DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Academic Year 2022-2023

M.Tech (Computer Science and Engineering)

Scheme& Syllabus First and Second Semesters

2022-2024 Batch (80 Credits)

INSTITUTE VISION AND MISSION

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students

- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation

- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION

To emerge as a department of eminence in Computer Science and Engineering in serving the Information Technology Industry and the nation by empowering students with a high degree of technical and practical competence.

MISSION

- To strengthen the theoretical and practical aspects of the learning process by strongly encouraging a culture of research, innovation and hands-on learning in Computer Science and Engineering

- To encourage long-term interaction between the department and the IT industry, through the involvement of the IT industry in the design of the curriculum and its hands-on implementation

- To widen the awareness of students in professional, ethical, social and environmental dimensions by encouraging their participation in co-curricular and extracurricular activities

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAM OUTCOMES (POs)

The student will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex Computer Science and engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems in Computer Science and Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design / Development of Solutions: Design solutions for complex engineering problems and design system components or processes of Computer Science and Engineering that meet the specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments in Computer Science and Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities related to Computer Science and Engineering with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Computer Science and Engineering.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions of Computer Science and Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual and as a member or leader to diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective report and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The student will be able to:

PSO1: Ability to design, develop, implement computer programs and use knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovations.

PSO2: Work with and communicate effectively with professionals in various fields and pursue lifelong professional development in computing.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

The Graduate of the program will be able to:

PE01: Develop proficiency as computer scientists with an ability to solve a wide range of computational problems in industry, government, or other work environments.

PE02: Attain the ability to adapt quickly to new environments and technologies, assimilate new information, and work in multi-disciplinary areas with a strong focus on innovation and entrepreneurship.

PE03: Possess the ability to think logically and the capacity to understand technical problems with computational systems.

PE04: Possess the ability to collaborate as team members and team leaders to facilitate cutting-edge technical solutions for computing systems and thereby providing improved functionality.

M.Tech., COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/Seminar	Tutorial/ Skill DevelopmentActivities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	BSC	22SCS11	MATHEMATICS FOR COMPUTATIONAL THINKING	03	00	00	03	50	50	100	3
2	IPCC/CSE	22SCS12	ADVANCED ALGORITHMS	03	02	00	03	50	50	100	4
3	PCC/CSE	22SCS13	ADVANCED COMPUTER ARCHITECTURE	03	00	02	03	50	50	100	4
4	PCC/CSE	22SCS14	CONCURRENT PROGRAMMING	02	00	02	03	50	50	100	3
5	PCC/CSE	22SCS15	UX/UI DESIGN PRINCIPLES	02	00	02	03	50	50	100	3
6	MCC/CSE	22RMI16	Research Methodology and IPR	03	00	00	03	50	50	100	3
7	PCCL/CSE	22SCL17	MACHINE LEARNING LAB	01	02	00	03	50	50	100	2
8	AUD/AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
			TOTAL	17	04	06	21	350	350	700	22

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, MCC- Mandatory Credit Course, AUD/AEC –Audit Course / Ability Enhancement Course(A pass in AUD/AEC is mandatory for the award of the degree), PCCL-Professional Core Course lab, **L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities**(Hours are for Interaction between faculty and students)

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MATHEMATICS FOR COMPUTATIONAL THINKING

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Course Code	: 22SCS11	**Credits:**	**03**
L: T: P: S	: 3:0:0:0	**CIE Marks:**	**50**
Exam Hours	: 03	**SEE Marks:**	**50**

Course Outcomes: At the end of the Course, the Student will be able to do the following:

22SCS11.1	To become computational proficient by involving procedures in Linear Algebra
22SCS11.2	To extrapolate the understanding of statistics.
22SCS113	To apply the concept of random variables and probability theory in computational processes
22SCS11.4	Apply the technique of Singular value decomposition for data compression, least square approximation solving in consistent linear systems.
22SCS11.5	Apply the Graph Theory concepts in solving problems related to computer science.

Mapping of CO v/s PO:

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SCS11.1	3	3	3	3	-	-	-	-	-	-	-	-
22SCS11.2	3	3	3	3	3	-	-	-	-	-	-	-
22SCS113	3	3	3	3	-	-	-	-	-	-	-	-
22SCS11.4	3	3	3	3	-	-	-	-	-	-	-	-
22SCS11.5	3	3	3	3	3	-	-	-	3	-	-	-

Correlation levels: 1-Slight (Low), 2-Moderate (Medium), 3-Substantial (High)

Course Syllabus:

Module No.	Contents of Module	Hours	CO's
1.	**Basic Arithmetic operations on Vectors and Matrices:** Inverse and elementary determinant calculation, Solving system of equations using row reduction, Euclidean spaces, Linear independence, Spanning, Basis, Rank, Nullity, Subspace, Positive definite matrix and its meaning.	9	**22SCS11.1**
2.	**Statistical inference:** Introduction to multivariate statistical models: Correlation	9	**22SCS11.2**

	and Regression analysis, Curve fitting (Linear and Non-Linear)		
3.	**Probability:** Basics of Probability, Sample points and Sample spaces, Independent events, Algebra of events, Partitions, Probability Axioms, Bayes' Theorem, Joint and Conditional Probability. **Random Variables:**Definition of random variables, continuous and discrete random variables, Cumulative distribution Function, probability density and mass functions, properties, Expectations.	9	**22SCS11.3**
4.	**Orthogonality and least squares:** Orthogonal Vectors and subspaces, projections and least square problems, orthogonal bases and Gram- Schmidt orthogonalization process, Computation of Eigen values and Eigen vectors, Diagonalization of a matrix, Singular Value Decomposition.	9	**22SCS11.4**
5.	**Graph Theory:** Basic Concepts of Graphs, Sub graphs, Matrix representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphism, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multi-graphs, Planar Graphs, Trees, Eccentricity, Radius, Diameter - (Concepts and Problems Only, Theorems without Proofs).	9	**22SCS11.5**

Reference Books:
1. Advanced Engineering Mathematics: E. Kreyszig and E.J. Norminton, Maple Computer Guide,
   10th Edition, ISBN: 978-0-470-45836-5.
2. Higher Engineering Mathematics, B S Grewal, KHANNA PUBLISHERS; Forty Fourth edition,
   ISBN: 978-8193328491.
3. Probability, Random Variables, and Random Processes: Theory and Signal Processing Applications, John J. Shynk, Wiley Publishers, 2012, ISBN: 978-0-470-24209-4
4. G.I.; V.P. DymnikovMarchuk, Problems of Computational Mathematics and Mathematical Modelling, MIR Publishers, First Edition, 1985, ISBN: 978-0828533744.
5. J. A. Bondy and U. S. R. Murty, —Graph Theory and Applications‖, Macmillan Press, 1982,
   ISBN: 978-1-84996-690-0.
6. Richard A Brualdi, Introductory Combinatorics 5[th]Edition, Pearson 2009, ISBN: 978-7-111-26525-2.

7. K. S. Trivedi, —Probability and Statistics with Reliability, Queuing for Computer Science Applications, 2nd Edition,2001, ISBN: 978-0-471-33341-8
8. David C. Lay, Steven R. Lay and Judi J. McDonald, Linear Algebra and its Applications, Pearson Education Limited, Sixth Edition, 2021, ISBN: 978-1292351216.

Assessment Pattern:

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests (25 Marks)	Assignments (15 Marks)	Quizzes (10 Marks)
Remember	5	5	-
Understand	5	5	-
Apply	10	5	10
Analyze	2.5	-	-
Evaluate	2.5	-	-
Create	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Category	Questions (50 Marks)
Remember	10
Understand	10
Apply	20
Analyze	5
Evaluate	5
Create	--

ADVANCED ALGORITHMS

Course Code	: 22SCS12	**Credits**	: 04
L: T: P: S	: 3:0:2:0	**CIE Marks**	: 50
Exam Hours	: 3	**SEE Marks**	: 50

Course Outcomes: At the end of the course, students able

CO #	COURSE OUTCOMES
22SCS12.1	Describe iterative and recursive algorithms
22SCS12.2	Understand graph search algorithms to analyze its space and time
22SCS12.3	Apply number theoretic algorithms and analyze its performance
22SCS12.4	Analyze and evaluate the implementation of various string matching
22SCS12.5	Formulate the strategies for algorithmic optimization
22SCS12.6	Develop efficient programming solutions to various real-time scenarios

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS12.1	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS12.2	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS12.3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS12.4	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS12.5	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS12.6	3	3	3	3	3	-	-	-	3	-	-	3	3	3

Module	Contents of the Module	COs	Hours
1	**Review of Analysis Techniques:** Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.	**22SCS12.1**	**9**
2	**Graph Algorithms:** Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The	**22SCS12.2**	**9**

	DFT and FFT; Efficient implementation of FFT		
3	**Number - Theoretic Algorithms:** Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA Crypto system; Primality testing; Integer factorization.	**22SCS12.3**	**9**
4	**String-Matching Algorithms:** Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.	**22SCS12.4**	**9**
5	**Probabilistic and Randomized Algorithms:** Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.	**22SCS12.5** **22SCS12.6**	**9**

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein: Introduction to Algorithms, Fourth Edition, Prentice-Hall of India, ISBN: 9780262046305, 2022.
2. Jeff Erickson: Algorithms, Jeff Erickson., 2019, ISBN: 1792644833, 9781792644832, 2019.
3. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, ISBN: 8131505219, 9788131505212, 2008.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Silicon press, ISBN-13: 978-0-929306-41-4, ISBN: 0-929306-41-4, 2007.

