SCHEME and SYLLABUS

OF

V and VI SEMESTER B.E.

INFROMATION SCIENCE AND ENGINEERING

FOR THE A.Y: 2023-24

Vision of the College:
To develop thoughtful and creative young minds in a learning environment of high academic ambience by synergising spiritual values and technological competence.

Mission of the College:
1. To continuously strive for the total development of students by educating them in state-of-the-art-technologies and managerial competencies providing best in class learning experience with emphasis on skills, values and learning outcomes and helping them imbibe professional ethics and societal commitment.
2. To create research ambience that promotes interdisciplinary research catering to the needs of industry and society.
3. To collaborate with premier academic and research institutions and industries to strengthen multidisciplinary education, applied research, innovation, entrepreneurship and consulting ecosystems.

Vision of the Department:
To be a centre for quality education and research in Information Science and Engineering to create high quality professionals for catering to the need of the society.

Mission of the Department:
1) To enable students to acquire strong fundamental concepts related to the Information Science and Engineering through experiential learning.
2) To educate students towards state-of-the-art-technologies and multidisciplinary practices for a successful career by creating learning-teaching-learning ambience.
3) To inculcate life-long learning through innovation and research attitudes among students related to Information Science and Engineering.

Program Educational Objectives (PEOs):

The objectives of Information Science and Engineering degree program are to prepare students to meet the academic excellence, professionalism, and ability to solve a broad range of problems in rapidly changing technological, economic and social environment.

Graduates of the program will:
1. Pursue career as software engineer, project manager, data scientist, entrepreneur and pursue higher studies and research in Information Science and Engineering domains.
2. Apply mathematical, scientific and Information Science and Engineering knowledge with multidisciplinary approaches to solve real world problems.
3. Possess professionalism, ethical and societal responsibilities and engage in life-long learning through pursuit of skill development and certification courses in Information Science and Engineering.

Programme Outcomes (POs):

To achieve the above objectives, Information Science and Engineering degree programme strives to obtain the following outcomes which should be achieved by all graduates at the time of their graduation.

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. 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.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. 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 reports and design documentation, make effective presentations, and give and receive clear instructions.
11. 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.
12. 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.

Programme Specific Outcomes (PSOs):

1) **Computing System:** Demonstrate the knowledge of evolving hardware and/or software to develop solutions to real life computational problems with a focus on performance optimization.

2) **Communication and Security:** Design and develop solutions for providing efficient transmission, storage, security and privacy of data in diverse computing environment.

3) **Information management:** Apply tools and techniques for management of information system, data analysis and knowledge discovery in the process of decision making.

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme): V Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week: Lecture L	Tutorial T	Practical/ Drawing P	Self Study Component S	Examination: Duration in hrs.	CIE Marks	SEE Marks	Total Marks	Credits
1.	IPCC	N5ISI01	Software Engineering and Testing (Integrated)	ISE	3	0	2	-	3	50	50	100	4
2.	PCC	N5IS01	Database Management Systems	ISE	3	0	0	-	3	50	50	100	3
3.	PCC	N5IS02	Fundamentals of Data Communication	ISE	3	0	0	-	3	50	50	100	3
4.	PCC	N5IS03	Theory of Computation	ISE	3	0	0	-	3	50	50	100	3
5.	PCC	N5IS04	Artificial Intelligence and Machine Learning	ISE	3	0	0	-	3	50	50	100	3
6.	PCCL	N5ISL01	Database Management Systems Laboratory	ISE	0	0	2	-	3	50	50	100	1
7.	HSMC	NHS05	Environmental Science	-	0	2	0	-	2	50	50	100	1
8.	AEC	AECIS5x	Ability Enhancement Course	-	2	0	0	-	3	50	50	100	2
				-	1	0	2	-					
9.	NCMC	NHS07	Soft Skills	T&P	36 hrs. during the entire semester			-		100	--	100	0
			Total					-		**500**	**400**	**900**	**20**
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									

Note: **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **INT** –Internship, **UHV**- Universal Human Value Courses

