Processing	23CSE6404	Text and Speech Analytics
										23CSE6305	MOOC	23CSE6405	MOOC
3	Cloud Computing	23CSE5109	Cloud Computing & Virtualization	23CSE5110	Web Technology and Cloud Application Development	23CSE5209	Cloud Infrastructure Management	23CSE5210	Distributed Systems	23CSE6306	Wireless Network Security	23CSE6406	AWS Cloud Essentials
										23CSE6307	MOOC	23CSE6407	MOOC
4	Networks and Cyber Security	23CSE5111	Cryptography	23CSE5112	Steganography and Digital Watermarking	23CSE5211	Cyber Security and Privacy	23CSE5212	Blockchain Technologies	23CSE6308	Wireless Networks & 5G	23CSE6408	Intrusion Detection Systems and Firewall
										23CSE6309	MOOC	23CSE6409	MOOC

MATHEMATICS FOR COMPUTER SCIENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5101	**Credits**	:	05
Hours / Week	:	4 Hours	**Total Hours**	:	52 Hours
L–T–P–J	:	3–2–0–0			

Course Learning Objectives:

This course will enable students to:

1. Apply knowledge of Mathematical foundations needed for Machine Learning/ IoT/ Artificial Intelligence/Cloud Computing/ Quantum computing
2. Mathematically analyze different techniques in Machine Learning/ IoT/ Artificial Intelligence/Cloud Computing domain

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Calculus and Optimization methods in ML	**09 Hours**

Calculus: Concept of a derivative, partial differentiation and Gradients

Machine Learning Problem, Linear Regression and optimization Algorithm, Generalization, Logistic Regression, Neural Network (Multilayer Perceptron): Model Selection, Underfitting, and Overfitting, Weight Decay, Forward Propagation, Backward Propagation, and Computational

Graphs, Numerical Stability and Initialization and Revision of Variables, coefficients, and functions: logarithmic and exponential functions such as Sigmoid, trigonometric such as tanh, SoftMax.

Optimization Algorithm: Optimization and Deep Learning, Gradient Descent, Stochastic Gradient Descent

UNIT – II: Linear Algebra	**09 Hours**

Scalars, Vectors, Matrices and Tensors, Multiplying Matrices and Vectors, Identity and Inverse Matrices, Solving Systems of Linear Equations, Vector spaces, Linear Independence Rank, Norms, Matrix Decomposition: Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Dimensionality Reduction***.***

UNIT – III: Probability and Information Theory	**06 Hours**

Random Variables, Probability, Distributions, Marginal Probability, Conditional Probability, The Chain Rule of Conditional Probabilities, Independence and Conditional Independence, Expectation, Variance and Covariance, Common Probability Distributions, Naïve Bayes', Bias and Variance tradeoff, Maximum Likelihood Estimation, Information Theory, Entropy, Mutual Information, Cross Entropy, Decision Trees

UNIT – IV: Graphs and Graph Databases	**07 Hours**

Graphs: Graph Models, Graph Terminology and Special types of Graphs, Representing Graphs and connectivity, Euler and Hamilton Paths, Shortest Path Problems

Graph Databases: High-level view of Graph Space: Graph Database, Data Modeling with Graphs: The Labeled Property Graph Model, Cross-Domain Models, Predictive Analysis with Graph Theory: Depth- and Breadth-First Search, Path-Finding with Dijkstra's Algorithm, Graph Theory and Predictive Modeling.

UNIT – V: Trends in Emerging Technologies	**08 Hours**

Mathematical analysis of latest research papers in machine Learning/Artificial Intelligence/IoT/Cloud Computing/ Graph Databases/ Quantum computing.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	**Apply** calculus and optimization algorithms to regression algorithms in Machine learning that includes linear regression, logistic regression, and neural network.	L3
2	**Solve** the problems related to dimensionality reduction and matrix decomposition in Machine learning using eigen decomposition in Linear algebra.	L2 & L3
3	**Utilize** conditional probability and Naïve Bayes in probabilistic modeling in machine learning and information theory to predict using decision tress.	L3
4	**Apply** graph theory and the concept of graph databases to do predictive analysis to graph-based problems including Depth- and Breadth-First Search, and Pathfinding.	L2 & L3
5	**Analyze and present** the application of various domains of mathematics in recent research developments.	L3 &L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1				2	1
CO2	3	2	2						1				2	1
CO3	3	2	2	1					1				2	1
CO4	3	2	2	1					1				2	1
CO5		2	2	2					1	2		1	2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, Dive into Deep Learning, Amazon Science, 2020
2. Mathematics for Machine Learning. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong., Cambridge University Press, 2020
3. Ian Robinson, Jim Webber, Emil Eifrem, Graph Databases, 2nd Edition, O'Reilly Media 2015

REFERENCE BOOKS:

1. Foundations of Machine Learning, Second Edition, Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, MIT Press, 2018.
2. KENNETH H. ROSEN, DR. KAMALA KRITHIVASAN, Discrete Mathematics and Its Applications, 8th Edition, Mac Graw Hill

E-Resources:

1. https://archive.nptel.ac.in/courses/111/107/111107137/
2. https://archive.nptel.ac.in/courses/111/105/111105090/
3. https://archive.nptel.ac.in/courses/106/106/106106139/

****

ADVANCES IN ALGORITHM

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	:	23CSE5102	**Credits**	:	05
Hours /Week	:	03 Hours	**Total Hours**	:	39(T) + 52 Hours(P)
L–T–P	:	3–0–4-0			

Course Learning Objectives:

This Course will enable students to:

1. **Analyze** the non-recursive and recursive algorithms and to represent efficiency of these algorithms in terms of the standard Asymptotic notations.
2. **Devise** the Brute Force and Divide and Conquer techniques to design the algorithms and apply these methods in designing algorithms to solve a given problem.
3. **Explain** the Decrease and Conquer, Transform and Conquer algorithm design techniques, and Time versus Space Trade-offs.
4. **Get the idea** of Greedy method and dynamic programming methods and apply these methods in designing algorithms to solve a given problem.
5. **Describe** and illustrate the idea of Backtracking and Branch and Bound algorithm design techniques to solve a given problem.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:

Fundamentals of Analysis Techniques:

Growth of Functions: Asymptotic notations, Standard notations and common functions.

Sorting: Review of various sorting algorithms, topological sorting.

Recurrences and Solution of Recurrence equations: The substitution method, The recurrence – tree method, The master method, **Amortized Analysis:** Aggregate, Accounting and Potential Methods.

UNIT – II	**08 Hours**

Graph Algorithms: Johnson's Algorithm for sparse graphs, Maxflow-mincut theorem, Flow networks and Ford-Fulkerson method, Maximum bipartite matching.

Polynomials and the FFT: Representation of polynomials; The DFT and FFT, Efficient implementation of FFT, Edmond's Blossom algorithm to compute augmenting path.

UNIT – III	**08 Hours**

String-Matching Algorithms: Naïve string Matching, Rabin - Karp algorithm, Knuth-Morris-Pratt algorithm, Boyer – Moore algorithms.

Representation of integers: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation, Powers of an element, RSA cryptosystem, Primality testing, Integer factorization.

UNIT – IV	**08 Hours**

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring, Fast Fourier Transform algorithm, Schönhage -Strassen Integer Multiplication algorithm.

UNIT – V	08 Hours
Linear Programming: Formulation of Problems as Linear Programs, Duality, Simplex, Interior Point, and Ellipsoid Algorithm, proof of NP-hardness and NP-completeness. **Probabilistic and Randomized Algorithms:** Probabilistic algorithms, Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms, Probabilistic numeric algorithms.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Explain** the algorithm design techniques and standard Asymptotic notations. Analyze non-recursive and recursive algorithms to obtain worst-case running times of algorithms using asymptotic analysis and derive and solve recurrences describing the performance of various sorting.	L2 & L3
2	**Interpret**. Graph data structures are particularly useful in fields such as social network analysis, recommendation systems, and computer networks. In the field of sports data science, graph data structures can be used for analysis and Polynomial algorithms are a class of algorithms that use polynomial expressions to solve problems. They are used in various fields such as machine learning, optimization, and cryptography	L2 & L3
3	**Describe** String matching algorithms It helps in performing time-efficient tasks in multiple domains. These algorithms are useful in the case of searching a string within another string and there are different ways to represent signed integers in binary form	L2 & L3
4	**Identify and explain** introduces important algorithms and techniques of scientific computing, focusing on the areas of linear algebra and matrix computations. The course presents both theoretical and practical aspects of the algorithms The FFT algorithm is an efficient algorithm for computing the DFT, and it is widely used in signal processing and other applications .	L2 & L3
5	**Describe** A linear programming algorithm finds a point in the polytope where this function has the smallest (or largest) value if such a point exists and Randomized algorithms, on the other hand, are algorithms that use a random number generator to make decisions during the execution of the algorithm.	L2

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		2	3							2		3
CO2	3	3	2	3	3							2		3
CO3	3	3		3	3							1		3
CO4	3	3	2	2	3							2		3
CO5	3	3			2							1		3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI, 2014.
2. Kenneth A. Berman. Algorithms. Cengage Learning. 2002

REFERENCE BOOKS:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms".
2. Aho, Hopcroft, Ullman "The Design and Analysis of Computer Algorithms".
3. Kleinberg and Tardos."Algorithm Design"

E-Resources:

1. https://nptel.ac.in/courses/106/101/106101060/
2. http://cse01-iiith.vlabs.ac.in/
3. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
4. Harvard University - YouTube
5. MIT OpenCourseWare - YouTube

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification, Cabbage puzzle, Konigsberg bridge puzzle etc.,
2. Demonstration of solution to a problem through programming.

ADVANCES IN ALGORITHMS LABORATORY

Following are experiments to be carried out using either java programming language or Object-oriented programming language:

1. Design, develop and run program in any language to implement the Bellman-Ford algorithm and determine its performance.
2. Design develop and run a program in any language to implement a Miller Rabin / Monte Carlo algorithm to test the primality of a given integer and determine its performance.
3. Design, develop and run program in any language to solve the string-matching problem using naïve approach and the KMP algorithm and compare their performances.
4. Compute the Transitive Closure for a given directed graph using Warshall's algorithm.
5. Determine Minimum Cost Spanning Tree for a given weighted graph using Prim's and Kruskal's algorithm.
6. Design, develop and write program to solve string matching problem using Robin Karp algorithm and determine its performance.

****

ADVANCES IN DATA BASE MANAGEMENT SYSTEM

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5103	**Credits**	:	05
Hours /Week	:	03 Hours	**Total Hours**	:	39(T)+52(P) Hours
L–T–P–J	:	3–0–4–0			

Course Learning Objectives:

This Course will enable students to:

1. Ability to design entity relationship and convert entity relationship diagrams into RDBMS and formulate SQL queries on the respect data.
2. Able to differentiate various database architecture.
3. Infer and represent the real-world data using object-oriented database.
4. Get familiarized about web and Mobile database.
5. Apply security concepts for the development of application software's

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. Raymond gladson daniel
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Database Design and tuning	**06 Hours**

Schema Refinement and Normal Forms: Introduction to schema refinement, functional dependencies, reasoning about FD's, Normal forms, properties of decompositions, normalization, schema refinement in database designs, other kinds of dependencies.

Physical Database Design and Tuning: *Introduction to physical database design, guidelines for index selection, basic examples of index selection, clustering and indexing, indexes that enables index- only plan, tools to assist in index selection, overview of database tuning, choices in tuning the conceptual schema, choices in tuning queries and views, Impact of concurrency.*

UNIT – II: PARALLEL AND DISTRIBUTED DATABASES	**09 Hours**

Parallel databases: introduction, architecture for parallel databases, parallel query evaluation, parallelizing individual operations, parallel query optimization.

Distributed DBMS-Concepts and Design: Introduction, overview of networking, functions and architecture of a DBMS, distributed relational database design, transparencies in a DDBMS, Dates twelve rules for a DBMS.

Distributed DBMS—Advanced Concepts: Distributed Transaction Management, Distributed Concurrency control, Distributed deadlock management, distributed database Recovery, the X/Open Distributed Transaction Processing Model, Distributed Query optimization, distribution in oracle.

UNIT – III: OBJECT-DATABASE Management SYSTEMS	**07 Hours**

Object-Oriented DBMS—Concepts and Design: Next-generation databased systems, introduction to OODBMSs, Persistence in OODBMSs, Issues in OODBMSs, Advantages and disadvantages of OODBMSs, comparison of ORDBMS and OODBMS, object-oriented database design and object-oriented analysis and design with UML.

Object-Oriented DBMS—Standards and Systems: Object Management Group, Object Data Standard ODMG 3.0,1999, Object Store.

UNIT – IV: Web and DBMS	**09 Hours**

Web Technology and DBMS: Introduction to the internet and the Web, the web, scripting languages, common gateway interface, HTTP Cookies, Extending the web server, Java, Microsoft web platform and oracle internet platform.

Semi structured Data and XML: Semi structure data, Introduction to XML, XML-Related technologies, XML schema, XML Query Languages, XML and databases and XML in oracle.	
UNIT – V: Mobile Databases and security	**08 Hours**
Introduction to Mobile Databases: Mobile DBMS, Issues with mobile DBMS. **Security and administration:** Database security, Countermeasures- computer based controls, security in Microsoft office access DBMS, security in Oracle DBMS, DBMSs and Web security, Database Administration.	

ADVANCES IN DATABASE MANAGEMENT SYSTEMS LABORATORY

1. SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables
2. Create database using XML attributes and Elements.
3. Write XML queries on given data.
4. Execute queries using type inheritance and table inheritance in SQL
5. Execute queries using object identity, abstract data type and reference types in SQL
6. Configure SQL server database security.
7. Database Application development

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Ability to design entity relationship and convert entity relationship diagrams into RDBMS and formulate SQL queries on the respect data.	L3
2	Able to differentiate various database architecture.	L2 & L3
3	Infer and represent the real-world data using object-oriented database.	L3
4	Get familiarized about web and Mobile database.	L2 & L3
5	Apply security concepts for the development of application software's	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	1					1					
CO4	3	2	2	1					1					
CO5	3	2	2	1					1					

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill, 3rd Edition, 2013.
2. Thomas M. Connolly, Carolyn E. Begg, "Database Systems - A Practical Approach to Design, Implementation, and Management", Sixth Edition ,Pearson Education, 2015.

REFERENCE BOOKS:

1. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2019

E-Resources:

1. https://link.springer.com/book/10.1007/978-3-7091-2704-9
2. https://youtu.be/MEePcZbocZI?si=lAS5jZrgb4-5j5bS
3. https://www.youtube.com/watch?v=nhKJ6kin3rc

****

SOFT SKILLS AND PERSONALITY DEVELOPMENT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5104	**Credits**	:	01
Hours / Week	:	03 Hours	**Total Hours**	:	13 Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Develop** Effective Communication Skills.
2. **Build** Strong Interpersonal Relationships.
3. **Adapt** to various technological communication platforms.
4. **Develop** a deep understanding of emotional intelligence (EQ) and its significance, as well as mastered key EQ competencies across the realms of self-perception, self-expression, and interpersonal relationships
5. **Acquire** a strong foundation in decision-making and stress management skills, including the ability to apply reality testing, problem-solving techniques, and impulse control in making sound decisions.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction	**03 Hours**
What are soft skills: Introduction, Top primary soft skills: Adaptability, critical thinking strategies, Interpersonal communication skills and diversity communication, Body language.	
UNIT – II: Soft Skills	**02 Hours**
Types Of Soft Skills: Self-Management Skills, Aiming for Excellence: Developing Potential and Self-Actualization, Habits: Guiding Principles, Conflict Resolution Skills	
UNIT – III: Communication skills	**02 Hours**
Communication skills, Significance of Listening, Technological Personality, Effective Communication, Presentation Skills, Reading Skills, Ethics and Etiquette	
UNIT – IV: Personality Development-1	**03 Hours**
The EQ Explosion: Exploring Emotional Intelligence, The Self-Perception Realm: Emotional Self-Awareness, Self-Regard, Self-Actualization, The Self-Expression Realm: Emotional Expression, Independence, Assertiveness, The Interpersonal Realm: Interpersonal Relationships, Empathy, Social Responsibility.	
UNIT – V: Personality Development-2	**03 Hours**
The Decision-Making Realm: Reality Testing, Problem Solving, Impulse Control, The Stress-Management Realm: Flexibility, Stress Tolerance, Optimism, General Well-Being: Happiness.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate** a comprehensive understanding of soft skills.	L2
2	**Develop** self-management abilities, pursue excellence by developing their potential and self-actualization.	L3
3	Build communication skills to become adept at active listening, adopting a technological personality suitable for various contexts	L3
4	Develop Deep understanding of emotional intelligence (EQ) and its importance, cultivated key self-perception skills	L3
5	Develop decision-making skills encompassing reality testing, problem solving, and impulse control.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								3		2		2		
CO2								3		2		2		
CO3								3		2		2		
CO4								3		2		2		
CO5								3		2		2		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013
2. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

REFERENCE BOOKS:

1. Peter S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
2. Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
3. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.