CIE- Continuous Internal Evaluation (50Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	-
Understand	5	--	5
Apply	5	7.5	5
Analyze	10	7.5	-
Evaluate	-	-	-
Create	-	-	-

SEE- Semester End Examination: Theory (50 Marks)

Bloom's Category	Tests
Remember	-
Understand	10
Apply	20
Analyze	10

Evaluate	10
Create	-

ADVANCED COMPUTER ARCHITECTURE

Course Code : 22SCS13   **Credits** : 04
L: T: P: S : 3:2:0:0   **CIE Marks** : 50
Exam Hours : 3   **SEE Marks** : 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS13.1	Describe and Identify the advanced parallel computational mechanism
22SCS13.2	Interpret and apply various techniques used in optimizing the storage capabilities
22SCS13.3	Analyze various performance issues related to memory and processor architectures
22SCS13.4	Evaluate the features and performance related issues in multi-core architecture
22SCS13.5	Assess the performance of Vector architecture and SIMD extensions
22SCS13.6	Formulate the performance measures in GPU architectures

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS13.1	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS13.2	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS13.3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS13.4	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS13.5	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS13.6	3	3	3	3	3	-	-	-	3	-	-	3	3	3

Course Contents

Module No	Module Contents	Hours	COs
1	**FUNDAMENTALS OF COMPUTER DESIGN AND ILP** Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges – Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading	9	22SCS13.1
2	**MEMORY HIERARCHY DESIGN** Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection - Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.	9	22SCS13.2
3	**MULTIPROCESSOR ISSUES** Introduction - Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks	9	22SCS13.3
4	**MULTICORE ARCHITECTURES** Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.	9	22SCS13.4
5	**VECTOR, SIMD AND GPU ARCHITECTURES** Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies –GPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.	9	22SCS13.5 22SCS13.6

Text Book(s):

1. John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier, Sixth Edition, 2017, ISBN:9780128119068, 0128119063.

2. Darryl Gove, ―Multicore Application Programming: For Windows, Linux, and Oracle Solaris, Pearson, 2011, ISBN : 9780321711373, 0321711378.

Reference Book(s):

1. David B. Kirk, Wen-mei W. Hwu, ―Programming Massively Parallel Processors, Morgan Kauffman, 2012 , ISBN:9780123914187, 0123914183.

2. Kai Hwang and Zhi.WeiXu, —Scalable Parallel Computing‖, Tata McGraw Hill, New Delhi, 2003 , ISBN : 9780070530706, 007053070X.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Bloom's Level	Bloom's Category	Tests (25 Marks)	Assignment(15)	Quiz(10)
L1	Remember			
L2	Understand	5		
L3	Apply	5	7.5	5
L4	Analyze	10	7.5	5
L5	Evaluate	5		
L6	Create			

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of 50)
L1: Remember	5
L2: Understand	10
L3: Apply	10
L4: Analyze	15
L5: Evaluate	10
L6: Create	-

CONCURRENT PROGRAMMING

Course Code : 22SCS14		**Credits** : 03
L: T: P: S : 2:2:0:0		**CIE Marks** : 50
Exam Hours : 3		**SEE Marks** : 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS14.1	Understand concepts commonly used in dynamic programming languages.
22SCS14.2	Distinguish how concurrent programming is architected to allow high scala-bility with asynchronous code.
22SCS14.3	Apply the even-driven programming constructs and techniques.
22SCS14.4	Examine basic web applications with concurrent programming.
22SCS14.5	Interpret and evaluation the concurrent application deployment paradigms.
22SCS14.6	Formulate the database requirements for the concurrent application development.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS14.1	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS14.2	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS14.3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS14.4	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS14.5	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS14.6	3	3	3	3	3	-	-	-	3	-	-	3	3	3

Module No	Module Contents	Hours	Cos
1	**Introduction to JavaScript:** Variables, Operators, Control Structures and Loop statements, Switch statement, Arrays, Functions, String functions. **JavaScript and HTML forms:** getElementById, Email function, Radio Button, Dropdown Lists, Checkboxes and Validating forms.	9	22SCS14.1
2	**Basics of node.js:** Definition, Concepts, Usage of node.js, Core modules, printing in color, Import npm modules, Debugging and Error messages. **Asynchronous Node.js:** Asynchronous basics, Call Stack, Callback	9	22SCS14. 2

	Queue, Event loop, Http requests, Error handling, Callback function, Callback abstraction and Callback chaining.		
3	**Event Driven Programming** – Introduction, Example and Node Applications working paradigm, **Event Emitter** – Class, Methods and Events, **Buffers** – create, read and write, Convert buffers to JSON format, **Streams** – read, write, piping and chaining, **Global objects** - __filename, __dirname, setTimeout(cb,ms), clearTimeout(t), console and process object.	9	**22SCS14.3**
4	**Web Servers** – Introduction, Web Application architecture, Creating a web server using Node, Serving up HTML and JSON, Static assets, CSS, JS images, Dynamic Pages with Templating, **Accessing API from browser** – The Query String, Default Function Parameters, Browser HTTP Requests with Fetch, Creating a Search Form.	9	**22SCS14.4, 22SCS14.5**
5	**Application Deployment** – Introduction to any one Online development platform (like GitHub, Heroku), Version control, Exploring, Integrating, Setting up SSH keys, Pushing code. **Databases: MongoDB and NoSQL introduction** - Installation, Connecting and Inserting, Querying, Update and Delete documents.	9	**22SCS14.6**

Text Book(s):

1. Learning Node.js Development, Andrew Mead, Packt Publisher, 2018, ISBN: 978-1-78839-554-0
2. A PDF Reference for The Complete Node.js Dev Course-tutorial, Taught by Andrew Mead.
3. Node.js, Tutorial Point Simply easy learning, Online contents.

Reference Book(s):

1. Beginning Node.js by Basarat Syed, Apress, 1st ed. Edition, ISBN: 978-1484201886.
2. Node.js Web Development: Create real-time server-side applications with this practical, step-by-step guide, David Herron, 3rd Revised edition, Packt Publishing, ISBN: 978-1785881503.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	
L3: Apply	5	5
L4: Analyze	10	5
L5: Evaluate	5	5
L6: Create		10

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks(Out of50)
L1: Remember	5
L2: Understand	10
L3: Apply	10
L4: Analyze	10
L5: Evaluate	10
L6: Create	5

UX/UI DESIGN PRINCIPLES

Course Code : 22SCS15   **Credits: 3**
L:T:P:S   : 2:2:0:0   **CIE Marks: 50**
Exam Hours :3   **SEE Marks: 50**

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS15.1	Learn the fundamentals of user interface design characteristics.
22SCS15.2	Describe the user interface design process with relevant case studies.
22SCS15.3	Illustrate the user experience framework and design cross platform experience.
22SCS15.4	Examine the critical elements of user experience for a good business.
22SCS15.5	Evaluate the requirements and structure of user experience elements design.
22SCS15.6	Formulate the skeleton and surface plane of user experience elements

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS15.1	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS15.2	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS15.3	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS15.4	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS15.5	3	3	3	3	3	-	-	-	3	-	-	3	3	3
22SCS15.6	3	3	3	3	3	-	-	-	3	-	-	3	3	3

Module No	Module Contents	Hours	Cos
1	**User Interface Introduction**: Definition, Importance and Benefits of good design. **Characteristics of Graphical Systems**: GUI, Advantage and disadvantages of graphical systems, Characteristics of GUI. **Characteristics of Web User Interface**: GUI vs. Web page design, Merging of graphical Business systems and the web, Principles of user interface design.	9	22SCS15.1

2	**The user interface design process**: Obstacles and pitfalls in development path, five commandments, Common Usability problems, practical and objective measures of usability. **Clients**: Important human characteristics in design, Human considerations in design, user's psychological and physical characteristics, methods for understanding users.	9	**22SCS15.2**
3	**Introduction to UX:** Product development cycle, characteristics of good user experience, The role of a beginner UX designer, responsibility of an entry level UX designer. **Design thinking:** A UX design framework, Designing cross platform experience, UX research, research methods, primary research, secondary research, bias in UX research.	9	**22SCS15.3**
4	**User Experience** – Introducing User Experience, From Product design to User experience design, Designing for experience, User experience and the web, Good user experience is good business. **Elements:** The five planes, Building from bottom to top, A basic duality, Elements of User experience. **Strategy Plane** – Defining the strategy, Product Objectives, User needs.	9	**22SCS15.4**
5	**Scope Plane** – Defining the scope Functionality and content, Defining requirements, Functional specification. **Structure Plane** – Defining the structure, Interaction Design, Information architecture. **Skeleton Plane** – Defining the Skeleton, Convention and Metaphor, Wireframes **Surface Plane** – Defining the surface, Making sense of the senses, Contrast and Uniformity, Design composite and Style guides.	9	**22SCS15.5,** **22SCS15.6**

Text Book(s):

1. The Elements of User Experience: User-Centered Design for the Web and Beyond, Jesse James Garrett, Second Edition, 2011, ISBN: 13: 978-0-321-68368-7.
2. A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012.
3. Wilbent. O. Galitz,"The Essential Guide to User Interface Design", John Wiley& Sons,2001.
4. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.