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

*** NHS06 for ME, IM, CS, IS, AD; Professional Core for CV, EE, EC, EI, ET, CH, BT**
Soft Skills Training Programme is a Non Credit Mandatory Course **for all the Programmes**. Dean Academic to schedule the even in the Academic Calendar.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

Ability Enhancement Course – III (Offered by the Department)

AECIS51	C# and .NET Technology	AECIS52	Python for Data Science
AECIS53	Natural Language Processing		

Software Engineering and Testing
(Integrated Course)

Contact Hours/ Week:	: 3L+2P	Credits:	4
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: N5ISI01	SEE Marks:	50

Course objectives:	
This course will enable students to:	
1.	Understand Software Development Life Cycle and development models and Agile Software development.
2.	Discuss an idea of using various process models in the software industry according to given circumstances.
3.	Comprehend how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.
4.	Discuss the fundamental concepts in software testing, including software testing objectives.
5.	Gain knowledge on functional and structural testing methods and skills on how to use automation software testing tools.

UNIT I
SOFTWARE AND SOFTWARE ENGINEERING: The Nature of Software, Software Engineering, The Software Process, Software Engineering Practice.
THE SOFTWARE PROCESS: PROCESS MODELS: A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models: The Waterfall Model, Evolutionary Process Models, The Unified Process models, Agility and Process: What is Agility?, Agility and cost change, What is agile Process, Scrum.
8 Hours

UNIT II
UNDERSTANDING REQUIREMENTS: Definition of Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements and Validating Requirements.
REQUIREMENTS MODELING: Requirements Analysis, Scenario-Based Modeling, Class-based Modelling.
8 Hours

UNIT III
DESIGN CONCEPTS: Definition of software design, The Design Process, Design Concepts, Design Model.
ARCHITECTURAL DESIGN: Software Architecture, Agility and Architecture, Architectural Styles, Architectural Considerations.
COMPONENT-LEVEL DESIGN: What Is a Component, Designing Class-Based Components.
8 Hours

UNIT IV
SOFTWARE TESTING STRATEGIES: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing and The Art of Debugging.
TESTING CONVENTIONAL APPLICATIONS: Software Testing Fundamentals, White box Testing and Basis Path Testing.
8 Hours

UNIT V
A PERSPECTIVE ON TESTING, EXAMPLES: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of Testing, Examples: The triangle problem, The commission problem, NextDate function. **BOUNDARY VALUE TESTING:** Boundary value analysis, Robustness testing, Worst-case testing, Special value testing, Examples. **THE EQUIVALENCE CLASS TESTING,** Equivalence classes, Equivalence test cases for the triangle problem, NextDate function.
8 Hours

TEXT BOOKS		
1	Roger. S. Pressman, Bruce R. Maxim	Software Engineering-A Practitioners approach. 9th Edition, Tata-McGraw Hill. 2020
2	Paul C. Jorgensen, Byron DeVries	Software Testing, A Craftsman's Approach, 5th Edition, Auerbach Publications, 2021

REFERENCE BOOKS		
1	Pankaj Jalote	An Integrated Approach to Software Engineering. Narosa Publications. 2019
2	Ilene Burnstein	Practical Software Testing: A Process-Oriented Approach, Springer international edition. 2016

List of Problems for Laboratory
Part A: Software Engineering
1. Practice of exercises from IIT Kharagpur, Software Engineering V Lab. Experiment 1 and Experiment 2.
2. Prepare the following documents and develop the software project report using software engineering methodology for the following scenarios or the applications. a) Problem Analysis and Project Planning - Thorough study of the problem– Identify Project scope, Objectives and Infrastructure. b) Software Requirement Analysis –Describe the individual Phases/modules of the project and Identify deliverables. c) Identification of the functional and non-functional requirements from the detailed problem statement. d) Do requirement analysis and develop Software Requirement Specification

document (SRS) for the given applications.

e) Software Modelling: Analysis and Designing - Develop the following UML diagram for the SRS document prepared for the applications.
   1. Use case diagrams,
   2. Activity Diagrams
   3. DFD-0 diagrams
   4. DFD-1 diagrams
   5. Sequence diagrams

The report including the detailed problem statement, SRS report, and requirements analysis and modeling report needs to be submitted for evaluation.