****

ARTIFICIAL INTELLIGENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5201	**Credits**	:	05
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hrs (T)+52 Hrs (P)
L–T–P–J	:	3–0–4–0			

Course Learning Objectives:

This Course will enable students to:

1. Gain a historical perspective of Artificial Intelligence (AI) and its foundations.
2. Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
3. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool.
5. Explore the current scope, potential, limitations, and implications of intelligent systems.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction to AI	**06 Hours**
Introduction to Artificial Intelligence: Foundation and history of Artificial Intelligence, Agents and Environments, Structure of intelligent agents, State-of-the-art applications of AI.	

UNIT – II: Problem solving	**08 Hours**
Solving problems by searching: problem solving agents, example problems, searching algorithms, uninformed and informed search strategies Search in complex environment – Local and optimization problems, local search in continuous spaces Constraint Satisfaction problem – Defining CSP, constraint propagation, backtracking search for CSP, local search for CSP **Adversarial search and games:** Game theory, optimal decisions in games, heuristic apha-beta tree search, monte carlo tree search.	

UNIT – III: Knowledge, reasoning and planning	**09 Hours**
Logical agents – knowledge-based agents, the Wumpus world, propositional Logic, agent based on propositional logic, First order logic Inference in First order logic, Knowledge representation, Automated planning	

UNIT – IV: Uncertain knowledge and reasoning	**09 Hours**
Quantifying uncertainty, Probabilistic reasoning, Probabilistic reasoning over time, Making simple decisions Making complex decisions, Multi agent decision making	

UNIT – V: AI Applications	**07 Hours**
AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception– Planning – Moving.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.	L2
2	Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing	L3 & L4
3	Attain the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning	L2
4	Solve problems with uncertain information using Bayesian approaches	L2 & L3
5	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	1					1					
CO4	3	2	2	1					1					
CO5	3	2	2	1					1					

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition,2022.

REFERENCE BOOKS:

1. Ivan Bratko, —Prolog: Programming for Artificial Intelligence, Fourth edition,AddisonWesleyEducational Publishers Inc, 2011.
2. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA

E-Resources:

1. Department of Computer Science, University of California, Berkeley, http://www.youtube.com/playlist?list=PLD52D2B739E4D1C5F
2. NPTEL: Artificial Intelligence, https://nptel.ac.in/courses/106105077/

ARTIFICIAL INTELLIGENCE LABORATORY

1. Create a SWI Prolog program to represent the family tree shown in below diagram.

The topmost, nodes are parents and bottom most nodes are children nodes. Nodes in the middle are

parent or child or both. All children have two arrows going to its parents. Create the least number of relations that enables to answer the following questions related to the following relations viz. Grandfather, Grandmother, Father, Mother, Son, Daughter, Uncle (Father or Mother's brother), Aunt (Father or Mother's sister), Husband, Wife, Brother, Sister, nephew (brother or sister's son), niece (brother and sister's daughter), cousin (male or female), grandson, granddaughter etc. Questions can be like 1) who is n's grandmother or what is the relation between a and b? Show your program works by answering at least 20 relation queries that cover all the relations mentioned above.

2. FACTORIAL, FIBONACCI SERIES AND PRIME NUMBER CHECKING Q1. Find whether a number N is prime or not Q2. Find factorial of a number N. Q3. Find Nth term of Fibonacci series. Q4. Translate the following text into Prolog Logic to answer the queries: Problem: A, B and C belong to the Himalayan club. Every member in the club is either a mountain climber or a skier or both. A likes whatever B dislikes and dislikes whatever B likes. A likes rain and snow. No mountain climber likes rain. Every skier likes snow. Query 1: Is there a member who is a mountain climber and not a skier? Query 2: Is there a member who is both a mountain climber and a skier? Query 3: Is there a member who likes both rain and snow?

3. Lists are important in Prolog. You will often need to pattern match against lists. Create a prolog file named Lab3_List_exercise.pl and create the following knowledge base. Write rules for:

```
isa_list/1          %argument is a list
member of/2         %an element is a member of a list
nonmember_of/2      %an element is not a member of a list
length_of_list/2    %length of list
bigger_than_one/1   %the list has more than one element
same_head/2         % two lists have the same head regardless of their length
prefix/2            %first list is the prefix of the second list
allfifferent/1      %using nonmember_of/2 check whether the elements of a list areall different
append_list/3       % append an element to a list to make a new list
insert_at/4         % insert an element to a specified position of a list to make a newlist
merge_lists/3       %merge two lists to make a new list
```

4. EIGHT QUEENS PROBLEM

Eight queens problem is a constraint satisfaction problem (CSP). The task is to place eight queens in the 64 available squares in such a way that no queen attacks each other. So the problem can be formulated with variables x1, x2, x3, x4, x5, x6, x7, x8 and y1, y2, y3, y4, y5, y6, y7, y8; where the xs represent the rows and ys the columns. Now a solution for this problem is to assign values for x and for y such that the constraint is satisfied. The problem can be formulated as: P={(x1,y1),(x2,y2),……..(x8,y8)} where (x1, y1) gives the position of the first queen and (x2, y2) of the second queen and so on. So, it can be clearly seen that the domains for xi and yi are Dx = {1,2,3,4,5,6,7,8} and Dy = {1,2,3,4,5,6,7,8} respectively. And the constraints are: i. No two queens should be in the same row, i.e yi≠yj for i=1 to 8; j=1 to 8; or i≠j ii. No two queens should be in the same column, i.e xi≠xj for i=1 to 8; j=1 to 8; or i≠j iii. There should not be two queens placed on the same diagonal line i.e (yi-yj) ≠ ±(xi-xj). Write the required predicates to solve the Eight Queens placement problem.

5. TOWER OF HANOI

The Tower of Hanoi puzzle was invented by the French mathematician Edouard Lucas in 1883. He was inspired by a legend that tells of a Hindu temple where the puzzle was presented to young priests. At the beginning of time, the priests were given three poles and a stack of 64 gold disks, each disk a little smaller than the one beneath it. Their assignment was to transfer all 64 disks from one of the three poles to another, with two important constraints. They could only move one disk at a time, and they could never place a larger disk on top of a smaller one. The priests worked very efficiently, day and night, moving one disk every second. When they finished their work, the legend said, the temple would crumble into dust and the world would vanish. Although the legend is interesting, you need not worry about the world ending any time soon. The number of moves required to correctly ove a tower of 64 disks is 2 64−1=18,446,744,073,709,551,615264−1=18,446,744,073,709,551,615,263. At a rate of one move per second, that is 584,942,417,355 years! Clearly there is more to this puzzle than

meets the eye. Figure 1 shows an example of a configuration of disks in the middle of a move from the first peg to the third. Notice that, as the rules specify, the disks on each peg are stacked so that smaller disks are always on top of the larger disks. If you have not tried to solve this puzzle before, you should try it now. You do not need fancy disks and poles–a pile of books or pieces of paper will work. Write a Prolog program that efficiently keep track of the disk movements and that helps in recursively solving the problem of Tower of Hanoi.

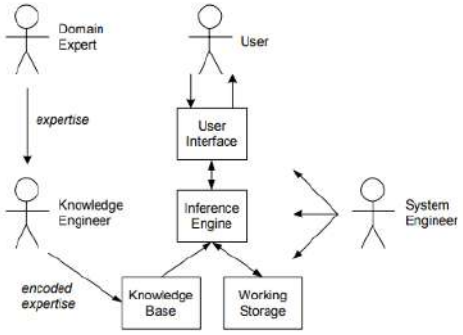
6. MEDICAL DIAGNOSIS EXPERT SYSTEM DESIGN

Expert systems are computer applications which embody some non-algorithmic expertise for solving certain types of problems. For example, expert systems are used in diagnostic applications servicing both people and machinery. They also play chess, make financial planning decisions, configure computers, monitor real time systems, underwrite insurance policies, and perform many other services which previously required human expertise. This Lab exercise is for Medical Diagnostic Expert system design which will hypothesis the name of the disease by learning the symptoms the patient have. The table below shows the expert knowledge about symptoms and name of the disease. A prolog program will represent this expert knowledge in terms of rules in its knowledge base.

Disease	**Symptoms**
Measles	Cough, sneezing, runny_ nose
German measles	Fever, headache, runny_ nose, rash
Common cold	Headache, sneezing, sore_ throat, runny nose, chills
Flu	Fever, headache, body_ ache, conjunctivitis, chills, sore throat.Runny nose, cough
Mumps	Fever, swollen glands
Chickenpox	Fever, chills, body ache rash

An expert system has several components as shown in the below figure. Other than the knowledge base other main components are user interface, working storage and the inference engine.

Prolog's inference engine is goal driven reasoning or backward chaining – an inference technique which uses IF THEN rules to repetitively break a goal into smaller sub-goals, which are easier to prove. For example, to hypothesis that a patient has a particular disease the patient should have all the symptoms of that disease as mentioned in the table. The expert system can be dramatically improved by providing a user interface which prompts for symptom information from the patient when needed. Write a ask/2 predicate which ask the patient about the symptoms he has to diagnose a disease. Store all these information gathered from the patient in the working storage one by one. Choose an appropriate data representation as attribute-value pair like symptom (Patient, german_measles) etc. As some symptoms are common in more than one disease the same question should not the asked twice to the patient to dignose a second disease. Use Prolog's in-built predicate assert/1 to put information in the working storage. Also, as your program will be run several times in the same session make sure to flush working storage before the next query. You can use prolog's in-built predicate retract/2 in the beginning of each query. Attach a screen shot about how the program runs with various patient input and predicted disease output.



****

AGILE PROJECT MANAGEMENT & DEVOPS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5202	**Credits**	:	05
Hours / Week	:	04 Hours	**Total Hours**	:	39 Hrs(T)+26Hrs(P)
L–T–P–J	:	3–1–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Compare and contrast** the differences between Agile and other Traditional project management methodologies.
2. **Interpret and apply** various Scrum principles, phases and activities of the Scrummethodology
3. **Develop** the Agile Scrum planning principles for real life situations and learn the basics of SAFe for scaled agile
4. **Understand** the Agile Testing principles for real life situations and learn the basics ofSAFe for scaled agile
5. **Identify and use** the various tools for Agile development and DevOps principles for CI/CD.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction	**07 Hours**

Introduction: Introduction to Software engineering, SDLC, Software process models: waterfall, V model, Iterative model, Spiral model etc.

Introduction to Agile: Agile development, The Agile Manifesto and principles, Agile Project management,

Specific Agile methodologies: Scrum, XP, Lean, and Kanban.

Agile Requirements: User Story and story mapping.

Scrum Introduction: What is scrum, Scrum Origins, Why Scrum?

UNIT – II: Scrum and Sprint	**9 Hours**

Scrum Process Frame Work: Overview, Scrum Roles, Scrum activities and Artifacts

Sprints: Overview, Time Boxed, Short Duration, consistent Duration, No Goal-Altering Changes, Definition of done.

Requirements and User Stories: Overview, what are user stories, 3cs, INVEST in good stories, Non-functional requirements, Knowledge Acquisition Stories, Story Mapping, Prioritizing Stories (WSJF technique from SAFe), How we do sprint planning, daily scrums, Multiple scrum teams

UNIT – III: Planning	**07 Hours**

Scrum Planning and Principles: Multilevel Planning, Portfolio Planning, Product Planning, Release Planning

UNIT – IV: Agile Testing	**08 Hours**

Introduction: What Is Agile Testing, What Do We Mean by “Agile Testing”? A Little Context for Roles and Activities on an Agile Team How Is Agile Testing Different? Traditional vs. Agile Testing, Ten Principles for Agile Testers, Applying Agile Principles and Values

Other Types of testing: Concurrency Testing, Internationalization and Localization, Regression Testing Challenges, User Acceptance Testing, A/B Testing, User Experience Testing, The Agile Testing Quadrants. Planning for Test Automation, Test automation pyramid.

UNIT – V: DevOps	**08 Hours**

Introduction to DevOps: DevOps application - business scenarios, Business drivers for DevOps adoption to big data, Planning the DevOps strategy, Benefits of DevOps. DevOps Framework

DevOps Process, DevOps Best Practices, DevOps – Continuous Integration and Delivery Best Practices for CI/CD, Jenkins, Git / Github Creating pipelines, Setting up runners Containers and container orchestration (Dockers and Kubernetes) for application development and deployment, DevOps Continuous Deployment, Chef, Configuration management - puppet, ansible, Continuous monitoring with Nagios; Introduction to DevOps on Cloud

AGILE PROJECT MANAGEMENT & DEVOPS Laboratory

1. Applying an Agile Mindset
2. Agile Estimation
3. Sprint Review, Retrospective and Execution
4. Scrum using Jira
5. Test Automation using Selenium
6. Test Automation using Appium
7. Unit Testing of Kafka Real-Time Streaming
8. CI/CD using Jenkins

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Compare and contrast** the differences between Agile and other Traditional project management methodologies.	L3
2	**Interpret and apply** various Scrum principles, phases and activities of the Scrummethodology	L2 & L3
3	**Develop** the Agile Scrum planning principles for real life situations and learn the basics of SAFe for scaled agile	L3
4	**Understand** the Agile Testing principles for real life situations and learn the basics ofSAFe for scaled agile	L2 & L3
5	**Identify and use** the various tools for Agile development and DevOps principles for CI/CD	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1										1	
CO2	3	2	2										1	
CO3	3	2	2	1									1	
CO4	3	2	1	1									1	
CO5	3	2	1	1									1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Kenneth S. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, 2012, published by Addison-Wesley Professional.
2. Craig Larman, Agile & iterative Development: A Manger's Guide, Pearson
3. DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive ...By Sricharan Vadapalli, Packt, 2018

REFERENCE BOOKS:

1. More Agile Testing: Learning Journeys for the Whole Team By Janet Gregory, Lisa Crispin,Addison Wesley, 2015
2. Software Engineering, A practitioner's Approach- Roger S. Pressman, 7th edition. McGraw Hill International Edition.
3. DevOps: Puppet, Docker, and Kubernetes By Thomas Uphill, John Arundel, Neependra Khare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, Packt, 2017
4. Agile Project Management: Creating Innovative Products, Second Edition By Jim Highsmith, Addison-Wesley Professional, 2009
5. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, By Andrew Stellman, Jennifer Greene, 2015, O Reilly.

****

ADVANCES IN OPERATING SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5203	**Credits**	:	05
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hrs(T)+56Hrs(P)
L–T–P–J	:	3–0–4–0			

Course Learning Objectives:

This Course will enable students to:

1. **To understand** the basic concepts and functions of operating systems.
2. **To understand** Processes and Threads
3. **To analyze** Scheduling algorithms.
4. **To understand** the concept of Deadlocks
5. **Examine** the challenges and complexities associated with distributed operating systems.
6. **Analyze** the Distributed Mutual Exclusive algorithms employed in multi-processor Operating Systems.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: OS Overview and System Structure	**09 Hours**

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Computing environments.

Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines;

UNIT – II: Process Management	**08 Hours**

Process Management: Process concept; Process scheduling; Operations on processes.

Multi-threaded Programming: Overview; Multithreading models; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms.

UNIT – III: Process Coordination	**08 Hours**

Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Sem problems of synchronization; Monitors

Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

UNIT – IV: Architectures of Distributed Systems	**07 Hours**

Architectures of Distributed Systems: System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.

Theoretical Foundations: Inherent Limitations of a Distributed System, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.

UNIT – V: Distributed Mutual Exclusion	**07 Hours**

Distributed Mutual Exclusion: Introduction, The Classification of Mutual Exclusion Algorithms,

Non-Token – Based Algorithms: Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm, **Token-Based Algorithms:** Suzuki-Kasami's Broadcast Algorithm, Singhal's Heurisric Algorithm, Raymond's Heuristic Algorithm.