Reference Book(s):

1. The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011.
2. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz, Wiley Publishing, 2007.
3. The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012
4. Alan Cooper, "The Essential of User Interface Design", Wiley – Dream Tech Ltd.,2002.
5. Wilbert O. Galitz, The Essential Guide to User Interface Design, John Wiley & Sons, Second Edition 2002.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember	--	--
L2: Understand	5	--
L3: Apply	5	5
L4: Analyze	10	5
L5: Evaluate	5	5
L6: Create	--	10

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks(Out of50)
L1: Remember	10
L2: Understand	10
L3: Apply	10

L4: Analyze	10
L5: Evaluate	10
L6: Create	--

RESEARCH METHODOLOGY & IPR

Course Code	: 22RMI16	**Credits**	: 3
L:T:P:S	: 3:0:0:0	**CIE Marks**	: 50
Exam Hours	:3	**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22RMI16.1	Describe the research objectives to define a research problem
22RMI16.2	Summarize the literature survey of research by referring reliable journal and other resources
22RMI16.3	Apply the suitable methods/tools or techniques for research design
22RMI16.4	Analyze several parametric tests of hypotheses to support the research findings and documentation
22RMI16.5	Interpret various forms of the intellectual property and its relevance in businesses
22RMI16.6	Formulate the strategies and resources appropriate for patent works

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
22RMI16.1	3	3	3	3	3	2	1	3	3	2	2	3	3	3
22RMI16.2	3	3	3	3	3	2	1	3	3	2	2	3	3	3
22RMI16.3	3	3	3	3	3	2	1	3	3	2	2	3	3	3
22RMI16.4	3	3	3	3	3	2	1	3	3	2	2	3	3	3
22RMI16.5	3	3	3	3	3	2	1	3	3	2	2	3	3	3
22RMI16.6	3	3	3	3	3	2	1	3	3	2	2	3	3	3

Module No	Module Contents	Hours	COs
1	**Research Methodology An Introduction:** Meaning of Research, Objectives, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Illustrations.	9	22RMI16.1
2	**Reviewing the literature:** Place of the literature review in research, Bringing clarity and focus to the research problem, Searching the existing literature, Reviewing the selected literature, Developing a theoretical/conceptual framework, Writing about the literature reviewed. **Research Design:** 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, Important Experimental Designs.	9	22RMI16.2
3	**Design of Sampling:** Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **Measurement and Scaling:** Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale. **Data Collection**: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	9	22RMI16.3
4	**Testing of Hypotheses:** Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis, Chi-square Test: Test of Difference of more than two proportions, Test of independence of attributes, Test of goodness of fit, Cautions in Using Chi Square Tests. **Interpretation and Report Writing:** Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Presentation, and Writing Research Reports.	9	22RMI16.4
5	**Intellectual Property:** The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, 1970, Trade	9	22RMI16.5

	Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, **Patents Act**: Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents.		22RMI16.6

Text Book(s):

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2. Research Methodology a step-by-stepguide for beginners, Ranjit Kumar, AGE Publications, 3rd Edition, 2011.
3. Study Material (For the topic Intellectual Property undermodule 5),Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September2013.

Reference Book(s):

1. Research Methods: the concise knowledge base Trochim Atomic Dog Publishing 2005.
2. Conducting Research Literature Reviews: From the Internet to Paper, Fink A Sage Publications, 2009.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	**25**	**25**
L1: Remember		
L2: Understand	5	
L3: Apply	5	5
L4: Analyze	10	5
L5: Evaluate	5	5

L6: Create		10

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of 50)
L1: Remember	
L2: Understand	10
L3: Apply	10
L4: Analyze	10
L5: Evaluate	10
L6: Create	*10*

MACHINE LEARNING USING PYTHON LAB

Course Code : 22SCL17   **Credits** : 2
L:T:P:S : 0:0:2:2   **CIE Marks** : 50
Exam Hours :3   **SEE Marks** : 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCL17.1	Discuss and apply the basic concept learning algorithm in machine learning.
22SCL17.2	Illustrate the supervised machine learning algorithmic model for the situation.
22SCL17.3	Apply and analyze the Bayesian statistical learning model.
22SCL17.4	Analyze and evaluate the given data points using classifiers.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCL17.1	3	3	3	3	3	-	-	-	3	-	-	3	3	-
22SCL17.2	3	3	3	3	3	-	-	-	3	-	-	3	3	-
22SCL17.3	3	3	3	3	3	-	-	-	3	-	-	3	3	-
22SCL17.4	3	3	3	3	3	-	-	-	3	-	-	3	3	-

Module No	Module Contents	Hours	COs
1	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	4	**22SCL17.1**
2	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	4	**22SCL17.2**
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	4	**22SCL17.2**
4	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets	4	**22SCL17.2**
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	4	**22SCL17.3**
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	4	**22SCL17.3**
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library classes/API	4	**22SCL17.3**
8	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means	4	**22SCL17.4**

	algorithm. Compare the results of these two algorithms and comment onthe quality of clustering. You can add Python ML library classes/API in the program		
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.	4	**22SCL17.4**
10	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs	4	**22SCL17.4**

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests
Marks (Out of 25)	**25**
L1: Remember	-
L2: Understand	-
L3: Apply	15
L4: Analyze	10
L5: Evaluate	-
L6: Create	-

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of 50)
L1: Remember	-
L2: Understand	-
L3: Apply	30
L4: Analyze	20
L5: Evaluate	-
L6: Create	-

Course Code : 22AUD18/22AEC18
Course Name : ONLINE courses
L:T:P:S : Classes and evaluation procedures are as per the policy of the online course providers.

Classes and evaluation procedures are as per the policy of the online course providers.

About NPTEL-SWAYAM:

1. **NPTEL-SWAYAM is the National MOOCs portal being developed by MHRD, Govt. of India.**

2. **In order to ensure best quality content is produced and delivered, seven National Coordinators have been appointed under SWAYAM.**

3. **NPTEL is the official SWAYAM national coordinator for engineering.**

4. **A learner must earn credits by completing the on-line course successfully.**

5. **Students can review and assess their own progress through assignments (weekly).**

6. **Inculcate mode of self-learning and get access to lectures of IIT/IISc distinguished Faculty.**

7. **Non-traditional education realized through MOOCs is a useful form of online learning and can complement traditional university learning.**

Instructions:

1. **The BoS members will decide the ONLINE courses for which the students need to register and complete within the academic semester.**

2. **The course will be a trending one as well as a need of an hour for student's placements.**

3. **The course will scale-up their employability & entrepreneurial skills**

M.Tech., COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC/CSE	22SCS21	Cloud Computing & Virtualization	02	00	02	03	50	50	100	3
2	IPCC/CSE	22SCS22	Advanced Databases	03	02	00	03	50	50	100	4
3	PEC/CSE	22SCS23X	Professional elective 1	02	00	02	03	50	50	100	3
4	PEC/CSE	22SCS24X	Professional elective 2	02	00	02	03	50	50	100	3
5	MPS/CSE	22SCS25	Mini Project with Seminar	00	04	02	--	100	--	100	3
6	PCCL/CSE	22SCL26	Business Intelligence & Analytics Lab	01	02	00	03	50	50	100	02
7	AUD/ AEC	22AUD27	Suggested ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
		TOTAL		10	08	08	15	350	250	600	18

Note: PCC: Professional core courses, PEC: Professional Elective Courses, IPCC-Integrated Professional Core Courses. MPS-Mini Project With Seminar; AUD/AEC; Audit Courses / Ability Enhancement Courses (Mandatory), PCCL-Professional Core Course lab, **L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities**(Hours are for Interaction between faculty and students)

Professional Elective 1		Professional Elective 2	
Course Code under 22XXX24X	**Course title**	**Course Code under 22XXX25X**	**Course title**
22SCS231	OBJECT ORIENTED ANALYSIS AND DESIGN	22SCS241	SOFTWARE TESTING & AUTOMATION
22SCS232	MICRO SERVICES DESIGN PATTERN	22SCS242	SOFTWARE PROJECT MANAGEMENT
22SCS233	SOFT COMPUTING	22SCS243	RECOMMENDER SYSTEMS
22SCS234	COMPUTER VISION	22SCS244	INFORMATION SECURITY AND ETHICAL HACKING PRACTICES
22SCS235	ARTIFICIAL INTELLIGENCE	22SCS245	NATURAL LANGUAGE PROCESSING