List of Applications are as follows:

1. Course Management Systems
2. Weather Forecasting System
3. Recommendation System
4. Student Information Management System
5. Online Banking
6. Social Networking
7. Face Recognition System
8. Insurance Management System

Part B: Software Testing

1. 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 a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis and execute the test cases and discuss the results.

Test Data: Enter the 3 Integer Value (a, b and c)

Pre-condition: $1 \le a \le 10$, $1 \le b \le 10$ and $1 \le c \le 10$ and $a < b + c$, $b < a + c$ and $c < a + b$

2. 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 a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on and equivalence class partitioning, execute the test cases and discuss the results.

3. 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 a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on decision tables-based testing, execute the test cases and discuss the results.

4. Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of boundary-value analysis testing, derive different test cases, execute these test cases and discuss the test results.

Test data : Enter the date with month/ day/ year format

Pre-condition: Month 1 to 12, Day 1 to 31 and Year 1812 to 2014

5. Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of Equivalence partition testing, derive different test cases, execute these test cases and discuss the test results.

Test data: Enter the date with month/ day/ year format

Pre-condition: Month 1 to 12, Day 1 to 31 and Year 1812 to 2014

6. Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of decision table-based testing, derive different test cases, execute these test cases and discuss the test results.

Test data: Enter the date with month/ day/ year format

Pre-condition: Month 1 to 12, Day 1 to 31 and Year 1812 to 2014

7. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of Boundary-value analysis and derive different test cases, execute these test cases and discuss the test results.

Test data: Price Lock - 45.0 Rs.,
Stock - 30.0 Rs.
Barrel - 25.0 Rs.

Sales = total lock * lock price + total stock * stock price + total barrel * barrel price

Commission: 10% up to sales Rs 1000,
15 % of the next Rs 800 and
20 % on any sales in excess of 1800

Pre-condition: lock = -1 to exit and 1< =lock < = 70,
1<=stock <=80 and 1<=barrel<=90

8. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of Equivalence class testing, derive different test cases, execute these test cases and discuss the test results.

Test data: Price Lock - 45.0 Rs.,
Stock - 30.0 Rs.
Barrel - 25.0 Rs.

Sales = total lock * lock price + total stock * stock price + total barrel * barrel price

Commission: 10% up to sales Rs 1000,
15 % of the next Rs 800 and
20 % on any sales in excess of 1800

Pre-condition: lock = -1 to exit and 1< =lock < = 70, 1<=stock <=80 and 1<=barrel<=90

Course Outcomes:

Upon completion of this course the student will be able to:

1.	**CO1: Comprehend** Software Development Life Cycle and its different phases.
2.	**CO2: Apply and articulate** Requirements Engineering Techniques to paraphrase the actual requirements of applications.
3.	**CO3: Apply** the fundamental concepts and principles of Software Design.
4.	**CO4: Identify** various software testing techniques, strategies, and principles.
5.	**CO5: Demonstrate** various levels of testing on real-time applications using appropriate techniques.

Database Management Systems

Contact Hours/ Week:	: 3L	Credits:	3
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: N5IS01	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Learn basic concepts of database and database management systems.
2.	Understand the fundamentals of relational system which includes data models, database architectures, database manipulations and ER diagram.
3.	Get a comprehensive overview of Structured Query Language (SQL), construction of queries in SQL.
4.	Learn the need of Normalization and the use of different types of Normalization.
5.	Discuss concepts of Transaction management.

UNIT I

Databases and Database Users: Introduction, an example, characteristics of database approach. Actors on the screen, workers behind the scene. Advantages of using DBMS approach. A brief history of database applications, When not to use a DBMS.

Database System – Concepts and Architecture: Data models, schemas and instances, three-schema architecture and data independence. Database languages and interfaces. The database system environment. Centralized and client-server architectures. Classification of database management systems.