ADVANCES IN OPERATING SYSTEMS LABORATORY

Exp. No	Division of Experiments	List of Experiments
1	System Calls	Write a C program to create a new process that exec a new program using system calls fork(), execlp() & wait()
2		Write a C program to display PID and PPID using system calls getpid () & getppid ()
3		Write a C program using I/O system calls open(), read() & write() to copy contents of one file to another file
4	Process Management	Write a C program to implement multithreaded program using pthreads
5		Write C program to simulate the following CPU scheduling algorithms a) FCFS b) SJF c) Priority d) Round Robin
6	Process synchronization	Write a C program to simulate producer-consumer problem using semaphores
7	Deadlock	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.
8		Write a C program to simulate deadlock detection.
9	Memory Management	Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU
10	I/O System	Write a C program to simulate the following file organization techniques a) Single level directory b) Two level directory
11		Write a C program to simulate the following file allocation strategies. a) Sequential b) Indexed

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO 1	Demonstrate need for OS and different types of OS	L2
CO 2	Analyze the performance of scheduling algorithms for the given problems	L4
CO 3	Demonstrate Process Coordination and synchronization techniques.	L2
CO4	Apply the deadlock handling mechanisms to solve the given problem	L3
CO 5	Formulate the solutions to schedule the real time applications.	L6
CO 6	Analyze the various resource management techniques for distributed systems	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2					1				1	
CO2	3	2	2	2					1				1	
CO3	3	2	2	2					1				1	
CO4	3	2	2	2					1				1	
CO5	3	2	2	2					1				1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2010

2. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata McGraw-Hill Edition 2001.

REFERENCE BOOKS:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.
2. Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall, Edition – 2, 2007

E-Resources:

1. https://www.udacity.com/course/advanced-operating-systems--ud189

****

RESEARCH METHODOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE5204	**Credits**	:	01
Hours / Week	:	01 Hours	**Total Hours**	:	13 Hours
L–T–P–J	:	1–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Develop a comprehensive understanding of the research process, including problem formulation, hypothesis development, data collection, analysis, and interpretation.
2. Learn how to identify and select appropriate research topics or questions based on relevance and feasibility.
3. Develop the ability to conduct a thorough literature review to understand the existing body of knowledge on a research topic and identify gaps in the literature.
4. Learn how to design research studies, including selecting appropriate research methods (qualitative, quantitative, mixed methods), sampling techniques, and data collection instruments.
5. Acquire skills in data collection, including surveys, interviews, observations, and the use of archival or secondary data source.
6. Gain proficiency in data analysis techniques relevant to the research methods chosen, including statistical analysis, content analysis, thematic analysis, or other appropriate methods.
7. Differentiate between quantitative and qualitative research approaches and demonstrate proficiency in both, depending on the research context.
8. Understand the principles and techniques of hypothesis testing and can apply them effectively in various research and analytical contexts.
9. Ability to effectively analyze data, draw meaningful conclusions, and communicate their findings clearly and professionally.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Research Methodology: An Introduction	**02 Hours**

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process,

Defining the Research Problem: What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

UNIT – II: Research Design	**03 Hours**

Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs

Sampling Design: Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? Random Sample from an Infinite Universe Complex Random Sampling Designs

UNIT – III: Methods of Data Collection	**03 Hours**

Collection of Primary Data, Observation Method 96 Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules

Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection. **Processing and Analysis of Data:** Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness)
UNIT – IV: Testing Hypothesis **03 Hours**
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 Hypothesis.
UNIT – V: Interpretation and Report Writing **02 Hours**
Meaning of Interpretation, Why Interpretation? Technique of Interpretation: Precaution in Interpretation, Significance of Report Writing Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate the deep understanding of** fundamental concepts of research, its purpose, types, and processes.	L2
2	**Identify & Explore** various types of research designs, measurement & Scaling techniques.	L2
3	**Compare and contrast** various data collection, processing and analysis techniques used in conducting research.	L4
4	**Formulate, test, and interpret** hypotheses using various parametric and non-parametric statistical techniques like chi-square test.	L4
5	**Interpret** research findings accurately and present them effectively in written reports.	L4

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1				3	1	2		2		
CO2	3	2	2					3	1	2		2		
CO3	3	2	2	1				3	1	2		2		
CO4	3	2	2	1				3	1	2		2		
CO5	3	2	2	1				3	1	2		2		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOK:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.

REFERENCE BOOKS:

1. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
2. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
3. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

E-Resources:

1. https://youtu.be/E2gGF1rburw?si=5JvyrezmAR8dXhfk
2. https://youtu.be/lfWlbjl1zzU?si=Yrgy84DPEUJeEJrC
3. https://youtu.be/E2gGF1rburw

****

Professional Electives: Core CSE Stream

Professional Electives: Core CSE Stream

DATA STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5105	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th)+26(P) Hrs
L–T–P-J	:	3–0–2-0			

Prerequisites:

Proficiency in C programming language.

Course Objectives:

This Course will enable students to:

1. **Understand** the basic approaches for analysing and designing data structures.
2. **Introduce** dynamic memory allocation and C language concepts required for building data structures
3. **Develop** essential skills to construct data structures to store and retrieve data quickly and **efficiently**.
4. **Utilize** different data structures that support different sets of operations which are suitable for various applications.
5. **Explore & implement** how to insert, delete, search and modify data in any data structure- Stack, Queues, Lists, Trees.
6. **Develop** applications using the available data structure as part of the course for mini-project.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/Animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**07 Hours**

IINTRODUCTION:

Introduction to Data Structures, Classification, C Structure and Union, Array Definition, Representation, Operations (Insertion, Deletion, Search and Traversal), Two/Multidimensional Arrays, sparse matrix, C Pointers

UNIT – II	**08 Hours**

INTRODUCTION TO Abstract Data Types (ADT):

Stack: Definition, Array Representation of Stack, Operations on Stacks.

Applications of Stack: Expression evaluation, Conversion of Infix to Postfix, Infix to Prefix Recursion, Tower of Hanoi

Queue: Definition, Representation of Queues, Operations of Queues, Circular Queue.

Applications of Queue: Job Scheduling, A Maze Problem

UNIT – III	**09 Hours**

DYNAMIC DATA STRUCTURES:

Linked List: Types, Representation of Linked Lists in Memory. Traversing, Searching, Insertion & Deletion from Linked List. Circular List, Doubly Linked List, Operations on Doubly Linked List (Insertion, Deletion, Traversal).

Applications: Stack & Queue Implementation using Linked Lists.

Case Study: Josephus problem.

UNIT – IV	**12 Hours**
TREES: Basic Terminology, Binary Trees and their representation, Complete Binary Trees, Binary Search Trees, Threaded Binary Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal), Optimal Binary Search Trees, AVL Trees, Red Black Trees, Splay Trees. **Applications:** Expression Evaluation **Case Study:** Game Tree	
UNIT – V	**03 Hours**
HASHING AND APPLICATIONS Basic concept of Hashing, Static Hashing, Hash functions, Overflow handling, Theoretical evaluation of overflow techniques, properties of good Hash functions, practical applications of hashing **Case Study**: Python like Dictionary implementation	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate** the key C programming concepts such as pointers, structures, unions and arrays data structures to perform operations such as insertion, deletion, searching, sorting, and traversing.	L3
2	**Utilize** the fundamental concepts of stacks and queues to solve the standard applications like tower of Hanoi, conversion and evaluation of expressions, job scheduling and maze.	L3
3	**Implement** Singly Linked List, Doubly Linked List, Circular Linked Lists, stacks and queues using linked list**.**	L3
4	**Develop** critical thinking and problem-solving skills by designing and implementing efficient algorithms for Non-linear tree data structure and perform insertion, deletion, search and traversal **operations** on it.	L3
5	**Apply** advanced techniques such as special types of trees and hashing to solve problems efficiently.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2	3		3									2	2	
CO3	3		3									2	2	
CO4	3	2	3									2	2	
CO5	3	2	3									2	2	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS (TB):

1. Ellis Horowitz, Susan Anderson-Freed, and Sartaj Sahni, "Fundamentals of Data structures in C", 2nd Edition, Universities Press(India) Private Limited, 2008.
2. A.M. Tannenbaum, Y Langsam, M J Augenstein "Data Structures using C", 1st Edition, Pearson, 2019.

REFERENCE BOOKS:

1. Brian. W. Kernighan, Dennis. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice-Hall, 1988.
2. Gilbert & Forouzan, "Data Structures: A Pseudo-code approach with C", 2nd Edition, Cengage Learning,2014.
3. Jean-Paul Tremblay & Paul G. Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, McGraw Hill, 2013.
4. R.L. Kruse, B.P. Learly, C.L. Tondo, "Data Structure and Program design in C", 5th Edition, PHI ,2009.

E-Resources:

1. https://nptel.ac.in/courses/106102064
2. https://www.coursera.org/learn/data-structures?specialization=data-structures-algorithms
3. https://www.udemy.com/topic/data-structures/free/
4. https://www.mygreatlearning.com/academy/learn-for-free/courses/data-structures
5. https://cse01-iiith.vlabs.ac.in/
6. https://kremlin.cc/k&r.pdf

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving using group discussion.
2. Role play E.g., Stack, Queue, etc.,
3. Demonstration of solution to a problem through programming.
4. Flip class activity E.g., arrays, pointers, dynamic memory allocation, etc.,

DATA STRUCTURES LABORATORY

Experiments to be carried out using C programming language

1. To Implement C programs using the concepts of pointers, structures for relevant simple applications.
2. To implement multidimensional array Matrix Multiplication.
3. To search elements in data structure with different search methods.
4. To implement stack, queue and their variations using arrays.
5. To implement stack, queue and their variations using singly linked lists
6. To implement conversion & evaluation of expression using stacks.
7. To Implement doubly circular Linked Lists and variations and use them to store data and perform operations on it.
8. To Implement Addition/multiplication of 2 polynomial using linked lists
9. To implement binary tree traversal techniques.
10. To implement a facility like Python's Dictionary data structure using Hashing.

OPEN-ENDED EXPERIMENTS

1. A man in an automobile search for another man who is located at some point of a certain road. He starts at a given point and knows in advance the probability that the second man is at any given point of the road. Since the man being sought might be in either direction from the starting point, the searcher will, in general, must turn around many times before finding his target. How does he search to minimize the expected distance travelled? When can this minimum expectation be achieved?
2. The computing resources of a cloud are pooled and allocated according to customer demand. This has led to increased use of energy on the part of the service providers due to the need to maintain the computing infrastructure. What data structure will you use for allocating resources which addresses the issue of energy saving? Why? Design the solution.
3. Mini-Project on applying suitable data structure to a given real-world problem.

****

COMPUTER NETWORKS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5106	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hrs
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** their knowledge of Networks and its different layers to analyze and learn the functionalities of a various layers of a network.
2. **Analyze** The layers of Network that includes Data Link Layer for assessing the functionality of it. Data Encoding Techniques used in Data Link Layer with detailed analysis.
3. **Utilize** The Layered architecture of a Network for Network Operations and its functionalities.
4. **Employ** Transport of Packets received from previous layers to next Transport Layer and its functionalities in terms of wired and wireless transportation of data
5. **Apply** The Layered architecture that is useful in different layers of a OSI model and TCP/IP model.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Overview of Networks	**09 Hours**

Layers of Standard Network Architecture – Structure and Architectural overview of a Network, Classification of Network Architecture (LAN-MAN-WAN-PAN), Comparison of the OSI and TCP/IP reference model.

Physical Layer: Physical Layer: Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.).

MAC Layer: Aloha, CSMA, CSMA/CD, CSMA/CA protocols. Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11). Time permitting, a quick exposure to Token Ring and to Bluetooth, WiMax may also be included.

UNIT – II: Data Link Layer	**09 Hours**

Data Link Layer – MAC (Media Access Control) and LLC (Logical Link Control) sublayer Functionalities– Error detection (Parity, CRC), Sliding Window, Stop and Wait protocols. Design, specifications of popular technologies, switching. A student should be able to design LAN of a campus or a building.

UNIT – III: Network Layer	**06 Hours**

Network Layer Issues, Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Classless addressing, Network Address Translation.

UNIT – IV: Transport Layer	**07 Hours**

Transport Layer functionalities, Connection and Connectionless protocol, UDP, TCP. Connection

establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, Design issues in protocols at different layers.	
UNIT – V: Applications Layer and its Security	**08 Hours**
Session, Presentation, and Application Layers. Examples: DNS, SMTP, IMAP, HTTP, etc. Network Security: Concepts of symmetric and asymmetric key cryptography. Symmetric Key Authentication Protocols. Pretty Good Privacy (PGP), IPSec, Firewalls.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** Layered Architecture used for OSI reference model and TCP/IP model	L3
2	**Analyze** Data link layer and its functionalities in terms of data encoding techniques	L2 & L3
3	**Solve** Network Layer architecture that is used to solve various problems of Network Operations in terms of packet header and payload formation and its capabilities	L3
4	**Utilize** The wired and wireless communications protocols used as TCP/IP and UDP for communications in Transport Layers are referenced	L2 & L3
5	**Apply** The layer used in user space for interfacing with layers down the Application layer for its functionalities	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	4	3	2	1										
CO4	3	2	2	1					1					
CO5	3	2	2	1					1					

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. A S Tanenbaum, DJ Wetherall, Computer Networks, 5th Ed., Prentice-Hall, 2010.
2. L L Peterson, BS Davie, Computer Networks: A Systems Approach, 5th Ed., Morgan-Kauffman, 2011.

REFERENCES:

1. JF Kurose, KW Ross, Computer Networking: A Top-Down Approach, 5th Ed., Addison-Wesley, 2009.
2. W Stallings, Cryptography and Network Security, Principles and Practice, 5th Ed., Prentice-Hall, 2010.

E-Resources:

4. https://archive.nptel.ac.in/courses/106/105/106105183/
5. https://digimat.in/nptel/courses/video/106105183/L01.html

****

DIGITAL IMAGE PROCESSING AND FORENSICS SCIENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5205	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th)+26(P) Hours
L–T–P-J	:	3–0–2-0			

Prerequisites:

Computer Graphics

Course Objectives:

This Course will enable students to:

1. Understand the roles of image processing systems in a variety of applications.
2. Explore and implement programs to read/write and manipulate images: enhancement, segmentation, spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/Animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**
INTRODUCTION: Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Examples of fields that uses digital image processing	
UNIT – II	**08 Hours**
IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	
UNIT – III	**08 Hours**
IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Image Enhancement In Frequency Domain: Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT, Discrete Cosine Transform (DCT), Image filtering in frequency domain.	
UNIT – IV	**08Hours**
IMAGE SEGMENTATION: Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.	

UNIT – V	07 Hours
INTRODUCTION TO DIGITAL FORENSICS: Digital forensics fundamentals: Use of Computer Forensics - Benefits of Professional Forensics Methodology - Steps Taken by Computer Forensics Specialists - Case Studies - Types of Computer Forensics Technology: Military, Law Enforcement, Business - Specialized Forensics Techniques -Hidden Data and How to Find It - Protecting Data from Being Compromised - Internet Tracing Methods.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1.	Utilize basic image fundamentals and perform mathematical transformations necessary for image processing	L3
2.	Analyze image enhancement techniques in Spatial &frequency domain	L4
3.	Apply restoration models and compression models for image processing	L3
4.	Ability to synthesis image using segmentation and representation techniques	L3
5.	Utilize the fundamentals of digital forensics technology along with different systems and services in real world practice.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1										2	2	
CO2			2	2	2								2	
CO3			2	2	2									
CO4			2	2	2								2	
CO5			2	2	2							1		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS(TB)

1. Gonzalez.R.C& Woods. R.E., "Digital Image Processing", 3rd Edition, Pearson Education, Indian edition published by Dorling Kindersely India Pvt. Ltd. Copyright© 2009, Third impression 2011.
2. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2015, Second Edition, Charles River Media, Inc

REFERENCE BOOKS:

1. Milan Sonka,"Image Processing, analysis and Machine Vision", Thomson Press India Ltd, Fourth Edition.
2. Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.
3. S. Sridhar , Digital Image Processing, Oxford University Press, 2nd Ed, 2016.
4. Digital Image Processing (with Matlab and Labview), Vipul singh, elsiver.Filip learning

E-Resources:

1. https://nptel.ac.in/courses/117105135
2. https://nptel.ac.in/courses/117/104/117104069/(NPTEL Course by Prof. Sumana Gupta from IIT Kanpur)

DIGITAL IMAGE PROCESSING AND FORENSICS SCIENCE Laboratory

1. Write program to read and display digital image using MATLAB or SCILAB
   a. Become familiar with SCILAB/MATLAB Basic commands
   b. Read and display image in SCILAB/MATLAB
   c. Resize given image

d. Convert given color image into gray-scale image
e. Convert given color/gray-scale image into black & white image
f. Draw image profile
g. Separate color image in three R G & B planes
h. Create color image using R, G and B three separate planes
i. Flow control and LOOP in SCILAB
j. Write given 2-D data in image file