CLOUD COMPUTING & VIRTUALIZATION

Course Code : 22SCS21		**Credits**	: 3
L: T: P: S : 2:2:0:0		**CIE Marks**	: 50
Exam Hours : 3		**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS21.1	Describe the knowledge on core concepts of cloud computing architecture and deployment models.
22SCS21.2	Understand the ideas on virtualization technology implementation and elements of cloud infrastructure.
22SCS21.3	Apply various cloud infrastructure mechanisms and resource billing management.
22SCS21.4	Analyse the cloud programming model using a framework for the distributed processing of large data sets across clusters of computers.
22SCS21.5	Evaluate cloud security mechanism to preserving the confidentiality and integrity of data.
22SCS21.6	Interpret and formulate the cloud computing infrastructure and services using simulation application frameworks.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS21.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS21.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS21.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS21.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS21.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS21.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Cloud Computing** – Introduction, Cloud Computing Architecture – The Cloud Reference Model – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds- Cloud Delivery Models: IaaS, PaaS, SaaS – Open-Source Private Cloud Software: Eucalyptus, Open Nebula, Open Stack. **Hands-on:** Develop insight into the AWS environment.	8	22SCS21.1

2	**VIRTUALIZATION -** Data Center Technology, Virtualization, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Implementation Levels of Virtualization, Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V, KVM, Virtual Box.	9	**22SCS21.2**
	Hands-on: AWS Computing and Marketplace		
3	**CLOUD COMPUTING MECHANISM -** Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System.	9	**22SCS21.3**
	Hands-On: Elastic Cloud Compute - Auto Scaling, Elastic Load Balancing, Catalog Marketplace of AWS		
4	**PROGRAMMING MODEL AND SECURITY -** Apache Hadoop, Hadoop Map Reduce, Hadoop Distributed File System, Hadoop I/O, Developing a Map Reduce Application, Map Reduce Types and Formats, Map Reduce Features, Hadoop Cluster Setup, Administering Hadoop, Threat Agents, Cloud Security Threats. **Cloud Security Mechanism:** Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups.	9	**22SCS21.4** **22SCS21.5**
	Hands-On: Users, Groups, and Roles - Understanding Credentials, Security Policies, IAM Abilities and Limitations of AWS.		
5	**CLOUD COMPUTING TOOLS AND APPLICATIONS -** Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud, Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer, Online Gaming.	9	**22SCS21.6**
	Hands-on: Cloud simulators		

TEXT BOOKS / REFERENCES:

1. Thomas Erl, ZaighamMahood, Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, 2013.
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata McGraw-Hill,2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach",Tata McGraw-Hill Edition, 2010.
4. ArshdeepBahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press(India) Private Limited, 2014.
5. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
6. James E Smith and Ravi Nair, "Virtual Machines", Elsevier, 2005.
7. John Rittinghouse& James Ransome, "Cloud Computing, Implementation,Management and Strategy", CRC Press, 2010.
8. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	
L3: Apply	5	5
L4: Analyze	10	5
L5: Evaluate	5	5
L6: Create		10

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of 50)
L1: Remember	05
L2: Understand	05
L3: Apply	15
L4: Analyze	15

L5: Evaluate	5
L6: Create	5

ADVANCED DATABASES

Course Code	: 22SCS22	**Credits**	: 4
L: T: P: S	: 3:0:2:0	**CIE Marks**	: 50
Exam Hours	: 3	**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS22.1	Identify the features of distributed database design.
22SCS22.2	Demonstrate the distribution strategy for a query of data transmission in advanced database system.
22SCS22.3	Compute the procedure which helps for the management of simultaneous processes to execute without conflicts.
22SCS22.4	Examine the databases that run across multiple processors or CPUs and is mainly designed to execute query operations in parallel.
22SCS22.5	Derive logically interrelated databases distributed over a computer network.
22SCS22.6	Develop the database system to handle data regarding e-commerce, and other online applications.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS22.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS22.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS22.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS22.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS22.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS22.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Distributed Database Design:** Top-Down design process, Distribution design issues, Fragmentation, Allocation, Data Directory. **Database Integration:** Bottom-Up design methodology, Schema Matching, Schema Integration, Schema mapping and Data cleaning. **Data and Access Control:** View Management, Data Security and Semantic Integrity Control.	9	22SCS22.1
2	**Overview of Query Processing**: Query processing problem, Objectives, Characterization of Query Processors, Layers of Query processing. **Query Decomposition** – Normalization, Analysis, Elimination of redundancy, Localization of distributed data. **Optimization of Distributed Queries** – Query Optimization, Centralized Query Optimization, and Join Ordering in distributed queries, Distributed Query Optimization.	9	22SCS22.2
3	**Introduction to transaction management:** Definition of transaction, Properties of transaction, Types of transactions. **Distributed concurrency control: Serializabilty** theory, Taxonomy of concurrency control mechanism.	9	22SCS22.3
4	**Parallel Database Systems** – Architectures, Parallel Data Placement, Parallel Query Processing, Load Balancing, Database Clusters. **Distributed Object Database Management** – Fundamental Object concepts and object models, Object distribution design, Architectural styles, Object Management, Distributed Object Storage.	9	22SCS22.4 22SCS22.5
5	**Web Data Management:** Web graph management, Web search, Web Querying, Distributed XML processing. **Research Issues:** Streaming Data and Cloud computing – Data stream management, Cloud data management.	9	22SCS22.6

TEXT BOOKS / REFERENCES:

1. M. Tamer OZSU and Patuck Valduriez: Principles of Distributed Database Systems, Pearson Edition.
2. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases, McGraw Hill.
3. Raghu Rama Krishnan, Database Systems, Third edition or higher.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	**25**	**25**
L1: Remember		
L2: Understand	5	
L3: Apply	5	5
L4: Analyze	10	5
L5: Evaluate	5	5
L6: Create		10

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of 50)
L1: Remember	05
L2: Understand	05
L3: Apply	15
L4: Analyze	15
L5: Evaluate	5
L6: Create	5

Professional Elective-1

OBJECT ORIENTED ANALYSIS AND DESIGN

Course Code : 22SCS231		Credits	3
L: T: P: S : 2:2:0:0		CIE Marks	50
Exam Hours : 3		SEE Marks	50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS231.1	Identify the requirements and generate use cases.
22SCS231.2	Discuss the unified modelling language notations to develop the system designs.
22SCS231.3	Apply conceptual models for solving operational problems in software and IT environment using UML.
22SCS231.4	Analyze the development of Object-Oriented Software models in terms of - static behavior and dynamic behavior.
22SCS231.5	Evaluate and implement various design patterns.
22SCS231.6	Formulate the concept of multithreading.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS231.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS231.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS231.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS231.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS231.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS231.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Introduction to UML:** Introduction to object-oriented concepts like inheritance, Polymorphism, Information hiding, Importance of modelling, Principles of modelling, Object oriented modelling, An overview of UML, Conceptual model of the UML, Architecture, Software development life cycle. **Basic Structural Modeling:** Classes: Terms and concepts, Common modelling techniques; Relationships Modelling simple dependencies, Single inheritance and structural relationships; Common mechanisms and diagrams. **Advanced Structural Modeling:** Advance classes, Advance relationships, Interfaces, Types and Roles, Packages, Instances.	9	22SCS231.1
2	**The Object-Oriented Design Process:** The object and class Concepts, Identifying classes, Identifying responsibilities, Relationships between Classes, Use Cases, CRC cards, UML class diagrams, Sequence diagrams, State diagrams, Using Java doc for design documentation, Case Study: A voice mail system.	9	22SCS231.2
3	**Class Design**: An overview of the date classes in the java library, designing a day class, the importance of encapsulation, analyzing the quality of an interface, programming by contract, unit testing. **Interface Types And Polymorphism:** The icon interface type, polymorphism, drawing shapes, the comparable interface type, the comparator interface type, anonymous classes, frames and user interface components, user interface actions, timers, designing an interface type.	9	22SCS231.3
4	**Patterns And GUI Programming:** Iterators, the pattern concept, the observer pattern, layout managers and the strategy pattern, components, containers and the composite pattern, scroll bars and the decorator pattern, how to recognize patterns, putting patterns to work. **Inheritance And Abstract Classes:** The concept of inheritance, graphics programming with inheritance, abstract classes, the template method pattern, protected interfaces, the hierarchy of swing components, the hierarchy of standard geometric shapes, the hierarchy of exception classes, when not to use inheritance.	9	22SCS231.4
5	**Frameworks**: Frameworks, applets as a simple framework, the collections framework, a graph editor framework, enhancing the graph editor framework. **Multithreading:** Thread basics, Thread synchronization, Animations. **More Design Patterns**: The Adapter pattern, Actions and the command pattern, the factory method pattern, the proxy pattern, the singleton pattern, the visitor pattern, other design patterns.	9	22SCS231.5 22SCS231.6

Text Book(s):

1. Grady Booch, James Rumbaugh, Ivar Jacobson (2009), The Unified Modeling Language User guide, 2nd edition, Pearson Education, New Delhi, India.
2. Cay Horstmann (2004), Object-Oriented Design and Patterns, Wiley India edition, New Delhi, India.