8 Hours

UNIT II

Entity-Relationship Model: Using high-level conceptual data models for database design, an example database application. Entity types, entity sets, attributes and keys, relationship types, relationship sets, roles and structural constraints, weak entity types, refining the ER design for the company database. ER diagrams, naming conventions and design issues.

7 Hours

UNIT III

SQL-The Relational Database Standard:SQL data definition and data types, schema and catalog concepts in SQL, the create table command in SQL, attribute data types and domains in SQL. Specifying attribute constraints and attribute defaults, specifying key and referential integrity constraints. Specifying basic constraints in SQL: giving names to constraints, specifying constraints on tuples using check. Schema change statements in SQL: the drop command, the alter command. Basic queries in SQL: the select-from-where structure of basic SQL queries, ambiguous attribute names, aliasing, and tuple variables, unspecified where clause and use of the asterisk, tables as sets in SQL, substring pattern matching and arithmetic operators, ordering of query results. More complex SQL queries: comparisons involving null and three-valued logic,

nested queries, tuples, and set/multi-set comparisons, correlated nested queries, the exists and unique functions in SQL. Explicit sets and renaming of attributes in SQL, joined tables in SQL, aggregate functions in SQL, grouping: the group by and having clauses, discussion and summary of SQL queries. Insert, delete statements in SQL, delete and update statements in SQL, additional features of SQL, specifying general constraints as assertion, views (virtual tables) in SQL.

9 Hours

UNIT IV

Database Design: Informal design guidelines for relation schemas semantics of the attributes, reducing the redundant information in tuples. Informal design guidelines for relation schemas reducing the null values in tuples, disallowing the possibility of generating spurious tuples. Definition of functional dependencies, inference rules for functional dependencies. Functional dependencies equivalence of sets of functional dependencies, minimal sets of functional dependencies. Normal forms based on primary keys, normalization of relations, practical use of normal forms. General definitions of first and second normal forms, with examples. General definitions of third normal form with examples. Boyce-codd normal form, with examples.

8 Hours

UNIT V

Transaction Processing Concepts : Introduction to transaction processing single-user versus multi-user transactions, read and write operations and DBMS buffers. Need of concurrency control and recovery. Transaction and system concepts transaction states and additional operations, system log, commit point. Desirable properties of transactions – acid properties, characterizing schedules based on recoverability.

8 Hours

TEXT BOOKS

1	Elmasri and Navathe	Fundamentals of Database Systems, 7th Edition, Mc-GrawHill, 2017.

REFERENCE BOOKS

1	Silberschatz, Korth and Sudharshan	Data base System Concepts, 7th Edition, Mc-GrawHill, 2019. ISBN 9780078022159
2	Raghu Ramakrishnan and Johannes Gehrke.	Database Management Systems, Third Edition, McGraw-Hill, 2022.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1:	**Describe** database concepts, architecture, applications.
CO2:	**Analyze and Design** of ER diagram based on application's data requirements.
CO3:	**Create** SQL queries for given schema.
CO4:	**Apply** normalization techniques to a given database.
CO5:	**Discuss** transaction processing for a given database.

Fundamentals of Data Communication

Contact Hours/ Week:	: 3	Credits:	3
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: N5IS02	SEE Marks:	50

Course objectives:
This course will enable students to:

1. Understand the basic concepts of data communications and the layered architecture of TCP/IP protocol.
2. Describe digital signal transmission, encoding and multiplexing techniques
3. Apply appropriate error detection and correction techniques for reliable transmission
4. Understand switching and data link control protocols

UNIT I

Data Communications and Network Models: Data Communications: Components, Data Representation, Data Flow, Networks, Network Criteria, Physical Structures, Network Types, Local Area Network, Wide Area Network, Switching, The Internet, Accessing the Internet.

Protocol Layering, Scenarios, Principles of Protocol Layering, Logical Connections, Contents, TCP/IP Protocol Suite, Layered Architecture, Layers In the **TCP/IP Protocol Suite**, Description of Each Layer, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI model, OSI versus TCP/IP, Lack of OSI Model's Success.