2. To write and execute image processing programs using point processing method
   a. Obtain Negative image
   b. Obtain Flip image
   c. Thresholding
   d. Contrast stretching
3. To write and execute programs for image arithmetic operations
   a. Addition of two images
   b. Subtract one image from other image
   c. Calculate mean value of image
   d. Different Brightness by changing mean value
4. To write and execute programs for image logical operations
   a. AND operation between two images
   b. OR operation between two images
   c. Calculate intersection of two images
   d. Water Marking using EX-OR operation
   e. NOT operation (Negative image)
5. To write a program for histogram calculation and equalization using
   a. Standard MATLAB function
   b. Program without using standard MATLAB functions
   c. C Program
6. To write and execute program for geometric transformation of image
   a. Translation
   b. Scaling
   c. Rotation
   d. Shrinking
   e. Zooming
7. To understand various image noise models and to write programs for
   a. image restoration
   b. Remove Salt and Pepper Noise
   c. Minimize Gaussian noise
   d. Median filter and Weiner filter
8. Write and execute programs to remove noise using spatial filters
   a. Understand 1-D and 2-D convolution process
   b. Use 3x3 Mask for low pass filter and high pass filter
9. Write and execute programs for image frequency domain filtering
   a. Apply FFT on given image
   b. Perform low pass and high pass filtering in frequency domain
   c. Apply IFFT to reconstruct image
10. Write a program in C and MATLAB/SCILAB for edge detection using different edge Detection mask

****

SOCIAL NETWORK ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5206	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

6. **Use** the basic concepts of social networks like nodes, edges, adjacency matrix, neighborhood, degree, geodesic, diameter and clustering coefficient to analyze the social network data
7. **Interpret** content-based analysis and static and dynamic analysis for real-time data or online content.
8. **Examine** the importance of Social network APIs and community detection in real-time networks.
9. **Predicting** the relationship between nodes by analyzing the impact on the specified social network like twitter, LinkedIn and Facebook.
10. **Simulate and Validate** the social networks by using different tools of SNA.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction	**07 Hours**
Social network analysis –Key concepts. Organizational Network analysis large scale networks, Community-centrality analysis, online social networking –Benefits, security threats. Social Network Data - Issues and challenges, Measuring social networks-connectivity, centrality. Applications of Social Networks.	
UNIT – II: Analysis of social networks	**08 Hours**
Linke based analysis-social network metrics-degree, density, connectedness, betweenness, ego-centric, closeness Content-based analysis-Conceptual and relational analysis. Static and dynamic analysis-Evolution in Dynamic Social Networks. Mathematical Representation of social networks- Centrality.	
UNIT – III: Social Networking APIs	**09 Hours**
Social networking API -Types of APIs Statistical Analysis of Social Networks. Community Detection in Social Networks - node-centric community, group-centric community, network-centric community and hierarchy-centric community. Node Classification in Social Networks -	
UNIT – IV: Social Influence analysis	**08 Hours**
Social Influence Analysis -Link Prediction in Social Networks- Preferential attachment score, Adamic/Adar, Jaccard coefficient. Data Mining - Social Media data mining-types of social media Text Mining in Social Networks - Social Tagging -Building social services	
UNIT – V: Social Network Analysis Tools	**07 Hours**
UCINET – PAJEK– NETDRAW – Stocnet – S-Plus - R – NodeXL- SIENA and RSIENA - Case Studies -Real-world networks (Facebook graph, Twitter networks,)	

SOCIAL NETWORK ANALYSIS LABORATORY
1. Create a network representation of the data, with individuals as nodes and their interactions as edges. 2. Create visualization using social network tools-Gephi, python libraries and NetworkX 3. Conduct statistical analyses on the network data to measure network metrics-degree, density, connectedness, betweenness, ego-centric, closeness 4. Implement community detection algorithm on the network data. 5. Implement centrality measures-degree, betweenness, eigenvector on the network data.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Use** the basic concepts of social networks like nodes, edges, adjacency matrix, neighborhood, degree, geodesic, diameter and clustering coefficient to analyze the social network data	L3: Applying
2	**Interpret** content-based analysis and static and dynamic analysis for real-time data or online content.	L3: Applying
3	**Examine** the importance of Social network APIs and community detection in real-time networks.	L4: Analyzing
4	**Predicting** the relationship between nodes by analyzing the impact on the specified social network like twitter, LinkedIn and Facebook.	L4: Analyzing
5	**Simulate and Validate** the social networks by using different tools of SNA.	L5: Evaluating

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1		1								1	
CO2	3	2	2		2	1			1	1			3	
CO3	2	3	2		2				1	1			3	
CO4	2	3	2		2	1			1	1			3	
CO5	2	2	3		2	1			1	1			2	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Christina Prell, Social Network Analysis: History, Theory and Methodology, SAGE Publications Ltd, Publication Year 2011
2. Stanley Wasserman and Katherine Faust, "Social Network Analysis: Methods and Applications", Cambridge University Press, 1994

REFERENCE BOOKS:

1. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", 2010
2. Carrington and Scott (eds). The SAGE Handbook on Social Network Analysis SAGE, First Edition 2011
3. Lei Tang and Huan Liu, Community Detection and Mining in Social Media, Morgan & Claypool Publishers
4. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.

E-Resources:

1. https://nptel.ac.in/courses/106106239
2. https://onlinecourses.nptel.ac.in/noc23_cs106/preview

3. https://onlinecourses.nptel.ac.in/noc20_cs78/preview
4. https://onlinecourses.nptel.ac.in/noc20_cs78/preview

****

MACHINE LEARNING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE6302	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th)+26(P) Hrs
L–T–P-J	:	3–0–2-0			

Prerequisites:

Linear Algebra, Probability, Statistics and Computer Programming

Course Objectives:

This Course will enable students to:

1. **Understand** the basic concepts and techniques of Machine Learning.
2. **Develop** the skills in using recent machine learning software for solving practical problems.
3. **Utilize** different a set of well-known supervised, semi-supervised and unsupervised learning algorithms
4. **Analyze** and formulate machine learning problems corresponding to different applications.
5. **Apply** machine learning algorithms to solve problems of moderate complexity.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/Animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:

Examples of Machine Learning Applications, Classification, Regression, Unsupervised Learning, Reinforcement Learning, Supervised Learning, VapnikChervonenkis (VC) Dimension, Probably Approximately Correct (PAC) Learning, Learning Multiple Classes, Regression, Model Selection and Generalization

Bayesian Decision Theory – Classification, Losses and Risks, Discriminant Functions, Utility Theory, Association Rules

UNIT – II	**08 Hours**

Parametric Methods - Maximum Likelihood Estimation, Bernoulli Density, Multinomial Density, Gaussian Density, Bias and Variance, Bayes' Estimator, Parametric Classification, Regression, Model Selection Procedures

Multivariate Methods - Multivariate Data, Parameter Estimation, Estimation of Missing Values, Multivariate Normal Distribution, Multivariate Classification, Multivariate Regression

UNIT – III	**08 Hours**

Clustering - Mixture Densities, k-Means Clustering, Expectation-Maximization, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering

Decision Trees – Univariate Trees, Classification Tree, Regression Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees

UNIT – IV	**08Hours**

Linear Discrimination - Generalizing the Linear Model, Geometry of the Linear Discriminant, Two Classes Multiple Classes, Gradient Descent, Logistic Discrimination, Discrimination by Regression

Bayesian Estimation - Estimating the Parameter of a Distribution, Bayesian Estimation of the Parameters of a Function, Use of Basis/Kernel Functions, Bayesian Classification, Gaussian Processes	
UNIT – V	**07 Hours**
Graphical Models - Canonical Cases for Conditional Independence, Example Graphical Models, Naive Bayes' Classifier, Linear Regression, Belief Propagation, Chains, Trees, Poly trees, Junction Trees, Markov Random Fields, Learning the Structure of a Graphical Model, Influence Diagrams	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1.	Choose some of the important learning algorithms pertaining to classification and regression.	L3
2.	Develop an appreciation for what is involved in learning from data.	L3
3.	Analyze variety of learning models for the tasks of classification, regression and clustering	L4
4.	Identify probabilistic framework can be used and applied for building various models of learning	L3
5.	Examine performs evaluation of learning algorithms and model selection.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	1							1	2	
CO2	2	2	2	2	1			1				1	2	
CO3	2	2	2	2	1			1				1		
CO4	2	2	2	2	1							1	2	
CO5	2	2	2	2	1							1		

TEXT BOOKS(TB)

1. . Ethem Alpaydin-Introduction to Machine Learning-The MIT Press (2014).pdf

REFERENCE BOOKS:

1. Tom Mitchell, Machine Learning, McGraw Hill (Oct 1997).
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Pub Springer (Aug 2006)
3. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Pub Chapman & Hall/Crc (Apr 2009)

E-Resources:

1. https://nptel.ac.in/courses/106106139

MACHINE LEARNING LABORATORY

1. Implement Decision Tree learning
2. Implement Logistic Regression
3. Implement classification using Multilayer perceptron
4. Implement classification using SVM
5. Implement Adaboost
6. Implement Bagging using Random Forests
7. Implement k-nearest Neighbors algorithm
8. Implement K-means, K-Modes Clustering to Find Natural Patterns in Data

9. Implement Hierarchical clustering
10. Implement Gaussian Mixture Model Using the Expectation Maximization
11. Implement Principle Component Analysis for Dimensionality Reduction
12. Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms

Note: Datasets may be taken from standard websites which pertain to realistic scenarios.

****

DEEP LEARNING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Course Code	:	23CSE6402	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. The objective of Deep Learning is to enable the student to understand the fundamentals of deep learning and its techniques in deep learning.
2. To understand the theoretical foundations, algorithms and methodologies of Neural Network
3. Be able to design and implement deep neural network systems. Be able to identify new application requirements in the field of ANN.
4. Be able to identify reasonable work goals and estimate the resources required to achieve the objectives.
5. To design and develop an application using specific deep learning models
6. To provide the practical knowledge in handling and analyzing real world applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction to Deep Learning	**09 Hours**
Introduction to Deep Learning: History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptron's, Perceptron Learning Algorithm and Convergence, Multilayer Perceptron's (MLPs), Activation functions, Feedforward Neural Networks, Backpropagation, Back-propagation algorithm and its variants Stochastic Gradient Decent, Curse of Dimensionality, underfitting, overfitting, weight decay	
UNIT – II: Deep Learning Architecture	**08 Hours**
Autoencoders, Denoising autoencoders, Sparse autoencoders, Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Batch Normalization	
UNIT – III: Convolutional Neural Networks	**07 Hours**
Introduction to Convolutional Neural Networks: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO. Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.	
UNIT – IV: Sequence modeling – Recurrent Neural Network	**06 Hours**
Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks, GRU	
UNIT – V: DEEP GENERATIVE MODELS and Hands on Practices and project	**09 Hours**
Deep Belief networks, Boltzmann Machines, Deep Boltzmann Machine, Generative Adversial Network(gan), Variational autoencoders, Autoregressive Models: NADE, MADE, PixelRNN,	

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	2	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	3	3	-	-	-	3	2	3	-	3	3
CO5	-	3	3	3	3	-	-	-	3	2	3	-	3	3
Avg	9/15	14/15	6/15	13/15	9/15	-	-	-	6/15	4/15	6/15	-	6/15	6/15

Hands-on projects applying deep learning techniques to real-world problems: Computer Vision application, Natural Language Processing, Time Series data		
urse Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	**Develop** the basic knowledge and remember the concepts of Perceptron, Back Propagation, recognize the characteristics of deep learning models	L3
2	**Develop** a strong comprehend of auto encoders- and apply Regularization, Denoising, Sparse, Contractive, Vectoral Representations of words Convolutional Neural Networks, LeNet, , VGGNet, GoogleNet, ResNet, Fast RCNN, Faster RCNN, YOLO	L2 & L3
3	**Apply** Long Short Term Memory (LSTM) in time series data analysis and understanding the sequential data pattern	L3
4	**Build** Variationalautoencoders, Autoregressive Models: NADE, MADE, PixelRNN, Generative Adversarial Networks (GANs), how to train DCGAN, limitations of deep learning	L2 & L3
5	**Illustrate** the deep learning algorithms, apply the learned concepts to real-world datasets, develop the skills to build, train and evaluate deep learning models for tasks, such as regression and classification.	L3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Deep learning with python – Francois Chollet, Manning publishers, 2018, ISBN-9781617294433
2. Grokking deep learning, Andrew w Trask, 2019, Manning publishers, ISBN-9781617293702
3. Ian Goodfellow and YoshuaBengio and Aaron Courville (2016) Deep Learning Book.

REFERENCE BOOKS

1. Deep Learning with PyTorch: A practical approach to building neural network models using PyTorch by Vishnu bramanian
2. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996 Pattern Recognition and Machine Learning, Christopher Bishop, 2007
3. Josh Patterson, "Deep Learning: A Practitioner's Approach", O'Reilly Media; 1st edition(August 19, 2017)

MOOC(s):

1. https://www.edx.org/course/deep-learning-with-python-and-pytorch
2. https://www.udacity.com/course/deep-learning-pytorch--ud188
3. https://www.udemy.com/practical-deep-learning-with-pytorch/

Tool(s) & Software: **Tensorflow, Python, Scikit, Keras, PyTorch**

****

Professional Electives: Computational & Data Science Stream

Professional Electives: Computational & Data Science Stream

DATA SCIENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE5107	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 (T) +26(P) Hrs
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** processes suitable to data preprocessing and transformation to be able to prepare data to extract insights.
2. **Visualize** data by computing and display graphs and plots to identify relationships and patterns and by modelling exploratory data analytics.
3. **Utilize** mathematical and statistical techniques to test hypothesis.
4. **Employ** central limit theorem and confidence interval enabling them to model real-world phenomena and make accurate predictions**.**
5. **Use** open-source tools to engage in practical application of the data to formulate problem statements and work to identify solutions.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: About Data	**09 Hours**
Introduction, Causality and Experiments - Data Pre-processing: Knowing data, Data cleaning, Data reduction, Data transformation, Data discretization.	
UNIT – II: Data Visualization	**09 Hours**
Visualization and Graphing: Visualizing Categorical Distributions, Visualizing Numerical Distributions, Overlaid Graphs, plots, and summary statistics of Exploratory Data Analysis (EDA). Exploring Univariate Data - Histograms -Stem-and-Leaf Quantile Based Plots - Continuous Distributions -Quantile Plots- QQ Plot- Box Plots.	
UNIT – III: Statistics	**06 Hours**
Introduction to Statistics- Sampling, Sample Means and Sample variance sample moments, covariance, correlation, Sampling Distributions - Parameter Estimation Bias -Mean Squared Error -Relative Efficiency – Standard Error - Maximum Likelihood Estimation. Empirical Distributions- Sampling from a Population- Empirical Distribution of a Statistic -Testing Hypotheses Error probabilities- Assessing Models-Multiple Categories -Decisions and Uncertainty- Comparing Two Samples -A/B Testing - ANOVA.	
UNIT – IV: Sampling theory	**07 Hours**
Estimation- Percentiles- The Bootstrap - Confidence Intervals- Using Confidence Intervals - The SD and the Normal Curve - The Central Limit Theorem - point and interval estimation, Prediction- Correlation -The Regression Line -The Method of Least Squares - Least Squares	

UNIT – V: Case studies on using computational tools for data analytics	08 Hours
Case studies on Visualization with the help of Tools like Altair Tableau, Rapid miner, and MATLAB. [Access to open-source tools will be granted for practical application to work on cases studies]	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** their knowledge of data preprocessing and transformation to be able to prepare data to extract insights.	L3
2	**Visualize** data by creating graphs and plots to identify relationships and patterns and by modelling exploratory data analytics.	L3
3	**Utilize** mathematical and statistical techniques to test hypothesis and to identify covariance with A/B testing and Analysis of Variance.	L3
4	**Employ** central limit theorem and confidence interval enabling them to model real-world phenomena and make accurate predictions**.**	L2 & L3
5	**Use** open-source tools to engage in practical application of the data to formulate problem statements and work to identify solutions and to build models.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	2					1					
CO4	3	2	2	2					1					
CO5	3	3	2	1	2				1				2	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Adi Adhikari and John De Nero, "Computational and Inferential Thinking: The Foundations of Data Science", 1st edition, 2019.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", 4th Edition, Elsevier, 2006.
3. Douglas C. Montgomery, George C. Runger, "Applied Statistics and Probability for Engineers", 6th Edition, Wiley,2013.

REFERENCE BOOKS:

1. Wendy L. Martinez, Angel R. Martinez, "Computational Statistics Handbook with MATLAB", 2nd Edition, Chapman Hall/CRC, 2008.

E-Resources:

1. Data Science for Engineers, IIT Madras- https://nptel.ac.in/courses/106106179
2. https://ifacet.iitk.ac.in/professional-certificate-course-in-data-science/
3. https://online.stat.psu.edu/stat506/lesson/1/1.4
4. https://onlinestatbook.com/2/advanced_graphs/q-q_plots.html

****

DATA WAREHOUSE AND DATA MINING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5108	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th)+26(P) Hours
L–T–P-J	:	3–0–2-0			

Prerequisites:

Understanding of Database and analytical tools.