Reference Book(s):

1. Meilir Page-Jones (2000), Fundamentals of Object-Oriented Design in UML, Pearson Education and NewYork.
2. Craig Larman (2005), An introduction to Object –Oriented Analysis and Design and Unified Process Appling UML and Patterns, 3rdedition, Pearson Education, New Delhi, India.
3. John W. Satzinger, Robert B Jackson, Stephen D Burd (2004), Object-Oriented Analysis and Design with theUnified Process, Cengage learning, India.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember	-	-
L2: Understand	5	5
L3: Apply	5	5
L4: Analyze	5	5
L5: Evaluate	5	5
L6: Create	5	5

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	-
L2: Understand	10
L3: Apply	10
L4: Analyze	10
L5: Evaluate	10
L6: Create	10

MICRO SERVICES DESIGN PATTERN

Course Code	: 22SCS232	**Credits**	: 3
L: T: P: S	: 2:2:0:0	**CIE Marks**	: 50
Exam Hours	: 3	**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS232.1	Identify the key concepts to model the Microservices.
22SCS232.2	Distinguish different types of Microservice communication styles.
22SCS232.3	Illustrate the protocol technology to communicate and propagate data asynchronously across Microservices in order to have eventual consistency.
22SCS232.4	Derive a workflow plan for business processes.
22SCS232.5	Evaluate logical architecture that might coincide (or not) with physical architecture.
22SCS232.6	Design an end-to-end testing procedures for Microservices design.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS232.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS232.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS232.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS232.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS232.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS232.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Microservices:** Introduction, Key concepts of Microservices, Monolith, Enabling technology, Advantages of Microservices. **Modeling Microservices –** Good Microservices attributes, Types of coupling, Domain-driven design, Alternatives to business domain boundaries, Mixing models and exceptions,	9	22SCS232.1
2	**Microservice Communication Styles:** From In-Process to Inter-Process, Technology for Inter-Process communication, Styles of Microservice communication, Pattern: Synchronous blocking and Asynchronous nonblocking, Communication through common data, Request-Response communication, Event-drive communication.	9	22SCS232.2
3	**Implementing Microservice Communication:** Looking for the Ideal technology, Technology choices – Remote Procedure calls, REST, GraphQL, Message Brokers, Serialization formats, Schemas, Handling change between Microservices, Service Discovery, Service Meshes and API gateways.	9	22SCS232.3
4	**Workflow:** Database transactions, Distributed transactions, Sagas. **Build:** Continuous Integration, Build pipelines and continuous delivery, Mapping source code and build to Microservices.	9	22SCS232.4
5	**Deployment:** From logical to physical, Principles of Microservice deployment, Deployment options, Kubernetes and container orchestration. **Testing:** Types of tests, Test scope, Implementing service tests, Implementing End-to-End tests.	9	22SCS232.5 22SCS232.6

Text Book(s):
1. Building Microservices, by Sam Newman, 2nd Edition, 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492034025
2. Microservices with Docker, Flask and React Michael Herman, 2017, EBOOK

Reference Book(s):
1. Production ready Microservices, Susan J. Fowler, O'Reilly, 2017, ISBN: 978-1-491-96597-9.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	
L3: Apply	5	5
L4: Analyze	10	5
L5: Evaluate	5	5
L6: Create		10

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	10
L2: Understand	10
L3: Apply	10
L4: Analyze	10
L5: Evaluate	10
L6: Create	--

SOFT COMPUTING

Course Code	: 22SCS233	Credits	: 3
L: T: P: S	: 2:2:0:0	CIE Marks	: 50
Exam Hours	: 3	SEE Marks	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS233.1	Recognize and depict soft computing methods and their roles in Artificial intelligence and fuzzy logic
22SCS233.2	Discuss neuro-fuzzy principles to deal with optimization problem.
22SCS233.3	Compute convolution neural networks to real time design classification problems.
22SCS233.4	Examine the text analysis on the natural language processing.
22SCS233.5	Interpret the swarm optimization principles for population-based heuristic optimization technique
22SCS233.6	Develop the python programs for nature-inspired computing models.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS233.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS233.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS233.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS233.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS233.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS233.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Artificial Intelligence** – A Brief Introduction – Pitfalls of traditional AI – Why Computational Intelligence? – Computational intelligence concept - Importance of tolerance of imprecision and uncertainty - Constituent techniques – Overview of Artificial Neural Networks, Fuzzy Logic, Evolutionary Computation. **Hands-on :** Python implementation of Fuzzy and evolutionary programs	9	22SCS232.1
2	**Neuro Fuzzy Modelling**: Introduction, Neuro-Fuzzy Hybrid Systems, Genetic Neuro-Hybrid Systems, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Simplified Fuzzy ARTMAP **Hands-on :** Python implementation of neuro Fuzzy model programs	9	22SCS232.2
3	**Deep Learning - Convolutional Neural Networks** : Introduction , Historical Perspective and Biological Inspiration, Broader Observations About Convolutional Neural Networks , The Basic Structure of a Convolutional Network , Padding ,Strides ,Typical Settings, The ReLULayer Pooling, Fully Connected Layers, Interleaving Between Layers, Local Response Normalization, Hierarchical Feature Engineering, Training a Convolutional Network, Backpropagating Through Convolutions, Backpropagation as Convolution with Inverted/Transposed Filter, Convolution/Backpropagation as Matrix Multiplications, Data Augmentation **Hands-on :** Python implementation of deep learning programs	9	22SCS232.3
4	**Natural language processing**- Introducing NLP: patterns and structure in language, Essential reading, Recommended reading ,Additional reading, ,Learning outcomes, Introduction Basic concepts , Tokenized text and pattern matching Activity: Recognizing names, Parts of speech - Identify parts of speech , Constituent structure, Activity: Writing production rules, Finite-state machines- Word structure, Using the Natural Language Toolkit , Corpora Computational tools for text analysis **Hands-on:** Python implementation of NLP program	9	22SCS232.4
5	**Swarm Algorithms:** Ant System, Ant Colony System, Bees Algorithm The Firefly algorithm - algorithm analysis - implementation - variants **Hands-on :** Python implementation swarm algorithm	9	22SCS232.5 22SCS232.6

Text Book(s):

1. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
2. Neural Networks and Deep Learning: 2018 ,Charu C. Aggarwal

Reference Book(s):
1. Jason Brownlee, Clever Algorithms: Nature-Inspired Programming Recipes, Revision 2, 16th June 2012 Chapter 6
2. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	
L3: Apply	5	5
L4: Analyze	10	15
L5: Evaluate	5	15
L6: Create		

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	
L2: Understand	10
L3: Apply	20
L4: Analyze	10
L5: Evaluate	10
L6: Create	

COMPUTER VISION

Course Code	: 22SCS234	**Credits**	: 3
L: T: P: S	: 2:2:0:0	**CIE Marks**	: 50
Exam Hours	: 3	**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS234.1	Understand the fundamentals of image processing techniques required for computer vision.
22SCS234.2	Illustrate image enhancement and filtering mechanism for noise reduction and quality of images.
22SCS234.3	Derive geometric transformation techniques for translation, rotation, scaling, nonlinear warping of images
22SCS234.4	Examine image segmentation for object detection for classification and object detection
22SCS234.5	Evaluate 3D vision and motion related techniques.
22SCS234.6	Formulate various applications of computer vision.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS234.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS234.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS234.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS234.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS234.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS234.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Getting started with OpenCV**: Introduction to Computer Vision and images, Basic image operations, Mathematical operations on images, Applications, Image Annotation. Video IO using High GUI, Binary image Processing: Thresholding, Erosion/Dilation, Opening and Closing, Connected Component Analysis, Contour Analysis, Blob Detection. **Hands-on:** Build QR Code Detector, image annotation using python, Morphological operations in MATLAB	9	22SCS234.1
2	**Image Enhancement and Filtering**: Color spaces, Color Transforms, Image Filtering, Image Smoothing, Image Gradients, **Advanced Image Processing and Computational Photography**: Hough transforms, High Dynamic Range Imaging, Seamless Cloning, Image Inpainting, **Hands-on:** Creating own Instagram filter, Chroma Keying	9	22SCS234.2
3	**Geometric Transforms and Image features**: Geometric Transforms, Image Features, Feature Matching, Applications **Image Segmentation and Recognition**: Image Segmentation using GrabCut, Introduction to AI, Image Classification, Object Detection **Hands-on :** Create Panorama for multiple images, Create your own Selfie App with the features like Skin smoothing filter and Sunglass filter.	9	22SCS234.3 22SCS234.4
4	**3D Vision and motion:** Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion. **Hands-on:** 3D motion capture with just a phone	9	22SCS234.5
5	**Face Recognition, Object Detection**: Overview, Two Stage Object Detectors, Single stage object detectors, YOLO, Measure Performance of Object Detectors, Train a Custom object Detector using YOLO **Text Detection and Recognition:** Overview of OCR , Graphic Text Recognition using Tesseract, Text Detection, Modified Pipeline for scene Text Recognition using Tesseract(Python),	9	22SCS234.6

	Scene Text recognition using Keras OCR(Python), Comparing Keras-OCR and Tesseract(Python) **Hands-on:** Train a face mask detector, Case Study: Automatic Number Plate Recognition(Python)		

Text Book(s):

1. R. Szeliski, —Computer Vision: Algorithms and Applications, 2nd ed. 2022 Edition
2. E. R. Davies, —Computer & Machine Vision, Fifth Edition, Academic Press, 2017.