8 Hours

UNIT II

TCP/IP Protocol Suite: Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI model, OSI versus TCP/IP, Lack of OSI Model's Success.

Data and Signals: Analog and Digital Data, Analog and Digital Signals, Periodic and Nonperiodic, Periodic Analog Signals- Sine Wave, Phase, Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Digital Signals- Bit Rate, Bit Length, Digital Signal as a Composite Analog Signal, Transmission of Digital Signals, Transmission Impairment-Attenuation, Distortion, Noise, Data Rate Limits, Noiseless Channel: Nyquist Bit Rate, Noisy Channel: Shannon Capacity, Using Both Limits, Performance-Bandwidth, Throughput, Latency (Delay), Bandwidth-Delay Product, Jitter.

8 Hours

UNIT III

Digital-To-Digital Conversion: Line Coding, Line Coding Schemes, Block Coding, Scrambling.

Analog-To-Digital Conversion: Pulse Code Modulation (PCM, Delta Modulation (DM), Transmission Modes, Parallel Transmission, Serial Transmission.

Digital-To-Analog Conversion: Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Amplitude Modulation.

8 Hours

UNIT IV
Error Detection & Correction: Introduction: Types Of Errors, Redundancy, Detection Versus Correction, Coding, Block Coding, Error Detection, Cyclic Codes, Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials, Cyclic Code Analysis, Advantages of Cyclic Codes, Other Cyclic Codes, Checksum, Concept, Other Approaches to the Checksum, Forward Error Correction, Using Hamming Distance, Using XOR, Chunk Interleaving, Combining Hamming Distance And Interleaving, Compounding High And Low-Resolution Packet.
8 Hours

UNIT V
Switching and Data Link Control (DLC): Introduction, Circuit switched networks, Packet switching, Structure of a switch, **DLC Services:** Framing, Flow and Error Control, Connectionless and Connection-Oriented, Data-Link Layer Protocols, Simple Protocol, Stop-And-Wait Protocol, Piggybacking, HDLC, Configurations And Transfer Modes, Framing, Point-To-Point Protocol (PPP), Services, Framing, Transition Phases, Multiplexing.
8 Hours

TEXT BOOKS		
1	Behrouz A. Forouzan	Data Communications and Networking, Tata McGraw-Hill, Ed.5. 2017.

REFERENCE BOOKS		
1	Alex Holmes	Communication Networks: Fundamental Concepts & key Architectures, Tata McGraw – Hill, Ed.10, 2004.
2	William Stallings	Data and Computer Communication, Pearson Education, Ed.10. 2013.

Course Outcomes:
Upon completion of this course the student will be able to:

CO1:	**Describe** the basics of data and signal types with transmission principles
CO2:	**Comprehend** the topologies, layered architecture, and their protocol suites.
CO3:	**Analyze** the working and adoption of modulation, and multiplexing techniques for real-world applications
CO4:	**Apply** error detection and correction coding techniques for reliable data transmission in the network.
CO5:	**Apply** switching techniques and data link layer protocols to solve basic network engineering problems

Theory of Computation

Contact Hours/ Week:	3	Credits:	3.0
Total Lecture Hours:	40	CIE Marks:	50
Sub. Code:	N5IS03	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Describe the concepts of automata theory and formal languages.
2.	Identify different formal language classes like regular and context free and their relationships.
3.	Design Regular expression, grammars and recognizers for different formal languages.
4.	Describe Turing machine, its variants and hierarchy of formal languages and automata.