Course Objectives:

This Course will enable students to:

1. Understand data warehouse concepts, architecture, business analysis and tools.
2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
3. Explore and implement data pre-processing and data visualization techniques
4. Apply algorithms for finding hidden and interesting patterns in data
5. Identify various classification and clustering techniques using tools

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/Animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

Data Warehousing, Business Analysis and On-Line Analytical Processing (OLAP): Basic Concepts, Data Warehousing Components, Building a Data Warehouse, Database Architectures for Parallel Processing, Parallel DBMS Vendors, Multidimensional Data Model, Data Warehouse Schemas for Decision Support, Concept Hierarchies, Characteristics of OLAP Systems, Typical OLAP Operations, OLAP and OLTP.

Data Lakes: Introduction to Data Lakes: Definitions and Discussions, Architecture, Metadata in Data Lake Ecosystems

Data marts: Benefits, Types, Structure, Data mart and cloud architecture, Data mart vs. data warehouse vs. data lake

UNIT – II	**07 Hours**

Data Mining – Introduction: Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, applications, Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

UNIT – III	**08 Hours**

Data Mining – Frequent Pattern Analysis: Mining Frequent Patterns, Associations and Correlations, Mining Methods, Pattern Evaluation Method, Pattern Mining in Multilevel, MultiDimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

UNIT – IV	08Hours
Classification: Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Back Propagation, Support Vector Machines, Lazy Learners, Model Evaluation and Selection, Techniques to improve Classification Accuracy	
UNIT – V	**08 Hours**
Clustering: Clustering Techniques, Cluster analysis, Partitioning Methods, Hierarchical methods, Density Based Methods, Grid Based Methods, Evaluation of clustering, Clustering high dimensional data, Clustering with constraints, Outlier analysis, outlier detection methods. **Case Study on Data lakes:** Advertising Data Analytics, Game Operation Analytics A Use Case of Data Lake Metadata Management	

DATA WAREHOUSE AND DATA MINING LABORATORY

1. a) Installation of WEKA Tool, Understand the features of WEKA toolkit, Explore the available data sets.
   b) Demonstration of preprocessing on .arff file using student data .arff
2. To perform the statistical analysis of data, Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets
3. Demonstration of association rule mining using Apriory algorithm on Supermarket data.
4. Demonstration of FP Growth algorithm on supermarket data
5. To perform the classification by decision tree induction using weka tools.
6. To perform classification using Bayesian classification algorithm using R.
7. To perform the cluster analysis by k-means method using R.
8. To perform the hierarchical clustering using R programming.
9. Study of Regression Analysis using R programming.
10. Outlier detection using R programming.
11. **Case Study**: Create Placement.arff file to identify the students who are eligible for placements using KNN

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1.	Comparison of functional differences between data warehouse and database systems.	L2
2.	Apply suitable pre-processing and visualization techniques for data analysis	L3
3.	Identify frequent pattern and association rule mining techniques for data analysis	L3
4.	Utilize appropriate classification techniques for data analysis	L3
5.	Select appropriate clustering techniques for data analysis	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2											2	2	
CO2	2											1		2
CO3	2	1	2	2								1	2	
CO4	2	2		2								1		
CO5	2	2										1	2	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS(TB)

1) Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.

REFERENCE BOOKS:

1) Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP‖, Tata McGraw – Hill Edition, 35th Reprint 2016.

2) K.P. Soman, ShyamDiwakar and V. Ajay, —Insight into Data Mining Theory and
   a. Practice‖, Eastern Economy Edition, Prentice Hall of India, 2006.
3) 3.Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.
4) Anne Laurent, Dominique Laurent, Cédrine Madera- Data Lakes-wiley,2020
5) https://onlinelibrary.wiley.com/doi/book/10.1002/9781119720430

E-Resources:

1) https://nptel.ac.in
2) https://www.saedsayad.com
3) http://onlinecourses.nptel.ac.in (NPTEL course by Prof.Pabitra Mitra)
4) https://nptel.ac.in/ (NPTEL course by Dr. Nandan Sudarshanam & Dr. Balaraman Ravindran)
5) https://www.ibm.com/topics/data-mart

****

BIG DATA ANALYTICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5207	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** processes suitable to define big data and learn business case studies for big
2. data analytics.
3. **Learn** foundation principles of NoSql usage in big data.
4. **Utilize** Hadoop as platform to build all ecosystem
5. **Employ** Yarn and MapReduce to big data jobs
6. **Use** open-source ecosystem to engage in practical application of the Big data to formulate problem statements and work to identify solutions with real time data and exposure the industry standard practices.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: About Big Data	**09 Hours**

Introduction-What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open-source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

TB -1

UNIT – II: No SQL and data models	**09 Hours**

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution

UNIT – III: Hadoop	**06 Hours**

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

UNIT – IV: MapReduce	**07 Hours**

MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output.

UNIT – V: Case studies on Practice	**08 Hours**

Modeling with Hbase, data model and implementations, Hbase clients, Hbase examples, Hive Examples

Case studies : a) Generate charts with Hadoop b) Exposure to Cloudera Apache Hadoop tools for 2 examples of Health care and Retail.

[https://www.cloudera.com/products/cdp-demos.html?menu-resources] **c)** Case study on Flight data analysis using Spark GraphX. [Team is instructed to use U.S department Transportation(DOT), Bureau of transportation statistics site for real time data)(Refer portal E- resources no 1. and 3.]

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** their knowledge of Big Data to manage and analyze solutions.	L3
2	**Demonstrate** solutions using NoSql principles for graph databases.	L4
3	**Utilize** and build Hadoop ecosystem to process Big Data solutions	L3
4	**Employ** Map reduce and Yarn for job scheduling.	L4
5	**Use** open-source tools to engage in practical application of the Big data to formulate problem statements and work to identify solutions and to build models in a lab OR Sandbox environment.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	2					1					
CO4	3	2	2	2					1					
CO5	3	3	2	1	3	1			1				2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books :

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", 1
2. Wiley, 2013. P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'Reilly, 2012.

E – Resources:

1. https://nptel.ac.in/courses/106104189
   [8 weeks course]
2. Infyspringboard course : Big Data Concepts: Big Data Essentials
3. Infyspringboard course : Big Data Analytics Projects with Apache Spark

****

BUSINESS INTELLIGENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – 2

Course Code	:	23CSE5208	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T) +26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. LEARN the fundamentals of Business Intelligence
2. ANALYZE various methods, techniques and algorithms for decision making in Business Intelligence
3. USE different tools to visualize dashboards
4. BUILD Predictive modeling and its applications

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Decision support Systems	**09 Hours**
An Overview of Business Intelligence, Analytics, and Decision Support, Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A Framework for Business Intelligence (Bl) APPLICATION CASE; Sabre Helps Its Clients Through Dashboards and Analytics	

UNIT – II: Phases of Decision Making	**09 Hours**
Foundations and Technologies for Decision Making, Decision Making: Introduction and Definitions, Phases of the Decision-Making Process, i. Decision Making: The Intelligence Phase ii. Decision Making: The Design Phase iii. Decision Making: The Choice Phase iv. Decision Making: The Implementation Phase v. How Decisions Are Supported APPLICATION CASE: SNAP DSS Helps OneNet Make Telecommunications Rate Decisions	

UNIT – III: Visualization	**06 Hours**
Brief introduction of data warehousing concepts, Business Reporting, Visual Analytics, and Business, Data and Information Visualization, Performance Measurement APPLICATION CASE; Tableau Saves Blastrac Thousands of Dollars with Simplified Information Sharing, Expedia.com's Customer Satisfaction Scorecard	

UNIT – IV: Predictive modeling	**07 Hours**
Brief concepts of data mining , Techniques for Predictive Modeling 243 APPLICATION CASE 5.1 Smarter Insurance: Infinity P&C Improves Customer Service and Combats Fraud with Predictive Analytics APPLICATION CASE; Data Mining in Cancer Research, Managing Student Retention with Predictive Modeling, Efficient Image Recognition and Categorization with kNN	

UNIT – V: Applications and Case study Hands on practice	**08 Hours**
Text Analytics, Text Mining, and Sentiment Analysis, Text Mining Applications, Create the Term-Document Matrix APPLICATION CASE; Text Mining for Patent Analysis, Web Analytics, Web Mining, Web Usage Mining (Web Analytics), Web Crawler, Understanding Why Customers Abandon Shopping Carts Results in $10 Million Sales Increase	

NOTE: For all Application cases, A problem to be formulated and visualize the solution through dashboard using tools. For Problem statement refer the respective Text book.

BUSINESS INTELLIGENCE LABORATORY

1. Traditional BI Tool end to end Example: Power BI, IBM Cognos, Tableau.
2. Self-service BI tool: Qlik, Altair - RapidMiner
3. Open source Programming for Visualization and Analytics: Python, R Programming.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** Apply Decision support models for gathering knowledge	L3
2	**Utilize** different phases of decision-making process in implementing Business Intelligence	L4
3	**Demonstrate** the downstream of Data warehousing model for analytics and representation of knowledge in dashboard visualization with existing industry standard open-source tools	L3
4	**Explore** the predictive modelling process of few business applications	L4
5	**Use** Text analytics and Web mining to discover the process of intelligence derivation from the information.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	2					1					
CO4	3	2	2	2					1					
CO5	3	3	2	1	3	1			1				2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015.ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4

REFERENCES:

1. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003.
2. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2009.

E – Resources:

1. https://archive.nptel.ac.in/courses/110/107/110107129/
   [Business Analytics and text modeling in Python]
2. Infyspringboard course : Business Intelligence with Tableau
3. Infyspringboard course : SQL *Business Intelligence*
4. Infyspringboard course Fundamentals of *Business Intelligence*

****

NATURAL LANGUAGE PROCESSING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE6304	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 (T)+26 Hours(P)
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
2. To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
3. To apply the Statistical learning methods and cutting-edge research models from deep learning.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction to Natural Language Processing — **08 Hours**

Introduction to NLP, Past, present and future of NLP, Various stages of NLP, Classical problems on text processing; Text Ambiguity, encoding schemes, Regular expressions, lexicon.

Introduction and Mathematical foundations: Elementary probability theory ,Statistics Essential Information Theory , Entropy, perplexity

Linguistic essentials: Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure.

UNIT – II Words & Sentences — **07 Hours**

Text Normalization, Spelling correction using Minimum Edit Distance , N-gram Language Models – N-grams, Simple unsmoothed n-grams, smoothing- backoff- Metrics to evaluate N-grams; Part-of-Speech Tagging, HMM for Part-of-Speech Tagging, Viterbi algorithm; Named Entities and Named Entity Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.

UNIT – III Feature Representation for Natural Language Processing — **07 Hours**

Word embedding: Word2Vec, CBOW, GloVe, BERT; Sequence to sequence theory and applications Vector Semantics, Cosine for measuring similarity, TF-IDF;

Machine Translation and Performance Metrics Machine Translation issues, MT Evaluation

UNIT – IV: Deep Learning Architecture for NLP — **08 Hours**

Design and application of Deep Networks to language modeling, RNNs as Language Models, Stacked and Bidirectional RNN architectures; LSTM; GRU; Convolutional neural networks;

Applications of NLP: Sentiment analysis, Question and answering, Chat Bot;

GRUs and LSTMs -- for Machine translation, for Parsing;

Convolutional neural networks -- for sentence classification, Question

Deep Reinforcement Learning, Reinforcement learning fundamentals –DRL for Text: Text Summarization, Machine Translation

UNIT – V: Transfer Learning and Language Model	09 Hours
Transfer Learning – Transfer Learning for NLP-Self-Taught Learning, Multitask Learning, Self-Attention and Self-Attention for NLP. Introduction Pre-Trained Language Model: Generative Pre-trained Transformer (GPT4), BERT, Robustly Optimized BERT Pretraining Approach, Pathways Language Model, Large Language Model Meta AI, OpenAI's GPT-3. Case Studies: Building AI Applications for Text Summarization, Topic Modeling, Sentimental Analysis etc. with Pre-Trained NLP Models	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand and apply approaches to syntax and semantics in NLP	L3
2	Apply the statistical estimation and statistical alignment models	L2 & L3
3	Analyze grammar formalism and context free grammars	L3
4	Analyze Rule based Techniques, Statistical Machine translation (SMT), word alignment	L2 & L3
5	Inspect and Evaluate Language Processing Methods using Deep learning architecture and language models	L3

NATURAL LANGUAGE PROCESSING LABORATORY

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	3	-	-	-	-	-	-	-	-	3
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	-	3	-	-	-	-	-	-	-	3	-
CO4	-	3	3	3	3	-	-	-	-	2	-	-	3	-
CO5	-	-	3	3	3	-	-	-	3	2	3	-	3	-
Avg	6/15	12/15	12/15	13/15	12/15	-	-	-	3/15	4/15	3/15	-	9/15	6/15

Tool(s) & Software: **Tensorflow, Python, Scikit, Keras,** PyTorch

1 Write a python program to show the word and sentence tokenization
- (a) Tokenization using Python's split() function
- (b) Tokenization using Regular Expressions (RegEx)
- (c) Tokenization using NLTK
- (d) Tokenization using the spaCy library

2. Take Gutenberg corpus collection, and answer the following questions with appropriate python code.
- (a) How many total words does this corpus have?
- (b)How many unique words does this corpus have?
- (c) What are the counts for the 10 most frequent words?

3. (a) Using nltk Adding or Removing Stop Words in NLTK's Default Stop Word List.
- (b) Using Gensim Adding and Removing Stop Words in Default Gensim Stop Words List
- (c) Using Spacy Adding and Removing Stop Words in Default Spacy Stop Words List

4. (a) Study of Wordnet Dictionary with methods as synsets, definitions, examples, antonyms
- (b) Study lemmas, hyponyms, hypernyms.

5. Write a program using python to find synonym and antonym of word "active" using Wordnet.
6. Identify semantic relationships between the words from given text (Use WordNet Dictionary)
7. Write python programs to implement N grams (Unigram, Bigram, Trigrams)
8. Illustrate part of speech tagging.
- a. Part of speech Tagging and chunking of user defined text.
- b. Named Entity recognition of user defined text.
- c. Named Entity recognition with diagram using NLTK corpus – treebank

9. Write a python program for a simple classification task of movie reviews. Take the corpus from nltk.corpus.movie reviews. The NaiveBayes Classifier will be used. Run the code 3 times and report the accuracy for each run. Explain why each time we got different accuracy.
10. Write a python program to identify the sequence of words using LSTM.
11. Write a python program to identify spam SMS using transformer BERT.
12. Providing an answer for a given contextual question. The idea is to build a system that can automatically answer questions posed by humans. The questions can be open or close-ended and the system should be designed to be compatible with both. The answers can be constructed either by querying a structured database or searching through an unstructured collection of documents. Build the application based on Hugging Face.

TEXT BOOKS :

1. Daniel Jurafsky and James H. Martin. 2009. Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2nd edition. Prentice-Hall.
2. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

REFERENCES:

1 Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning,Release 0.16.0, Jan 2021

2. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT press, 2016. (deeplearningbook.org)

3. Lecture Notes | Advanced Natural Language Processing | Electrical Engineering and computerScience | MIT OpenCourseWare

4 Akshay Kulkarni, Adarsha Shivananda, "Natural Language processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python". ISBN-13 (pbk): 978-1-4842-4266-7 ISBN-13 (electronic): 978-1-4842-4267-4 https://doi.org/10.1007/978-1-4842-4267-4

5 Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing - Creating Neural Networks with Python. ISBN-13 (pbk): 978-1-4842- 3684-0 ISBN-13 (electronic): 978-1-4842-3685-7, https://doi.org/10.1007/978- 1-4842-3685-7

****

TEXT AND SPEECH ANALYTICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Course Code	:	23CSE6404	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Interpret the foundational concepts of natural language processing (NLP), the key principles of text and speech analytics.
2. Identify text processing techniques to process unstructured text data effectively.
3. Apply text and speech analytics in solving specific problems and use evidence-based reasoning to make informed decisions.
4. Analyze solutions to address complex challenges in the field of text and speech analytics.
5. Examine the efficiency of methods used in NLP applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: NLP BASICS	**08 Hours**
Regular Expressions, Text Normalization, Edit Distance, N-Grams, Evaluating Language Models, Sampling sentences from a language model, Generalization and Zeros, Smoothing, Huge Language Models and Backoff, Kneser-Ney Smoothing, Perplexity's Relation to Entropy	

UNIT – II: TEXT ANALYTICS	**08 Hours**
Naive Bayes Classifiers, Optimizing for Sentiment Analysis, Naive Bayes as a Language Model, Test sets and Cross-validation, Avoiding Harms in Classification, Logistic Regression: The sigmoid function, Classification with Logistic Regression, Multinomial logistic regression, RNNs and LSTMs: Recurrent Neural Networks, RNNs as Language Models, Stacked and Bidirectional RNN architectures, The LSTM	

UNIT – III: TEXT PROCESSING	**08 Hours**
Vector Semantics and Embeddings: Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, PMI, Applications of the tf-idf or PPMI vector models, Word2vec, Bias and Embeddings, PoS: HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs) Evaluation of Named Entity Recognition, Transformers and Pretrained Language Models: Self-Attention Networks, Pretraining Large Language Models, BERT.	