Reference Book(s):

1. Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning, 3rd Edition,2020
2. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2013.
3. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
4. D. L. Baggio et al., —Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	**25**	**25**
L1: Remember		
L2: Understand	**5**	
L3: Apply	**5**	**5**
L4: Analyze	**10**	**5**
L5: Evaluate	**5**	**5**
L6: Create		**10**

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	**10**
L2: Understand	**10**
L3: Apply	**10**
L4: Analyze	**10**
L5: Evaluate	**10**
L6: Create	

ARTIFICIAL INTELLIGENCE

Course Code	: 22SCS235	Credits	: 3
L: T: P: S	: 2:2:0:0	CIE Marks	: 50
Exam Hours	: 3	SEE Marks	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS235.1	Describe various Artificial Intelligence problem solving techniques and strategies for state space search.
22SCS235.2	Apply and implement search techniques for solving various problems.
22SCS235.3	Analyze the knowledge representation techniques for various problem solving.
22SCS235.4	Evaluate reasoning techniques for uncertainty information domain
22SCS235.5	Examine the natural language in the field of Artificial Intelligence
22SCS235.6	Compose relative challenges pertaining to design of Intelligent Systems

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS235.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS235.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS235.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS235.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS235.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS235.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Introduction to Artificial Intelligence:** Artificial Intelligence and its Application areas; **AI as Knowledge Representation and Search:** The Predicate Calculus: The Propositional Calculus, The Predicate Calculus, Using Inference Rules to Produce Predicate Calculus Expressions, Application: A Logic-Based Financial Advisor. **Structures and strategies for state space search:** Introduction, Structures for state space search, Strategies for State Space Search, Using the State Space to Represent Reasoning with the Predicate Calculus – state space description of logical systems, And/or Graphs.	9	22SCS235.1
2	**Heuristic Search:** Introduction, Hill Climbing, The Best-First Search Algorithm, Heuristic Search and Expert Systems,Admissibility, Monotonicity and Informedness, Using Heuristics in Games, Complexity Issues. **Control and Implementation of State Space Search:** Introduction, Recursion-Based Search, Recursive Search in Knight's tour Problem, Pattern Directed Search, Production Systems, The Blackboard Architecture for Problem Solving.	9	22SCS235.2
3	**Knowledge Representation:** Network representation, Conceptual Graphs, Structured Representation-Frames, Scripts, Issues in Knowledge Representation. **Knowledge Intensive Problem Solving:** Overview of Expert System Technology, Rule-Based Expert Systems, Model-Based Reasoning, Case based Reasoning, Hybrid Design. Classical Planning: Introduction to Planning, Algorithms as State-Space Search, Planning graphs.	9	22SCS235.3
4	**Representing Knowledge in Uncertain Domain:** The Statistical approach to uncertainty, Bayesian Reasoning, Bayesian belief network, Reasoning with Fuzzy sets, **Symbolic Reasoning Under Uncertainty:** Introduction to non-monotonic reasoning, Logic for non-monotonic reasoning, Implementation Issues, BFS,DFS, Statistical Reasoning: Probability and bayes Theorem, Certainty factors and rule-based systems. **Automated Reasoning:** Introduction to Weak Methods in Theorem Proving, The General Problem Solver and Difference Tables, Resolution Theorem Proving; **Hands-on:** 1.Translate each of the following sentences into predicate calculus, conceptual dependencies, and conceptual graphs: "Jane gave Tom an ice cream cone." "Basketball players are tall." "Paul cut down the tree with an axe." "Place all the ingredients in a bowl and mix thoroughly.''	9	22SCS235.4

	2. Using conceptual dependencies, define a script for: a. A fast-food restaurant b. Interacting with a used-car salesperson c. Going to opera		
5	**Understanding Natural Language in Artificial Intelligence:** Language understanding: A Symbolic Approach, Syntax, Combining syntax and semantics in ATN Parsers, Stochastic tool for Language Analysis. NLP Applications. **Artificial Intelligence as Empirical Enquiry:** AI - Revised Definition, Cognitive Science an overview, Understanding Intelligence: Issues and Directions	**9**	**22SCS235.5**

Text Book(s):
1. Artificial Intelligence – Structures and Strategies for Complex problem Solving, George F Luger, 6th Edition, Pearson Publication, 2009, ISBN-10: 0-321-54589-3, ISBN-13: 978-0-321-54589-3.
2. Artificial Intelligence A Modern Approach, Stuart Russel, Peter Norvig, 3rd Edition, Pearson Publication, 2015, ISBN-13: 978-93-325-4351-5.
3. Artificial Intelligence, Elaine Rich, Kevin Knight, 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709, ISBN-13: 978-0070087705

Reference Book(s):
1. Intelligent Systems-A Modern Approach, Grosan, Crina, Abraham, Ajith, Springer-Verlag Berlin Heidelberg 2011, ISBN 9783642269394, 2011.
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, ISBN-13: 9780934613101

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	5
L3: Apply	10	10
L4: Analyze	5	5
L5: Evaluate	5	5
L6: Create		

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	
L2: Understand	10
L3: Apply	20
L4: Analyze	10
L5: Evaluate	10
L6: Create	

Professional Elective – 2

SOFTWARE TESTING & AUTOMATION

Course Code	: 22SCS241	**Credits**	: 4
L: T: P: S	: 2:1:0:0	**CIE Marks**	: 50
Exam Hours	: 3	**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS241.1	Understand the process of Software Development and importance of Software Testing.
22SCS241.2	Illustrate the test cases for various black box and white box testing techniques.
22SCS241.3	Examine the software modules and integrate logically to test as a group.
22SCS241.4	Investigate on software testing, after System Testing and before making the system available for actual use
22SCS241.5	Evaluate the process of testing the modified parts and fixing new errors.
22SCS241.6	Formulate new test cases and strategies with other automation testing tools.

Course Outcomes to Program Outcomes Articulation Matrix

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS241.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS241.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS241.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS241.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS241.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS241.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Introduction:** Software Development Life Cycle Model: Phases of Software Project, Life Cycle Models-Waterfall Model, Spiral model, V-model. Basics of software testing: Faults, Errors, and Failures, Testing objectives, Principles of testing, Requirements, behavior and correctness, Test/Debug Life cycle, Test metrics and measurements, Verification and Validation, Software Quality Assurance, Software Quality and Reliability**,** Software defect tracking, Types of testing. **Problem Statements: The triangle problem, The Next Date function, The commission problem, The SATM (Simple Automatic Teller Machine) problem.** Consider any ATM system, design and develop a program in a language of your choice for the same. Create the test cases for the following scenarios: Successful selection of amount to be withdrawn. Unsuccessful operation due to invalid account type Expected message due to amount to withdraw is greater than possible balance. Unsuccessful operation due to enter wrong PIN number 3 times Insufficient balance. Current balance to display. Execute the test cases manually and discuss the result.	9	22SCS241.1
2	**Black Box and White Box Testing:** Black Box testing: Requirements based testing, Boundary value analysis, Equivalence partitioning, State/Graph-based testing, Model based testing and model checking, Differences between white box and Black box testing. White box testing: Static testing, Static analysis tools, Structural testing: **Path Testing, DD-Path Testing, Module/Code functional testing,Miller's Test coverage metrics**, **Code Coverage Testing**, **McCabe's Basis Path Testing**, **Code complexity testing**, **Cyclomatic Complexity, Data Flow Testing, Define/Use Testing.** Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Create the test cases for the following given scenario.	9	22SCS241.2

3	**Integration, System and Acceptance Testing:** Top down and Bottom-up integration, Bi-directional integration, System integration, Scenario Testing, Defect Bash, Functional versus Non-functional testing, Design/Architecture verification, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing, Acceptance testing: Acceptance criteria, test cases selection and execution,	9	22SCS241.3 22SCS241.4
4	**Test Selection & Minimization for Regression Testing:** Regression testing, Regression test process, Initial Smoke or Sanity test, Selection of regression tests, Regression Testing Techniques, Execution Trace, Dynamic Slicing, Test Minimization, Tools for regression testing. Ad hoc Testing: **Buddy Testing,** Pair testing, Exploratory testing, Iterative testing, Agile and Extreme Testing, Defect seeding.	9	22SCS2414.5
5	**Software Test Automation**: Fundamentals of Test Automation – Design and Architecture for Automation – Challenges in Automation. **Introduction to Selenium**: Selenium IDE installation – Recording and running test cases using Selenium IDE – Selenium Commands. **Selenium Web Driver**: Introduction to Web Driver – Architecture – Installation of Selenium Web Driver **Recent Tools in Automation:** Case Study: Appium, Katalon Studio, Cucumber, Test Complete, Lambda Test.	9	22SCS241.6

Text Book(s):
1. Desikan and G. Ramesh, "Software Testing: Principles and Practices", Pearson Education,1st Edition 2005.
2. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 4th Edition, Auerbach Publications, 2017.