UNIT I

Introduction to Finite Automata: The central concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata; An Application: Text search; Finite automata with Epsilon-transitions; Equivalence and Minimization of Automata- Testing equivalence of states, Testing equivalence of regular languages, Minimization of DFA's. (Text Book 1- 1.1.1, 1.5, 2.2, 2.3, 2.4, 2.5, 4.4.1-4.4.3) [Theorem: 2.11]

8 Hours

UNIT II

Regular expressions: Finite Automata and Regular Expressions- From DFA's to Regular Expressions, Converting DFA's to Regular expressions by eliminating states, Converting regular expressions to automata; Application of Regular Expressions, Properties of Regular languages- Proving languages not to be regular languages; Closure properties of regular languages- Boolean operations, reversal, homomorphisms. (Text Book 1- 3.1, 3.2.1, 3.2.2, 3.2.3, 3.3, 4.1, 4.2.1-4.2.3) [Theorems: 3.4,3.7,4.1,4.4,4.5,4.8,4.10,4.11]

8 Hours

UNIT III

Context-Free Grammars and Languages:
Context –free grammars; Parse trees- Constructing Parse Trees, The yield of a parse tree; Applications of Context Free Grammars, Ambiguity in grammars and languages- Ambiguous grammars, Leftmost derivation as a way to express ambiguity, Inherent ambiguity. (Text Book 1- 5.1, 5.2.1, 5.2.2,5.3, 5.4.1, 5.4.3,5.4.4)
Simplification of CFG's and Normal forms (Text Book 2, chapter 6- 6.1,6.2). [Theorems: 6.1,6.2,6.3,6.4,6.5,6.6]

8 Hours

UNIT IV

Pushdown Automata:
Definition of the Pushdown automata; The languages of a PDA; Equivalence of PDA's and CFG's; Deterministic Pushdown Automata- Definition of a DPDA. (Text Book 1- 6.1, 6.2, 6.3, 6.4.1) [Theorems: 6.9,6.11]

8 Hours

UNIT V

Introduction To Turing Machine:
The Turing Machine: Notation for the TM, Instantaneous Descriptions for the TM, Transition diagrams for the TM, The Language of a TM, TM and Halting; A hierarchy of Formal Languages and Automata- Definitions of Recursive and Recursively Enumerable Languages, Definition of Unrestricted Grammars, Definition of Context Sensitive Grammars and Languages, Chomsky hierarchy. (Text Book 1, Chapter 8- 8.2.2-8.2.6, Text Book 2, Chapter 11- 11.1, 11.2, 11.3, 11.4 only mentioned definitions of chapter 11).

8 Hours

TEXT BOOKS

1	John E.. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman	Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson education, 2008.
2	Peter Linz	An Introduction to Formal Languages and Automata, 4th edition, Narosa publication.

REFERENCE BOOKS

1	John C Martin	Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.

Course Outcomes:
Upon completion of this course the student will be able to:

CO 1.	**Apply** the basic mathematical properties to understand grammars, automata theory and formal languages.
CO 2.	**Apply** the automata theory to show the equivalence among different notations of regular and context free languages.
CO 3.	**Design** the regular expressions and context free grammars for a given language.
CO 4.	**Apply** the properties of pumping lemma, norm forms, context free grammars and regular grammar to prove the properties of a given languages.
CO 5.	**Design** the finite automata, pushdown automata and Turing machine for a given problem.

Artificial Intelligence and Machine Learning

Contact Hours/ Week:	: 3	Credits:	3
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: N5IS04	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand fundamental concepts in Artificial Intelligence.
2.	Be familiar with basic principles of AI such as problem solving, searching, knowledge representation and learning.
3.	Explain the role of agents in AI and structure of the agents.
4.	Analyze and identify significant characteristics of data sets.
5.	Understand and implement the training, testing, and validation phases of supervised and unsupervised learning algorithms.

UNIT I

INTRODUCTION: What is AI? Acting humanly: The Turing Test approach, Thinking humanly: The cognitive modelling approach, Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach.

INTELLIGENT AGENTS: Agents and Environments, Rationality, Omniscience, learning, and autonomy, the nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents; Agent programs, Simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents.

SOLVING PROBLEMS BY SEARCHING: Problem-solving agents; Well-defined problems and solutions, Formulating problems, Example problems; Toy problems, Real-world problems.

8 Hours

UNIT II

SOLVING PROBLEMS BY SEARCHING (CONTD.): Searching for solution; Infrastructure for search algorithms, Measuring problem-solving performance, Uninformed search strategies, Uniform-cost search, Depth-limited search.