UNIT – IV: SPEECH RECOGNITION	**07 Hours**
The Automatic Speech Recognition Task, Feature Extraction for ASR: Log Mel Spectrum, Speech Recognition Architecture, CTC, ASR Evaluation: Word Error Rate, TTS, Other Speech Tasks	

UNIT – V: APPLICATIONS	**08 Hours**
Machine Translation: Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, MT Evaluation, Bias and Ethical Issues, Question Answering and Information Retrieval: Information Retrieval, IR-based Factoid Question Answering, Knowledge-based Question Answering, Chatbots & Dialogue Systems: Chatbots, GUS: Simple Frame-based Dialogue Systems, The Dialogue-State Architecture, Evaluating Dialogue Systems	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain the foundational concepts of NLP, showcasing their knowledge of key terminology and principles.	L2
2	Demonstrate a deep understanding of text and speech analytics, including their components and the underlying theories that drive these fields.	L2
3	Apply advanced text processing techniques and methods to extract meaningful insights and information from textual data.	L3
4	Apply speech analytics techniques to analyze real-world data, using their skills to solve practical problems.	L3
5	Analyze NLP methods, techniques, and models, distinguishing between effective and less effective approaches.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2	3	3	1										2	1
CO3	3		1		2	1							1	
CO4	3		2		2	1					1		1	2
CO5	3	3	3	2	3	2	1	2	2	2	3	2	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2023

REFERENCES:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.
2. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
5. Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

E-Resources:

5. https://nptel.ac.in/courses/106105158
6. https://nptel.ac.in/courses/117105145
7. https://www.ibm.com/topics/speech-recognition

****

Professional Electives:
Cloud Computing Stream

Professional Electives: Cloud Computing Stream

CLOUD COMPUTING AND VIRTUALIZATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5109	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 (T) + 26(P) Hrs
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** Cloud Computing Concepts that includes: cloud computing and its key characteristics, historical context and evolution of cloud computing, advantages, and disadvantages of cloud computing.
2. **Comprehend** Cloud Enabling Technologies that includes: virtualization technologies and their role in cloud computing, Differentiate between server, network, and storage virtualization.
3. **Analyze** Cloud Infrastructure Mechanisms and evaluate various infrastructure components in a cloud environment (e.g., data centers, networking, and storage). Identify scalability, elasticity, and resource provisioning needs in the context of cloud infrastructure.
4. **Analyze** cloud architecture patterns and best practices for designing scalable and resilient cloud systems.
5. **Identify** common security challenges in cloud computing, Discuss security mechanisms such as encryption, access control, and authentication in the cloud. Explore best practices for securing cloud-based applications and data.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.

2. Interactive Teaching: *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.

3. Show ***Video/animation*** films to explain functioning of various concepts.

4. Encourage ***Collaborative*** (Group Learning) Learning in the class.

5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.

6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.

8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Understanding Cloud Computing	**6 Hours**
Cloud origins and influences, basic concepts and terminology, goals and benefits, risks, and challenges. Fundamental Concepts and Models: Roles and boundaries, cloud characteristics, cloud delivery models, cloud deployment models.	
UNIT – II: Virtualization and Cloud Infrastructure Mechanisms	**6 Hours**
Virtualization technology , Network perimeter, virtual server, cloud storage device, cloud usage monitor, resource replication.	
UNIT – III: Fundamental Cloud Architectures	**12 Hours**
Workload distribution architecture, resource pooling architecture, dynamic scalability architecture, elastic resource capacity architecture, service load balancing architecture, cloud bursting architecture, elastic disk provisioning architecture, redundant storage architecture Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture	
UNIT – IV: Cloud Delivery Model Considerations	**8 Hours**
Cloud Delivery Model Considerations: The cloud provider perspective- Building IaaS environments, equipping PaaS environments, optimizing SaaS environments, the cloud consumer perspective, working with IaaS environments, working with PaaS environments, working with SaaS services.	

UNIT – V: Fundamental Cloud Security and Mechanisms	7 Hours
Basic terms and concepts, Threat agents, Cloud security threats, Encryption, Hashing, Digital Signature, Public Key Infrastructure(PKI), Identity and Access Management(IAM), Single Sign-On(SSO), Cloud Based Security Groups, Handed Virtual Server Machines	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Define** cloud computing and virtualization, and explain their key concepts, technologies, strengths, and limitations.	L1
2	**Identify** the different types of cloud computing services (SaaS, PaaS, IaaS), deployment models (public, private, hybrid), and architectures.	L1, L4
3	**Analyze** the core issues of cloud computing, such as security, privacy, and interoperability.	L4
4	**Select** and use the appropriate technologies, algorithms, and approaches to solve cloud computing problems.	L5
5	**Evaluate** the effectiveness of different cloud computing solutions.	L5

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	1		-								1	
CO2		2	3		2								1	
CO3		2	3		2								2	
CO4		2	3		2								2	
CO5		2	3		-								1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", PHI Publications, 2018.

REFERENCE BOOKS:

1. John W. Rittinghouse, James F.Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.
2. Sandeep Bhowmik, "Cloud Computing" , Cambridge University Press, publishers 2017.
3. Meikang Qiu, Keke Gai, "Mobile Cloud computing : models, implementations and security ", CRC Press, 2017;

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs90/preview

****

WEB TECHNOLOGY AND CLOUD APPLICATION DEVELOPMENT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5110	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+29(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Gain the skill into advanced web programming using advanced JavaScript Features.
2. Develop the ability to apply Node.js for server-side scripting.
3. Implement RESTful Services with Node JS and develop a strong understanding of React's most essential concepts:
4. Learn the essential characteristics of cloud computing.
5. Apply and develop a comprehensive understanding of the various aspects of cloud application development and cloud platforms.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Modern JavaScript	**08 Hours**

Modern JavaScript Features: Adding types, Working with strings, Enhancing your code, Defining functions, Programming functionally, Doing async calls compactly, Working with objects and classes, Organizing code in modules.

UNIT – II: Developing with Node	**07 Hours**

Developing with Node: Checking Node's setup, Working with modules, Running your Node code with Nodemon, Using promises instead of error first callbacks, Working with streams to process requests, Compressing files with streams, Working with a database, Executing external processes with exec(),Using spawn() to run a command, and communicating with it ,Using fork() to run Node commands.

UNIT – III: Implementing RESTful Services with Node, Developing with React	**8 Hours**

Implementing RESTful Services with Node: Introduction, Developing a server with Express, Adding middleware, Getting request parameters ,Serving static files, Adding routes, Implementing secure connections, Adding security safeguards with Helmet, Implementing CORS, Adding authentication with JWT, Tying it all together – building a REST server.

Developing with React: Starting out with React, Reinstalling your tools, Defining components, Handling state, Composing components, Handling life cycle events.

UNIT – IV: Cloud computing	**08 Hours**

Introduction: Cloud Computing At A Glance, Historical Developments, Building Cloud Computing Environments, Principles of Parallel and Distributed Computing: Eras of Computing, Parallel Vs Distributed Computing, Elements Of Parallel Computing, Elements Of Distributed Computing, Technologies For Distributed Computing, Virtualization: Introduction, Characteristics Of Virtualized Environments, Taxonomy Of Virtualization Techniques, Virtualization And Cloud Computing, Pros And Cons Of Virtualization,

Technology Examples, Cloud Computing Architecture: Introduction, The Cloud Reference Model, Types Of Clouds, Economics Of The Cloud, Open Challenges.
UNIT – V: Cloud Application Development **08 Hours**
Aneka: Cloud Application Platform, Framework Overview, Anatomy of The Aneka Container, Building Aneka Clouds, Cloud Programming and Management, Cloud Platforms in Industry: Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Applications: Scientific applications - Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Biology: Gene Expression Data Analysis for Cancer Diagnosis, Geoscience: Satellite Image Processing, Business and consumer applications-CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Create** dynamic and interactive web applications using modern JavaScript programming techniques.	L3
2	**Develop** robust server-side applications by employing Node.js event-driven, non -blocking I/O model	L3
3	**Implementing** RESTful services with Node.js on the backend and developing the frontend with React.	L3
4	**Analyze** and evaluate the fundamental concepts of cloud computing	L2,L4
5	**Developing, deploying, and managing** the execution of applications on various types of clouds and **analyse** the various platforms for developing cloud applications.	L2,L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		3				2		2	2	3	2
CO2	3	2	2		3				2		2	2	3	2
CO3	3	2	2		3				2		2	2	3	2
CO4	3	2	2		3				2		2	2	3	2
CO5	3	2	2		3				2		2	2	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Federico Kereki ,"Modern JavaScript Web Development Cookbook", Packt Publishing Ltd.
2. Rajkumar Buyya. "Mastering Cloud Computing", Morgan Kaufmann, Elsevier 2013.

REFERENCE BOOKS:

1. Robert W. Sebesta , "Programming the World Wide Web", 7th Edition, Pearson
2.Basarat Ali Syed," Beginning Node.js ",Apress ,2014
3. Kirupa Chinnathambi, "Learning React", 1 Edition, Addison-Wesley Professional
4. Ben Piper, David Clinton, 'AWS Certified Solutions Architect Study Guide: Associate SAA-C02 Exam (Aws Certified Solutions Architect Official: Associate Exam)" Paperback 22 February 2021

E-Resources:

https://www.edureka.co/blog/ebook/web-development-ebook

MOOC:

https://www.coursera.org/learn/server-side-javascript-with-nodejs

****

CLOUD INFRASTRUCTURE MANAGEMENT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5209	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** Cloud Computing architecture for various Cloud based enterprises, challenges, workflow and architectural style of cloud computing.
2. **Comprehend** Cloud Enabling Technologies that includes: virtualization technologies and their role in cloud computing, Differentiate between full and para virtualization, and Cloud resource management and scheduling
3. **Analyze** Cloud storage Mechanisms and evaluate various infrastructure components in a cloud environment
4. **Identify** common security challenges in cloud computing, Discuss security and privacy concern for cloud users, virtual machines and shared images.
5. **Evaluate** the key technologies used in Xen VMM and various cloud applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching****: Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Encourage ***Collaborative*** (Group Learning) Learning in the class.
4. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
5. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Cloud Infrastructure and Application Paradigms	**9 Hours**

Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing.
Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model.

UNIT – II: Virtualization and Resource Management & Scheduling	**9 Hours**

Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization.
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Stability of a two level resource allocation architecture, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling.

UNIT – III: Cloud Storage Structure	**7 Hours**

The Evolution of Storage Technology, Storage Models, File Systems, and Databases, Distributed File Systems: The Precursors, General Parallel File System, Google File System, Apache Hadoop, Locks and Chubby: A Locking Service, Transaction Processing and NoSQL Databases, BigTable, Megastore.

UNIT – IV: Cloud Security and Mechanisms	**7 Hours**

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor.

UNIT – V: Case Study	7 Hours
The Grep the Web application, Cloud for science and engineering, High performance computing on a cloud, Cloud computing for social computing, digital content and cloud computing Xen a VMM based para virtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Examine** the cloud computing infrastructure at Amazon, Google, and Microsoft and **analyse** the challenges of cloud.	L4
2	**Identify** the different layers of virtualization and **make use of** the proper scheduling algorithm to manage the resources.	L3
3	**Compare** the different types of file system used in cloud environment and **analyze** the transaction process using NoSQL databases.	L4, L5
4	**Analyze** the core issues of cloud computing, such as security, privacy, and interoperability.	L4
5	**Evaluate** the effectiveness of different cloud computing solutions for various applications.	L5

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		1	1		-								1	
CO2		2	3		2								1	
CO3		2	3		2								2	
CO4		2	3		2								2	
CO5		2	3		-								1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Cloud Computing: Theory and Practice, Dan C Marinescu Elsevier (MK), 2013.

REFERENCE BOOKS:

1. Computing Principles and Paradigms, RajkumarBuyya , James Broberg, Andrzej Goscinsk,i Willey, 2014.
2. Cloud Computing Implementation, Management and Security John W Rittinghouse, James F Ransome, CRC Press, 2013.

E-Resources:

https://www.digimat.in/nptel/courses/video/106105167/L01.html
https://archive.nptel.ac.in/courses/106/105/106105167/

****

DISTRIBUTED SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5210	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Explain** the evolution of distributed computing systems, different models and issues in distributed systems.
2. **Make use of** the concept of Inter-process communication for synchronization, fault handling and group process communication.
3. **Make use of** the concept of Remote procedure calls, models, transparency, marshaling arguments and exception handling in distributed systems.
4. **Examine** the distributed process management procedure with respect to clock synchronization, event ordering, election algorithm and process migration activities.
5. **Utilize** the concept of file accessing models, file sharing semantics and caching semantics in distributed file systems.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction to Distributed computing systems and networks	**08 Hours**

Fundamentals: What is a Distributed computing system, Evolution of distributed computing systems, Distributed computing system models, Distributed operating system, Issues in the design of distributed operating systems, Distributed computing environment.

Computer Networks: Introduction, Network types, LAN technologies, WAN technologies, Communication protocols, Internetworking, ATM technology.

UNIT – II: Inter-process communication in Distributed systems	**08 Hours**

Message passing: Introduction, Desirable features, Issues in IPC by message passing, Synchronization, buffering, multi-datagram messages, Encoding and Decoding of Message data, Process addressing, Failure handling, Group communication.

Resource & Process management: Introduction, Desirable features of a good global scheduling algorithm, Task assignment approach, Load-balancing approach, Load sharing approach, Process migration, Threads.

UNIT – III: Remote Procedure Calls	**08 Hours**

Remote procedure calls (RPC): RPC models, RPC Transparency, Implementing RPC mechanism, Stub generation, RPC messages, marshaling arguments and results, Server management, Parameter passing Semantics, Call semantics.

RPC Communication: Communication protocols in RPC, Complicated RPCs, Client server Binding, Exception handling, security, Special types of RPC, RPC in heterogeneous environments, Lightweight RPC, Optimization for better performance.

UNIT – IV: Distributed Shared Memory	**07 Hours**

Distributed shared memory: General architecture of Distributed shared memory (DSM), Design & Implementation Issues of DSM, Granularity, Structures of shared memory space, Consistency models,

Replacement strategies, Thrashing, Other approaches to DSM, Heterogenous DSM, Advantages of DSM.	
UNIT – V: Distributed Process Management and File systems	**08 Hours**
Synchronization – Clock synchronization, Event Ordering, Mutual exclusion, Election algorithm. **Distributed file systems:** Introduction, Desirable features of a good distributed file system, File models, File accessing models, file sharing semantics, file caching semantics, File replication, Fault tolerance, atomic transactions, Design principles.	

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	**Explain** the evolution of distributed computing systems, different models and issues in distributed systems.	L2
2	**Make use of** the concept of Inter-process communication for synchronization, fault handling and group process communication.	L3
3	**Make use of** the concept of Remote procedure calls, models, transparency, marshaling arguments and exception handling in distributed systems.	L3
4	**Examine** the distributed process management procedure with respect to clock synchronization, event ordering, election algorithm and process migration activities.	L4
5	**Utilize** the concept of file accessing models, file sharing semantics and caching semantics in distributed file systems.	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3							1				1	
CO2	2	2	3						1				1	
CO3	2	2	3						1				1	
CO4	2	2	2	3					1				1	
CO5	2	3							1				1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

DISTRIBUTED SYSTEMS LABORATORY

1	Develop a program to implement hello world service using RMI
2	Develop a program to implement calculator using RMI
3	Develop a program to implement time service using RMI
4	Develop a program to implement hello world service using RPC
5	Develop a program to implement date service using RPC
6	Develop a program to implement Echo SOCKET in JAVA
7	Develop a program to implement Echo server using RPCGEN
8	Develop a program to implement producer-consumer concept using THREAD
9	Develop a program to find the length of string using THREAD
10	Experiments on Hadoop Distributed File System

TEXT BOOKS:

1. P.K. Sinha, Distributed Operating Systems, Concept and Design, Prentice Hall of India, 2019.

REFERENCE BOOKS:

1. A.S Tannenbaum, M.V. Steen, Distributed Systems, Principles and Paradigms, Pearson Prentice Hall of India, 3rd edition, 2017.
2. Vijay K Garg, Elements of distributed computing, Wiley-IEEE, 2002.