Reference Book(s):
1. Aditya P. Mathur, "Fundamentals of Software Testing", Pearson Education.
2. Naik and Tripathy, "Software Testing and Quality Assurance", Wiley
3. K. K. Aggarwal and Yogesh Singh, "Software Engineering", New Age International Publication.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	5
L3: Apply	5	5
L4: Analyze	10	10
L5: Evaluate	5	5
L6: Create		

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	
L2: Understand	10
L3: Apply	15
L4: Analyze	15
L5: Evaluate	10
L6: Create	

SOFTWARE PROJECT MANAGEMENT

Course Code	: 22SCS242		Credits	: 3
L: T: P: S	: 2:2:0:0		CIE Marks	: 50
Exam Hours	: 3		SEE Marks	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS242.1	Identify the project management terminologies and processes.
22SCS242.2	Summarize the elements of project integration, scope and schedule management.
22SCS242.3	Compute project cost and quality management.
22SCS242.4	Examine the software project resource and communication management.
22SCS242.5	Evaluate software project risk management.
22SCS242.6	Formulate the software procurement and stakeholder management.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS242.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS242.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS242.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS242.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS242.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS242.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Introduction to Project Management Terminologies:** Basics of Project Management, Project-definition, Project life cycle, Relationship between portfolio management, Program management, Operations management. **Organizational Influences and the Project Life Cycle:** Project Management and various other key topics like the project stakeholders, project governance, the creation of and the importance of a project team, and the project life cycle. **Project Management Processes:** Project Management knowledge areas.	9	22SCS242.1
2	**Project Integration Management:** Coordination of the different elements within a project, project activities, resources, schedules, stakeholders. **Project Scope Management:** Requirements collection, WBS creation, scope control. **Project Schedule Management**: Scheduling the various activities, Deliverables, and Milestones within a project, Defining the relationship between these elements, and Estimating resource allocation and task durations.	9	22SCS242.2
3	**Project Cost Management:** Different processes involved in estimating, Allocating, and Controlling the project budget and Individual activity and Resource costs. **Project Quality Management:** Different processes involved in defining the quality standards and Methods to test the quality and ensure the standards a plan quality management, Perform quality assurance, and control end quality**.**	9	22SCS242.3
4	**Project Resource Management:** Different processes involved in planning resource management, Estimating resource requirements based on activities, and acquiring resources, steps to build, develop, manage, and control resource teams. **Project Communications Management:** Various modes of communication that can be set up within a project for smooth operations.	9	22SCS242.4
5	**Project Risk Management:** Various processes involved in identifying risks, performing a risk analysis, planning risk responses, implementing these responses, and monitoring risks. **Project Procurement Management:** Processes related to the procurement of various resource elements: Workers, Materials, and Equipment. **Project Stakeholder management:** Final knowledge area and process related to the management of individuals who are impacted by the project, namely the stakeholders.	9	22SCS242.5

Text Book(s):

1. PMP Project Management Professional Study Guide, Kim Heldman, 10th edition 2021, ISBN: 978-1119658979

Reference Book(s):

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Seventh Edition and the Standard for Project Management, By Project Management Institute Project Management Institute, ISBN: 9781628257007, 2021

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember	5	-
L2: Understand	5	-
L3: Apply	5	10
L4: Analyze	5	5
L5: Evaluate	-	5
L6: Create	5	5

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	
L2: Understand	10
L3: Apply	10
L4: Analyze	10
L5: Evaluate	10
L6: Create	10

RECOMMENDER SYSTEMS

Course Code	: 22SCS243	**Credits**	: 3
L: T: P: S	: 2:2:0:0	**CIE Marks**	: 50
Exam Hours	: 3	**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS243.1	Provide students with basic concepts of recommender systems.
22SCS243.2	Understand and distinguish the classification models and cluster analysis.
22SCS243.3	Illustrate the content based recommendation systems uses item features to recommend other items.
22SCS243.4	Examine the collaborative filtering uses algorithms to filter data from user reviews to make personalized recommendations for users with similar preferences.
22SCS243.5	Evaluate the constraint-based recommenders support customers by explaining items automatically.
22SCS243.6	Formulate a context-aware recommender system applies sensing and analysis of user context to provide personalized services.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS243.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS243.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS243.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS243.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS243.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS243.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Introduction:** Recommender System function, Data and knowledge sources, Recommendation techniques, Application and evaluation, Recommender systems and human computer interaction, Recommender systems as a multi-disciplinary field. **Mining methods for Recommender Systems:** Data pre-processing – similarity measures, sampling, reducing dimensionality, denoising.	9	22SCS244.1
2	**Classification:** Nearest Neighbors, Decision trees, Ruled-based classifiers, Bayesian classifiers, Artificial Neural Networks, Support Vector Machines, Ensembles of classifiers, Evaluating classifiers. **Cluster Analysis:** k-means. Association rule mining.	9	22SCS244.2
3	**Content-based recommender systems:** Basics of content-based recommender systems – high level architecture, advantages and drawbacks. State of the art of content based recommender systems – Item representation, methods for learning user profiles. **Neighborhood-based recommendation:** User-based rating prediction, User-based classification, Regression vs. classification, Item-based recommendation, User-based vs Item-based recommendation.	9	22SCS244.3
4	**Components of Neighborhood methods:** Rating normalization, Similarity weight computation, Neighborhood selection. Advanced techniques – Dimensionality reduction methods, Graph-based methods. **Collaborative filtering:** Introduction, Matrix factorization models- SVD, SVD++, Time-aware factor model, Neighborhood models – similarity measures, similarity based interpolation.	9	22SCS244.4
5	**Developing constraint based recommenders** – Development of recommender knowledge bases, User guidance in recommendation processes, Calculating recommendations. **Context-aware recommender systems** – Context, Modeling contextual information in RSs, Obtaining contextual information. **Recommendation system properties, Applications of Recommender Systems**.	9	22SCS244.52 2SCS244.6

Text Book(s):
1. Recommender Systems Handbook, Francesco Ricci · Lior Rokach · Bracha Shapira · Paul B. Kantor, ISBN 978-0-387-85819-7 e-ISBN 978-0-387-85820-3 DOI 10.1007/978-0-387-85820-3, c Springer Science+Business Media, LLC 2011.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

3. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.

Reference Book(s):
1. M.D. Ekstrand, J.T. Riedl, J.A. Konstan, Collaborative filtering recommender systems

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	5
L3: Apply	5	5
L4: Analyze	10	10
L5: Evaluate	5	5
L6: Create		

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	
L2: Understand	10
L3: Apply	15
L4: Analyze	15
L5: Evaluate	10
L6: Create	

INFORMATION SECURITY AND ETHICAL HACKING PRACTICES

Course Code	: 22SCS244	Credits	: 3
L: T: P: S	: 2:2:0:0	CIE Marks	: 50
Exam Hours	: 3	SEE Marks	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS244.1	Summarize the concept of Information security and ethical hacking concepts
22SCS244.2	Interpret the importance of foot printing tools
22SCS244.3	Design and evaluate the scanning networks and Enumeration
22SCS244.4	Analyze the trojans, backdoors, and countermeasures
22SCS244.5	Compare and contrast the different vulnerable analysis concepts
22SCS244.6	Develop sniffing and DoS/DDoS Counter measures

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS244.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Information security overview**: Introduction, Elements of information security, The Security, Functionality, and Usability Triangle, Information Security Threat Categories, Types of attacks on a system, Information security controls, information security Laws and standards, **Ethical hacking**: Ethical Hacking concepts	9	**22SCS244.1, 22SCS244.2**
2	**Footprinting and Reconnaissance:** Foot printing Concepts, Foot printing through Search Engines, Foot printing through Web Services, Foot printing through Social Networking Sites, Website Foot printing, Email Footprinting, Competitive Intelligence, WhoisFoot printing, DNS Network, Foot printing ,Footprinting through Social Engineering, ,Countermeasures ,Footprinting Pen Testing.	9	**22SCS244.3**
3	**Scanning Networks:** Network Scanning Concepts, Scanning Techniques, Scanning Beyond IDS and Firewall, Banner Grabbing, Scanning Pen Testing **Enumeration**: Enumeration Concepts, NetBIOS Enumeration, SNMP Enumeration, LDAP Enumeration, NTP Enumeration, SMTP Enumeration and DNS Enumeration, Enumeration Counter measures, Other Enumeration Techniques	9	**22SCS244.4**
4	**Vulnerability Analysis**: System Hacking, Malware Threats, Vulnerability Assessment Concepts, Vulnerability Assessment Solutions, System Hacking Concepts, Cracking Passwords, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Penetration Testing, Malware Concepts, Trojan Concepts, Virus and Worm Concepts, Malware Analysis, Countermeasures, Anti-Malware Software, Malware Penetration Testing	9	**22SCS244.5**
5	**Sniffing**: Sniffing Concepts, Sniffing Technique: MAC Attacks, Sniffing Technique: DHCP Attacks, Sniffing Technique: ARP Poisoning, Sniffing Technique: Spoofing Attacks, Counter measures, Sniffing Detection Techniques, Sniffing Pen Testing, Social Engineering, Denial-of-Service, Session Hijacking, Social Engineering Concepts **DoS / DDoS Concepts**: DoS / DDoS Attack Techniques, Botnets, DDoS Case Study, DoS / DDoS Attack Tools, Counter measures	9	**22SCS244.6**

Text Book(s):
1) CEH (v11) - Certified Ethical Hacker Training
2) James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing", Auerbach Publications, CRC Press

Reference Book(s):

1) EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning
2) Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Défense", Cengage Learning

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	**25**	**25**
L1: Remember		
L2: Understand	**5**	
L3: Apply	**5**	**5**
L4: Analyze	**10**	**5**
L5: Evaluate	**5**	**5**
L6: Create		**10**

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	**10**
L2: Understand	**10**
L3: Apply	**10**
L4: Analyze	**10**
L5: Evaluate	**5**
L6: Create	**5**

NATURAL LANGUAGE PROCESSING

Course Code : 22SCS245		**Credits** : 3
L: T: P: S : 2:2:0:0		**CIE Marks** : 50
Exam Hours : 3		**SEE Marks** : 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS245.1	Compute and analyze the natural language text by applying the basic building blocks.
22SCS245.2	Generate the natural language by using Corpora and Lexical Resources.
22SCS245.3	Demonstrate different text mining processes from various sources.
22SCS245.4	Design a tag set and classifiers with basic language features for real-time applications.
22SCS245.5	Apply various information extraction techniques.
22SCS245.6	Analyze the sentence structure by building and parsing the Context-Free Grammars.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS244.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS244.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Module No	Module Contents	Hours	COs
1	**Language Processing, Accessing Corpora and Lexical Resources:** Computing with Language: Texts and Words - Searching texts - Counting Vocabulary, Texts as Lists of Words: Lists - Indexing Lists - Variables -Strings, Frequency Distributions - Fine-Grained Selection of Words - Collocations and Bigrams, Making Decisions and Taking: Conditions - expressions - Nested Blocks - Looping with Conditions. Accessing Text Corpora: Web and Chat Text - Annotated Text Corpora - Corpora in Other Languages, Conditional Frequency Distributions, Generating Random Text with Bigrams, Lexical Resources Working with NLTK library and WordNet	9	**22SCS244.1, 22SCS244.2**
2	**Text Processing:** Accessing Text from Web and Disk: Electronic Books-Dealing with HTML-Processing Search Engine Results - Processing RSS Feeds - Reading Local Files - Extracting Text from PDF, MSWord, and Other Binary Formats, Strings: Basic Operations - Printing Strings - Accessing Individual Characters – Substrings, Text Processing with Unicode: Extracting Encoded Text, Regular Expressions for Detecting Word Patterns: Metacharacters - Ranges and Closures, Applications of Regular Expressions: Extracting Word Pieces - Word Stems, Normalizing Text: Stemmers - Lemmatization, Regular Expressions for Tokenizing Text, Sentence and Word Segmentation, Formatting. Practicing with functions, Algorithm design, Implementing dynamic Programming and visualization with Matplotlib	9	**22SCS244.3**
3	**Categorizing, Tagging and Classification:** Using a Tagger, Tagged Corpora, Mapping Words to Properties, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, Supervised Classification, Evaluation, Modeling Linguistic Patterns Decision Trees and Naive Bayes Classifiers	9	**22SCS244.4**
4	**Extracting Information from Text:** Information Extraction and Architecture, Chunking: Noun Phrase Chunking - Tag Patterns - Chunking with Regular Expressions - Chinking - Tags Versus Trees, Developing and Evaluating Chunkers - Training Classifier-Based Chunkers, Recursion in Linguistic Structure: Building Nested Structure - trees and Traversal, Named Entity Recognition, Relation Extraction.	9	**22SCS244.5**

5	**Analyzing Sentence Structure:** Grammatical Dilemmas: Linguistic Data and Unlimited Possibilities - Ubiquitous Ambiguity - Beyond n-grams, Context-Free Grammar, Parsing with Context-Free Grammar, Dependency Grammar, Valency and the Lexicon, Scaling Up, Grammar Development, Pernicious Ambiguity, Weighted Grammar, Building Feature-Based Grammars. Development of grammatical features and Processing with thefeature structures	9	22SCS244.6

Text Book(s):
1. Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python" O'Reilly Media, 2009

Reference Book(s):
1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

2. Anne Kao and Stephen R. Potee, "Natural Language Processing and Text Mining", Springer-Verlag London Limited, 2007.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	**25**	**25**
L1: Remember	-	-
L2: Understand	-	-
L3: Apply	**10**	**5**
L4: Analyze	**10**	**5**
L5: Evaluate	**5**	**5**
L6: Create	-	**10**

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	10
L2: Understand	10
L3: Apply	10
L4: Analyze	10
L5: Evaluate	10
L6: Create	

BUSINESS INTELLIGENCE ANALYTICS

Course Code : 22SCS25		**Credits**	: 2
L: T: P: S : 1:0:2:0		**CIE Marks**	: 50
Exam Hours : 3		**SEE Marks**	: 50

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO #	COURSE OUTCOMES
22SCS25.1	Derive a high-level and abstract design phase in the process of database design.
22SCS25.2	Organize the calculated columns and measures for the given use case.
22SCS25.3	Build automated dynamic dashboards using BI tool.
22SCS25.4	Investigate on the visualization to reveal all options that are available.
22SCS25.5	Create and share content (dashboards, reports, apps), or open content to share with someone.
22SCS25.6	Design and generate necessary reports based on the activity.

Course Outcomes to Program Outcomes Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22SCS25.1	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS25.2	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS25.3	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS25.4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS25.5	3	3	3	3	3	-	-	-	3	-	-	1	3	2
22SCS25.6	3	3	3	3	3	-	-	-	3	-	-	1	3	2

Exp No	Module Contents	Hours	COs
1	Design Data Modeling and Navigation, to connect multiple data sources in BI tool using a relationship.	6	**22SCS25.1, 22SCS25.6**
2	Create calculated columns using BI tool by combining two or more elements of the existing data.	6	**22SCS25.2, 22SCS25.6**
3	Create a dashboard by pinning visualizations from BI reports that are published using BI desktop.	6	**22SCS25.3, 22SCS25.6**
4	Create visualizations to effectively present your data using a Business Intelligence tool.	6	**22SCS25.4, 22SCS25.6**
5	Publish reports using Power BI Service	6	**22SCS25.5, 22SCS25.6**

Text Book(s):
1. Mastering Microsoft Power BI, By Greg Deckler, Brett Powell, Leon Gordon, Packt Publishing, 2022, ISBN: 9781801818193.

Reference Book(s):
1. Mastering Microsoft Power BI, By Brett Powell, Packt Publishing, 2018, ISBN: 9781788292283.

CIE – Continuous Internal Evaluation: Theory (50 Marks)

Blooms Taxonomy	Tests	INTERNAL QUALITATIVE ASSESSMENTS
Marks (Out of 50)	25	25
L1: Remember		
L2: Understand	5	5
L3: Apply	5	5
L4: Analyze	10	10
L5: Evaluate	5	5
L6: Create		

SEE – Semester End Examination: Theory (50 Marks)

Blooms Taxonomy	Marks (Out of50)
L1: Remember	
L2: Understand	10
L3: Apply	15
L4: Analyze	15
L5: Evaluate	10
L6: Create	

BOS recommended ONLINE courses

Course Code   : **22AUD27**
Course Name   : **ONLINE courses**
L:T:P:S   : **Classes and evaluation procedures are as per the policy of the online courseproviders.**

Classes and evaluation procedures are as per the policy of the online course providers.

About NPTEL-SWAYAM:

1. **NPTEL-SWAYAM is the National MOOCs portal being developed by MHRD, Govt. of India.**

2. **In order to ensure best quality content is produced and delivered, seven NationalCoordinators have been appointed under SWAYAM.**

3. **NPTEL is the official SWAYAM national coordinator for engineering.**

4. **A learner must earn credits by completing the on-line course successfully.**

5. **Students can review and assess their own progress through assignments (weekly).**

6. **Inculcate mode of self-learning and get access to lectures of IIT/IISc distinguished Faculty.**

7. **Non-traditional education realized through MOOCs is a useful form of online learning and cancomplement traditional university learning.**

Instructions:

1. **The BoS members will decide the ONLINE courses for which the students need to register andcomplete within the academic semester.**

2. **The course will be a trending one as well as a need of an hour for student's placements.**

3. **The course will scale-up their employability & entrepreneurial skills**

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