E-Resources:

1. NPTEL Distributed Computing Systems: https://nptel.ac.in/courses/106/106/106106107/
2. NPTEL Distributed Systems: https://nptel.ac.in/courses/106/106/106106168/

****

WIRELESS NETWORK SECURITY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE6306	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Provides an essential study of network security issues and methods in networking systems.
2. Understand various defensive measures to counter potential threats, attacks and intrusions.
3. Identify and mitigate various threat categories and vulnerabilities through the implementation of appropriate countermeasures to ensure robust security.
4. Design secured wireless and mobile networks that optimize accessibility whilst minimizing vulnerability to security risks

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction to Wireless Network Security	**08 Hours**
Introduction to wireless networks security: Wired vs. wireless network security, Threat categories and the OSI model, Vulnerabilities, Countermeasures, Security architectures. IEEE 802.11 standard security issues: Authentication and authorization mechanisms, Confidentiality and Integrity, pre-RSNA protocols (WEP), RSNA (802.11i), Key management, Threat analysis and case studies. Mobile networks security.	

UNIT – II: Securing Wireless Networks	**08 Hours**
Overview of Wireless security, Scanning and Enumerating 802.11 Networks, Attacking, 802.11 Networks, Attacking WPA protected 802.11 Networks, Bluetooth Scanning and Reconnaissance, Bluetooth Eavesdropping, Attacking and Exploiting, Bluetooth, Zigbee Security, Zigbee Attacks..	

UNIT – III: Ad-hoc Network Security	**08 Hours**
Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues, and Challenges in Security Provisioning, Network Security Attacks, Key Management in Adhoc Wireless Networks, Secure Routing in Adhoc Wireless Networks.	

UNIT – IV: Mobile Security	**07 Hours**
Mobile system architectures, Overview of mobile cellular systems, GSM and UMTS, Security architecture & Attacks, Vulnerabilities in Cellular Services, Cellular Jamming, Attacks & Mitigation, Security in Cellular VoIP Services, Mobile application security.	

UNIT – V: Security in Mobile Platforms	**08 Hours**
Android vs. ioS security model, threat models, information tracking, rootkits, Threats in mobile	

applications, analyzer for mobile apps to discover security vulnerabilities, Viruses, spywares, and keyloggers and malware detection.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO 1	Gain knowledge on security and privacy topics in wireless and mobile networking	L2
CO 2	Understand the security and privacy problems in the realm of wireless networks and mobile computing	L2
CO 3	Apply proactive and defensive measures to counter potential threats, attacks and intrusions.	L3
CO4	Analyze the various categories of threats, vulnerabilities, and countermeasures in the area of wireless and mobile networking	L4
CO 5	Examine secured wireless and mobile networks that optimize accessibility whilst minimizing vulnerability to security risks	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	0					1				1	
CO2	3	2	2	0					1				1	
CO3	3	2	2	0					1				1	
CO4	3	2	2	0					1				1	
CO5	3	2	2	0					1				1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. S. Kami Makki, Peter Reiher, Kia Makki, Niki Pissinou, Shamila Makki, "Mobile and Wireless Network Security and Privacy", Springer, ISBN 978-0-387-71057-0, 09-Aug- 2007

2. Anurag Kumar, D. Manjunath, Joy Kuri "Wireless Networking" Morgan Kaufmann Publishers, First edition, 2009.

REFERENCE BOOKS:

1. C. Siva Ram Murthy, B.S. Manoj, "Adhoc Wireless Networks Architectures and Protocols", Prentice Hall, ISBN 9788131706885, 2007
2. Noureddine Boudriga, "Security of Mobile Communications", ISBN 9780849379413, 2010.
3. Kitsos, Paris; Zhang, Yan, "RFID Security Techniques, Protocols and System-On-Chip Design ", ISBN 978-0-387-76481-8, 2008.
4. Johny Cache, Joshua Wright and Vincent Liu," Hacking Wireless Exposed: Wireless Security Secrets & Solutions ", second edition, McGraw Hill, ISBN: 978-0-07-166662-6, 2010

E-Resources:

- Coursera - Wireless Network Security Courses
- edX - Wireless Network Security Courses

****

AWS CLOUD ESSENTIALS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Course Code	:	23CSE6406	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** their knowledge Elastic Load Balancer and Auto Scaling to solve distribution of load among instances and Instance creation and termination using Autoscaling.
2. **Analyze** AWS Virtual Private Cloud, Simple Storage Service (S3) to Custom VPCs in AWS, thereby enhancing their ability to understand and manipulate Network interfaces, route tables, internet gateway and also object versioning, object lifecycle management, cross-region replication, data encryption, connecting using VPC endpoint.
3. **Utilize** Amazon RDS, DynamoDB, and Amazon Redshift to build, deploy, and run database applications in the cloud. AWS CloudFormation enables to use a template file to create and delete a collection of resources together as a single unit. AWS management service can be learned by SNS, SNQ and SES.
4. **Employ** Administering user access using AWS IAM-Application Services in AWS and Configuration Management**.**
5. **Apply** Migrating an on-premises database server to RDS. AWS DevOps, AWS Developer tools to Host code, build, test, and deploy applications quickly and effectively.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: AWS COMPUTE-Introduction to AWS, Load Balancing, Autoscaling	**08 Hours**

Introduction to AWS S3, EC2, VPC, EBS, ELB, AMI - Introduction to Elastic Load Balancer-Types of ELB – Classic, Network, and Application-Load balancer architecture-Cross-zone load balancing-Introduction to Auto Scaling, vertical and horizontal scaling, the lifecycle of Auto Scaling-Components of Auto Scaling, scaling options and policy, instance termination-Using load balancer with Auto Scaling-Pre-Route 53 – How DNS works - Routing policy, Route 53 terminologies.

Case Study: Using Different Operations on EC2 and EWS- Autoscaling Compute Capacity in AWS.

UNIT – II: AWS NETWORKING- Virtual Private Cloud, Simple Storage Service (S3)	**06 Hours**

What is Amazon VPC, VPC as a networking layer for EC2, IP address and CIDR notations, Components of VPC – Network interfaces, route tables, internet gateway, NAT, Security in VPC – Security groups and NACL, types of VPC, what is a subnet, VPC peering with scenarios, VPC endpoints, VPC pricing, and design patterns. Introduction to AWS storage, pre-S3 – online cloud storage, API, S3 consistency models, Storage hierarchy, buckets in S3, Objects in S3, metadata and storage classes, object versioning, object lifecycle management, cross-region replication, data encryption, connecting using VPC endpoint.

Case Study: Creating Custom VPCs in AWS- Using AWS S3 for Lifecycle Access Management.

UNIT – III: AWS Database & Management	**08 Hours**
Databases on AWS-Introduction to Amazon RDS-Introduction to Amazon Aurora, benefits of Aurora, Aurora pricing, and design patterns-Introduction to DynamoDB, components of DynamoDB, DynamoDB pricing, and design patterns-What is Amazon Redshift, What is ElastiCache- Introduction to CloudFormation, CloudFormation components, CloudFormation templates, Introduction to Simple Notification Service, how does SNS work, Introduction to Simple Email Service, how does SES work, Introduction to Simple Queue Service, how does SQS work. **Case Study:** Highly Available Relational Database in AWS-Sending Notifications to Patients using Push Notifications.	
UNIT – IV: AWS Access Management and Configuration Management	**08 Hours**
Pre-IAM, why access management, Amazon Resource Name (ARN), IAM features, Multi-factor Authentication (MFA) in IAM, IAM policies, IAM permissions, IAM roles, identity federation, Introduction to CloudWatch, metrics and namespaces, CloudWatch architecture, dashboards in CW, CloudWatch alarms, CloudWatch logs, Introduction to AWS Lambda, How does Lambda work, Integrating S3 with Lambda, Introduction to Elastic Beanstalk, how does Beanstalk work- Introduction to Configuration Management- Introduction to AWS OpsWorks. **Case Study:** Administering user access using AWS IAM-Application Services in AWS and Configuration Management.	
UNIT – V: AWS TOOL's: Migration, DevOps,	**09 Hours**
Migration process in AWS, the 6 R's migration strategy- Virtual machine migration, migrating a local VM onto the AWS cloud-Migrating databases using Database Migration Service (DMS)- Migrating a local database to RDS-Migrating an on-premises database server to RDS using DMS, and other migration services. Introduction to AWS DevOps, AWS Developer tools – CodeCommit, CodeBuild, CodeDeploy, and CodePipeline, integrating GitHub with CodePipeline, creating a DevOps lifecycle using AWS DevOps tools. **Case Study:** CloudFormation for Infrastructure-as-Code.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** Elastic Load Balancer and Auto Scaling to solve distribution of load among instances and Instance creation and termination using Autoscaling, demonstrating Load balancer, Autoscaling Compute Capacity in AWS	L2, L3 &L6
2	**Analyze** AWS Virtual Private Cloud, Simple Storage Service (S3) will be able to Custom VPCs in AWS. Demonstrate VPCs in AWS for cross-region replication, data encryption, connecting using VPC endpoint	L2, L4, &L6
3	**Solve** Amazon RDS, DynamoDB by applying CloudFormation Template, Simple Notification Service, and Simple Email Service. Demonstrate Relational Database in AWS-Sending Notifications	L3 & L6
4	**Utilize** Identity Access Management, Multi-factor Authentication (MFA) such as Access Management. CloudWatch, AWS Lambda, Beanstalk and Configuration Management, AWS OpsWorks. Creating Administering user access using AWS IAM.	L2, L3 & L6
5	**Apply** Code Deploy using AWS Developer tools. Migration process in AWS, Migrating an on-premises database server to RDS. Create CloudFormation for Infrastructure-as-Code	L3, L4 & L6

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	0	2	0	0	0	0	0	0	1	2	1
CO2	3	2	2	0	2	0	0	0	0	0	0	1	2	1
CO3	3	2	2	0	2	0	0	0	0	0	0	1	2	1
CO4	3	2	2	0	2	0	0	0	0	0	0	1	2	1
CO5	3	2	2	0	2	0	0	0	0	0	0	1	2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Ben Piper, David Clinton, "**AWS Certified Solutions Architect Study Guide**",22 February 2021.

REFERENCE BOOKS:

1. Abdul Jaseem, "**AWS Certified Solution Architect Associate**",2020.
2. John Culkin, Mike Zazon, "**AWS Cookbook**", O'REILLY, First edition, 2021.
3. Saurabh Shrivastava, Neelanjali Srivastav, Alberto Artasanchez , Imtiaz Sayed , "**AWS for Solutions Architects**", Packt Publishing (2023).

E-Resources:

1. https://docs.aws.amazon.com/
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/amazon-web-services-aws/

****

Professional Electives: Networks and Cyber Security Stream

Professional Electives: Networks and Cyber Security Stream

CRYPTOGRAPHY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE5111	**Credits**	:	4
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** their knowledge of Divisibility and Prime numbers to learn the Congruency which will be used in techniques of Cryptography like Euclid algorithm, Fermat theorem and Chinese Remainder Theorem.
2. **Illustrate** the importance of Discrete logarithm by learning concepts like Groups, Rings and Fields knowns as algebraic structures, that will be used in designing Crypto systems.
3. **Analyze** the design principles of Symmetric ciphers by applying Linear Congruential Generators and Shift Registers to design the Pseudo Random number generators in the operation of Key generation phase.
4. **Apply** the number theory concepts to design the Encryption techniques to secure the data in the Applications and the Networks.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: NUMBER THEORY	**8 Hours**
Introduction-Divisibility-Greatest common divisor -Prime numbers - Fundamental theorem of arithmetic - Fermat numbers - Euclidean algorithm - Fermat's theorem - Euler totient function - Euler's theorem. Congruences: Definition - Basic properties of congruences - Residue classes - Chinese remainder theorem.	
UNIT – II: GROUPS, RINGS & FIELDS	**7 Hours**
Groups - Cyclic groups, Cosets, Modulo groups -Primitive roots - Discrete logarithms. Rings – Sub rings, ideals and quotient rings, Integral domains. Fields - Finite fields – GF(Pn), GF(2n) - Classification -Structure of finite fields.	
UNIT – III: PSEUDO RANDOM GENERATORS	**8 Hours**
Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/ KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M,PKZIP (Text 3: Chapter 16),	
UNIT – IV: BASICS OF CRYPTO	**8 Hours**
Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties Cryptographic Hash - Introduction, Properties, Construction, Applications and Performance, The Birthday Attack, Discrete Logarithm	
UNIT – V: Private & Public Key Crypto	**8 Hours**
SYMMETRIC KEY CIPHERS: – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation Public Key Cryptography and RSA – RSA Operations, Why Does RSA Work?, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS)	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand how to design the Algorithms for building the Crypto systems by using Number theory	L2
2	Apply algebraic structures to design the Discrete logarithm for securing the data	L3
3	Understand the basic principles of Cryptography to design the Crypto systems.	L2
4	Apply symmetric and asymmetric cryptography algorithms to encrypt and decrypt the information.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1			1		
CO2	3	2	2	1					1			1		
CO3	3	2	2	1					1			1		
CO4	3	2	2	1	3				1			1		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

CRYPTOGRAPHY LABORATORY

Experiments are conducted using suitable programming language, tools

1. Write a program to implement the Divisibility of a number.
2. Design a model for Chinese Remainder theorem using suitable program.
3. Implement the Discrete logarithm to check the complexity of factorization
4. Write a program to implement Hill cipher and also check for possible attacks on it.
5. Write a program to implement RSA algorithm and show the time complexities for encryption and decryption process

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition
3. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C",Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

REFERENCE BOOKS:

1. Cryptography and Network Security- William Stallings, Pearson Education, 6th Edition
2. Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-GrawHill, 3rd Edition, 2015

E-Resources:

1. https://www.youtube.com/watch?v=Oyw5OmOd9B8
2. https://www.youtube.com/watch?v=Dorm0_UyKFw
3. https://www.youtube.com/watch?v=WUSG7sI6YoU&t=71s

****

STEGANOGRAPHY AND DIGITAL WATERMARKING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Course Code	:	23CSE5112	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** their knowledge of water marking and steganography its applications, properties, Evaluating and testing watermarking systems and steganographic systems
2. **Analyze**. Communication based models of watermarking, geometric models and modeling detection by correlation, analyzing error, authentication.
3. **Utilize** the practical dirty paper codes, perceptual models and content authentication.
4. **Employ** various models, applications and examples used in watermarking and steganography
5. **Apply** the techniques and practical examples to be implemented in real world systems.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction, Applications and Properties Models of Watermarking	**08 Hours**
Information hiding, steganography and water marking its history and importance, Applications, properties of watermarking and steganography, communication and geometric based watermarking	
UNIT – II: Basic Message Coding, Watermarking with Side Information	**08 Hours**
Mapping messages and message vectors, Error correction coding, information embedding, Watermarking with Side Information, dirt paper codes,	
UNIT – III:, Analyzing Errors, Using Perceptual Models	**08 Hours**
Message False positive, False negative errors, ROC curves, evaluating perceptual impact of watermarks, two examples, perceptually adaptive water marking	
UNIT – IV: Watermark Security, Content Authentication	**08 Hours**
Security requirements, watermark security and cryptography, exact authentication, selective authentication, localization, restoration	
UNIT – V: Steganography, Steganalysis	**07 Hours**
Steganographic communication, information theoretic foundations of steganography, minimizing the embedding impact, steganalysis scenarios	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** their knowledge of water marking and steganography its applications, properties, Evaluating and testing watermarking systems and steganographic systems	L3
2	**Analyze** Communication based models of watermarking, geometric models and modeling detection by correlation, analyzing error, authentication.	L2 & L3
3	**Solve** various models, applications and examples used in watermarking and steganography	L3
4	**Utilize** the practical dirty paper codes, perceptual models and content authentication.	L2 & L3
5	**Apply Apply** the techniques and practical examples to be implemented in real world systems	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1	1			2	
CO2	3	2	2	1					1	1			2	
CO3	3	2	2	1					1	1			2	
CO4	3	2	2	1					1	1			2	
CO5	3	2	2	1					1	1			2	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker "Digital Watermarking and Steganography", Second Edition, Morgan Kaufmann Series in Multimedia Information and Systems, 2008.

REFERENCE BOOKS:

1. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Mathew Miller, "Digital Watermarking: Principles and Practice", Morgan Kaufmann Series in Multimedia Information and Systems, 2008.
2. Stefan Katzenbeisser, Fabien A. P. Petitcolas, "Information Hiding Techniques for Steganography and Digital Watermarking", Artech House, 2000.
3. Frank Y. Shih, "Digital Watermarking and Steganography: Fundamentals and Techniques", CRC Press, USA, 2007.
4. Juergen Seitz, "Digital Watermarking for Digital Media", IGI Global, 2005.

E-Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105217/

****

CYBER SECURITY AND PRIVACY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5211	**Credits**	:	4
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. To understand various types of cyber-attacks and cyber-crimes
2. To learn threats and risks within context of the cyber security
3. To have an overview of the cyber laws & concepts of cyber forensics
4. To study the defensive techniques against these attacks

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction to Cyber Security	**8 Hours**

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT – II: Cyberspace and the Law & Cyber Forensics	**8 Hours**

Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT – III: Cybercrime: Mobile and Wireless Devices	**8 Hours**

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT – IV: Cyber Security: Organizational Implications	**7 Hours**

Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations

UNIT – V: Privacy Issues	**8 Hours**

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Analyze and evaluate the cyber security needs of an organization.	L4
2	Understand Cyber Security Regulations and Roles of International Law.	L2
3	Design and develop a security architecture for an organization.	L2
4	Understand fundamental concepts of data privacy attacks	L2

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	2				1			1		
CO2	3	2	2	1	1				1			1		
CO3	3	2	2	1	1				1			1		
CO4	3	2	2	1	1				1			1		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

CYBER SECURITY AND PRIVACY LABORATORY

Experiments are conducted using suitable programming language, tools

1. Analyze the packets in the network flow using Wireshark. Also show the various layer headers and inspect at deep level.
2. Conduct the packet sniffing to grab the User credentials on the network using Wireshark.
3. Extract the metadata from the hidden image using any Exif tool
4. Demonstrate Man in the Middle attack using Burpsuite and prepare a report of data breach
5. Demonstrate the Email spoofing using suitable tools

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.

REFERENCE BOOKS:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

****

BLOCKCHAIN TECHNOLOGIES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Course Code	:	23CSE5212	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the basic concepts of blockchain and cryptography, mining, merkle tree concepts used in blockchain to develop decentralized applications. .
2. **Apply** the solidity programming language for smart contract development in real world applications such as library management system, student management system ,employee management system.
3. **Utilize** Ethereum blockchain to build applications using geth, metamask, ganache, truffle blockchain tools.
4. **Develop** Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare - Blockchain in Cyber security - Blockchain in Financial Industry.
5. **Understand** Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, Hosting our frontend: Serving your frontend using IFPS, Serving your frontend using Swarm, IPFS file uploader project: Project setup the web page.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE 1: INTRODUCTION TO BLOCKCHAIN	**09 Hours**

Distributed DBMS – Limitations of Distributed DBMS, Introduction to Block chain – History, Definition, Distributed Ledger, Blockchain Categories – Public, Private, Consortium, Blockchain Network and Nodes, Peer-to-Peer Network, Mining Mechanism, Generic elements of Blockchain, Features of Blockchain, and Types of Blockchain.

Blockchain Architecture – Block, Hash, Distributer P2P, Structure of Blockchain- Consensus mechanism: Proof of Work (PoW), Proof of Stake (PoS), Byzantine Fault Tolerance (BFT), Proof of Authority (PoA) and Proof of Elapsed Time (PoET)

MODULE 2: BLOCKCHAIN-BASED FUTURES SYSTEM	**09 Hours**

Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3J- Installing web3j- Wallet creation, Java client: The wrapper generator- Initializing web3j- Setting up Ethereum accounts- Deploying the contract.

Practical component:

1. create a Maven project using Web3j.
2. Construct and deploy your contract (Use deploy method)

MODULE 3: ETHEREUM	**06 Hours**

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

Ethereum (ETH) – Smart Contracts, UTXO, Types of Accounts - Externally controlled accounts and Contract account, Merkley Tree, Ether, Components of Ethereum Transaction, DApps, Hard & Soft Fork, Bitcoin Stack versus Ethereum Stack.

Practical Component: 1. Study of Ethereum tool -Ganache.	
MODULE 4: DISTRIBUTED STORAGE IPFS AND SWARM	**07 Hours**
Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS, Hosting our frontend: Serving your frontend using IFPS, Serving your frontend using Swarm, IPFS file uploader project: Project setup the web page.	
MODULE 5: USE CASES	**08 Hours**
Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare - Blockchain in Cyber security - Blockchain in Financial Industry. Practical Component: 1) Do a survey on the various real-time applications in cryptocurrencies (Bitcoin and Ethereum) and give pictorial representation of the same by considering the common aspects. 2) Suggested Readings: https://builtin.com/blockchain/blockchain-applications.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Outline** the basic concepts of blockchain and cryptography, mining ,merkle tree concepts used in blockchain to develop decentralized applications.	L3
2	**Use** solidity programming for smart contract development in real world applications such as library management system ,student management system ,employee management system.	L3
3	**Implement** Ethereum blockchain applications using geth, metamask, ganache , truffle blockchain tools.	L3
4	**Develop** Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare - Blockchain in Cyber security - Blockchain in Financial Industry.	L4
5	**Adapt** the advanced concepts of blockchain programming language and tools to develop complex blockchain application	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		3										2	
CO2	3		3		3							3	2	
CO3	3		3		3								2	
CO4	3		3		3								3	
CO5	3		3	3	3				3			3	3	
avg	15/15		15/15	3/3	12/12				3/3			`6/6	12/15	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.

REFERENCE BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfede, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, 2016.
2. Melanie Swa "Blockchain", First Edition, O'Reilly Jan 2015.

E-Resources:

1. https://www.udemy.com/course/build-your-blockchain-az/

2. https://www.coursera.org/specializations/introduction-to-blockchain
3. https://www.udemy.com/course/build-blockchain/

****

WIRELESS NETWORKS AND 5G

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE6308	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(T)+26(P) Hrs
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** the knowledge of frequencies & regulations, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular system.
2. **Analyze**. the Medium Access Control terminologies such as SDMA, FDMA, TDMA CDMA and Telecommunication Systems such as GSM, TETRA, UMTS.
3. **Utilize** the concepts of Wireless LAN in IR vs. radio, infrastructure/ad-hoc, IEEE 802.11, mobile QoS, Bluetooth, IEEE 802.15
4. **Employ** the High-level requirements for 5G architecture – Fundamentals architecture and 5G flexibility – Physical Architecture and 5G deployment.
5. **Apply** the knowledge of Radio Resource Management (RRM) for mobile broadband applications, multi-hop D2D communication, and multi-operator D2D communication

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction, Wireless Transmission	**08 Hours**
Introduction: applications, history, market vision, overview, **Wireless Transmission:** frequencies & regulations, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular system	
UNIT – II: Medium Access Control, Telecommunication Systems:	09 **Hours**
Medium Access Control: motivation, SDMA, FDMA, TDMA (fixed, Aloha, CSMA, DAMA, PRMA, MACA, collision avoidance, polling), CDMA **Telecommunication Systems:** GSM (HSCSD, GPRS), TETRA, UMTS/IMT-2000	
UNIT – III:, Wireless LAN	**07 Hours**
Wireless LAN: IR vs. radio, infrastructure/ad-hoc, IEEE 802.11 (a, b, g, h), mobile QoS, Bluetooth, IEEE 802.15	
UNIT – IV: 5G ARCHITECTURE	**08 Hours**
Introduction – High level requirements for 5G architecture – Fundamentals architecture and 5G flexibility – Physical Architecture and 5G deployment.	
UNIT – V: DEVICE TO DEVICE D2D COMMUNICATION	**07 Hours**
– D2D: from 4G to 5G – Radio resource management for mobile brand D2D – Multihop D2D communications for proximity and emergency services – Multi-operator D2D communications.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** the knowledge of frequencies & regulations, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular system	L3
2	**Analyze**. the Medium Access Control terminologies such as SDMA, FDMA, TDMA CDMA and Telecommunication Systems such as GSM, TETRA, UMTS.	L2 & L3
3	**Utilize** the concepts of Wireless LAN in IR vs. radio, infrastructure/ad-hoc, IEEE 802.11, mobile QoS, Bluetooth, IEEE 802.15	L3
4	**Employ** the High-level requirements for 5G architecture – Fundamentals architecture and 5G flexibility – Physical Architecture and 5G deployment.	L2 & L3
5	**Apply** the knowledge of Radio Resource Management (RRM) for mobile broadband applications, multi-hop D2D communication, and multi-operator D2D communication	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1	1			2	
CO2	3	2	2	1					1	1			2	
CO3	3	2	2	1					1	1			2	
CO4	3	2	2	1					1	1			2	
CO5	3	2	2	1					1	1			2	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1, Mobile Communications, Jochen Schiller, Addison Wesley/Pears
2. 5G Mobile and Wireless Communications Technology by Afif Osseiran(ed.); Jose F. Monserrat(ed.); Patrick Marsch(ed.); Mischa Dohler(other); Takehiro Nakamura(other) June 2016.

REFERENCE BOOKS:

1.Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
2.Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, —Principles of Mobile Computing‖, Springer, 2003.
3.William.C.Y.Lee,—Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition, Tata Mc Graw Hill Edition ,2006
4. Prasant Kumar Pattnaik, Rajib Mall, —Fundamentals of Mobile Computing‖, PHI Learning Pvt. Ltd, New Delhi – 2012

E-Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105134/
2. https://onlinecourses.nptel.ac.in/noc21_ee102/preview

****

INTRUSION DETECTION SYSTEMS AND FIREWALL

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Course Code	:	23CSE6408	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39(Th)+26(P) Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise.
2. **Understand** theory as well as practical aspects of a subject through scheduled lectures and labs, course will also cover details of concept of security.
3. **Apply** knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems
4. **Understand** the concepts of Introduction to Intrusion, Classification of Intrusion Detection, Vulnerabilities Sources, Counter measures against attacks
5. **Analyze** intrusion detection alerts and logs to distinguish attack types from false alarms and firewalls.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Introduction	**08 Hours**
History of Intrusion detection, Audit, Concept and definition, Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.	

UNIT – II: Types of IDS	**09 Hours**
Intrusion Prevention Systems, Network IDs protocol-based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis	

UNIT – III: Snort IPS	**08 Hours**
Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes	

UNIT – IV: Snort Rules	**07 Hours**
Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with SQL. Using ACID and Snort Snarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs.	

UNIT – V: Firewalls	**07 Hours**
Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology-, Types of Firewalls, Firewall designs, Virus and related threats, Countermeasures, Firewalls design principles, Trusted systems	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Understanding** the concept of Intrusion Detection Systems with the various tools and approaches to detect attacks for securing the network resources	L2
2	**Apply** various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.	L3
3	**Understanding** the snort tool installation and Running Snort on Multiple Network Interfaces by learning features of snort for intrusion detection systems.	L2
4	**Apply** the snort rules, Configuration Files, Preprocessors Output Modules and SQL for the development of intrusion detection, Architecture models of IDs and IPs	L3
5	**Analyze** the types of firewalls and Firewalls design principles used in the internet.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1						1	1				1	1
CO2	3	2	1					1	1				1	1
CO3	2	1			1			1	1				1	1
CO4	3	2	1		1			1	1				1	1
CO5	3	2	2	2				1	1				1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Rafeeq Rehman: "Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall, 2003.
2. Ali A. Ghorbani, Network intrusion detection and prevention concepts and techniques, Springer, 2010

REFERENCE BOOKS:

1. Cryptography and Network Security Principles and Practice William Stallings Pearson Education, Fourth Edition 2005.
2. Stephen Northcutt, Judy Novak: "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002.
3. C. Endorf, E. Schultz and J. Mellander, Intrusion Detection & Prevention, McGrawHill/Osborne.
4. https://www.researchgate.net/publication/339551603_INTRUSION_DETECTION_SYSTEM_-A_STUDY

E-Resources:

1. http://nptel.iitm.ac.in
2. https://www.youtube.com/@iit- https://youtu.be/2YGUvopGkQc?si=GeSHt9pLkX2BGGWT
3. https://www.coursera.org/learn/detecting-cyber-attacks
4. https://www.intechopen.com/books/intrusion-detection-systems/

****

INTERNSHIP

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Course Code	:	23CSE6301	**Credits**	:	12
Hours / Week	:	24 Hours	**Total Hours**	:	312 Hours
L–T–P–J	:	0–0–0–24			

Course Learning Objectives:

This course will enable students to:

3. To expose students to the industrial environment
4. To create competent professionals for the industry.
5. To provide possible opportunities to learn, understand and sharpen the real time technical /managerial skills required at the job
6. To work on a problem assigned by a mentor at industry, prepare action plan and complete within time limit
7. To learn, create/prepare report for Project/research as used in industry with productive and efficient way
8. To strengthen industry-institute linkage and increase employability of the students

Guideline for Internship:

1. The course includes a 16 weeks of on-job training on current industry-relevant problem through supervised self-learning approach The internship is an individual activity.
2. The student should obtain approval from the chairman/supervisor to pursue.
3. A student shall submit a brief proposal about the work to be carried out in the internship, to a coordinator within 3 weeks, after starting the internship.
4. A comprehensive report is required to be prepared and submit to the department at the end of the semester.
5. A certificate shall be attached with this report duly signed by the competent authority of the industry for the successful completion of the internship.
6. An attendance report shall also be attached with this report.
7. The CIA evaluation will be done by faculty mentor or Industry Supervisor. There is no SEE Exam for this course.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand the modern tools used in the field of Computer science and engineering for product development.	L2
2	Demonstrate ethical conduct and professional accountability while working in a team for the benefit of society	L2
3	Understand the resources requirement and planning to facilitate the project success	L2
4	Develop and refine oral and written communication skills	L3
5	Demonstrate knowledge of the industry in which the internship is done	L3

****

DISSERTATION / RESEARCH PROJECT

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Course Code	:	23CSE6401	**Credits**	:	12
Hours / Week	:	24 Hours	**Total Hours**	:	312 Hours
L–T–P–J	:	0–0–0–24			

Course Learning Objectives:

This course will enable students to:

1. Detailed design of the solution to the problem statement and project management using software engineering skills
2. Write efficient code and test the code to find any bugs and resolve the same leading to completion and deployment of the project using modern tools.
3. Analyze and synthesize the project results.
4. Demonstrate knowledge and understanding of writing the publication/report.
5. Able to work in teams and present the project work

Guideline for Dissertation / Research Project:

1. The project proposed by both the guide and the student should be approved by the department chairman to proceed further.
2. A degree of industrial input and involvement will be encouraged, and can be facilitated through existing academic-industrial collaborations or by addressing specific topics that are of interest to industrial partners.
3. All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from the conception to completion.
4. The project work comprises of the detailed design, implementation, and testing results during the internal and external review. Each student needs to submit the technical paper.
5. There will be CIA evaluation (Project reviews) done by a committee of senior faculty of the Department.
6. Additionally, there will be a Semester end evaluation of the work done that would include an internal Faculty and an external academic expert.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Conduct** a survey of several available literature in the preferred field of study to find the recent advances and gaps	L3
2	**Implement** the mathematics concept and engineering fundamentals, and specialization to **design** a solution using **modern tools** for the defined problem.	L4
3	**Experimenting and evaluating** the results from test data to provide a conclusion to the project work.	L6
4	Develop and refine oral and written communication skills	L3
5	**Demonstrate** an ability to work in teams and to prepare quality documents of project work & **exhibit** technical presentation skills.	L3

****

MOOC COURSE
SEMESTER III & IV

Guidelines

1. Students shall enrol the MOOC courses that is available on the NPTEL/SWAYAM (Swayam.gov.in) platform whenever it notifies (twice in a year).
2. The list of NPTEL / SWAYAM courses related to the department specific that is in line with the students' interest will be announced at the departmental level for enrolment.
    a. That is, the predefined list of courses is provided by the department to the students, and only those courses shall be considered and not others.
3. Students shall also enrol in Coursera / Udemy / Udacity / Infosys Spring Board, where DSU can consider the grades / marks provided by these platforms if they are proctored ones. Examinations are to be conducted by DSU if proctored assessments are not conducted by these platforms.
4. The MOOCs courses option shall be considered ideally for students having a minimum CGPA of 6.75 or students having >= 6.0 CGPA and expressing their keen interest along with undertaking letter (stating they have full confidence in completing the course).
5. The interested student has to enrol as per the guidelines of the NPTEL / SWAYAM or other platforms mentioned in item 3 within enrolment end date.
6. The credits assigned would depend on the number of weeks. The department shall consider 12 weeks course to map for 04 Credits.
7. A faculty member shall be appointed as SPOC to keep a track of students undertaking courses and collect certificates from students upon completion on the platforms mentioned above.
8. Student has to pursue and acquire a certificate for a MOOCs course and after successful completion, the student shall submit the certificate to the Department and credits shall be transferred to the grade card accordingly based on the items 1-3 above.
9. The examination fee for obtaining the certificate shall be borne by the student.
10. In case a student fails to complete the MOOC course, then the student shall repeat the same on the NPTEL/SWAYAM or other platforms mentioned in item 3 or the student may opt for department elective with permission of the department chair.
11. Following is the proposed range for the award of grades towards the credits transfer

Range: Consolidated MOOC Score (Assignment + Proctored exam)	Proposed Grade Point	Grade
90-100	10	O
80-89	9	A+
70-79	8	A
60-69	7	B+
55-59	6	B
50-54	5	C
40-49	4	P
<40	0	F