ADVERSIAL SEARCH: Games, Optimal Decisions in Games; The minimax algorithm.

CONSTRAINT SATISFACTION PROBLEMS: Defining Constraint satisfaction problems; Example problem: Map colouring, Example problem: Job-shop scheduling.

8 Hours

UNIT III

INTRODUCTION: If Data had Mass, The Earth Would Be A Black Hole, Learning; Machine Learning, Types of Machine Learning, Supervised Learning; Regression, Classification, The Machine Learning Process.

PRELIMINARIES: Some Terminology; Weight Space, The Curse of Dimensionality, Knowing What You Know; Overfitting, Training, Testing, and Validation Sets,

The Confusion Matrix, Accuracy Metrics, The Receiver Operator Characteristic (ROC) Curve, Unbalanced Datasets, Measurement Precision,: Testing Machine Learning Algorithms, Turning Data into Probabilities; Some Basic Statistics.
8 Hours

UNIT IV
DIMENSIONALITY REDUCTION: Linear Discriminant Analysis (LDA), Principal Components Analysis (PCA), Relation with the Multi-layer Perceptron, Kernel PCA, Methods Comparisons.
LEARNING WITH TREES: Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART); Gini Impurity, Regression in Trees, Classification Examples and Problems.
8 Hours

UNIT V
PROBABILISTIC LEARNING: Nearest Neighbour Methods **UNSUPERVISED LEARNING; CLUSTERING:** Introduction, Hierarchical Clustering, Agglomerative Clustering, The single Linkage Algorithm, The complete linkage Algorithm, The Average Linkage Algorithm, Partitional Clustering, Forgy's Algorithm, The k-means Algorithm, Vector Quantization, The *K*-Means Algorithm.
8 Hours

TEXT BOOKS		
1	Stuart J. Russell and Peter Norvig	Artificial Intelligence, A Modern Approach, Third Edition, PearsonIndia Education Services, 2015 (UNIT I and II)
2	Stephen Marsland	Machine Learning, An Algorithmic Perspective, Second Edition, CRC Press, 2015 (UNIT III and IV)
3	Earl Gose, Richard Johnson Baugh, Steve Jost	Pattern Recognition, Image Analysis, Pearson Education, 1997 (UNIT V)

REFERENCE BOOKS		
1	Elaine Rich, Kevin Knight:	Artificial Intelligence, 3rdEdition, Tata McGraw Hill, 2009. ISBN: 9780070087705.
2	Christopher Bishop	"Pattern Recognition and Machine Learning", CBS Publishers & Distributors- New Delhi.2006.
3	Tom M Mitchell	"Machine Learning", McGraw-Hill, Inc. New York, NY, USA. 2013.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1.	**Understand** and **Explore** knowledge representation techniques and problem-solving strategies to common Artificial Intelligence (AI) applications.

CO2.	**Discuss** the structure of the agents and different types of agents commonly used in AI.
CO3.	**Differentiate** between machine learning algorithms based on learning criteria and parameter employed.
CO4.	**Apply** and **illustrate** the significances of dimensionality reduction techniques for supervised and unsupervised problem solving.
CO5.	**Design** applications to solve real world problems by **applying** machine learning algorithms such as classification, regression, and clustering

Database Management System Laboratory

Contact Hours/ Week:	: 2	Credits:	1
Total Lecture Hours:	: 24	CIE Marks:	50
Sub. Code:	: N5ISL01	SEE Marks:	50

Course objectives:	
This course will enable students to:	
1.	Understand and implement SQL queries in DBMS.
2.	Design and implement tables and key constraints.
3.	Compare the performance of SQL queries.

List of Problems for Laboratory

1. Consider the following schema for a Library Database:
BOOK (Book_id, Title, Publisher_Name, Pub_Year)
BOOK_AUTHORS (Book_id, Author_Name)
PUBLISHER (Publisher_Name, Address, Phone)
BOOK_COPIES (Book_id, Branch_id, No-of-Copies)
BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date)
LIBRARY_BRANCH (Branch_id, Branch_Name, Address)
BORROWER (Card_no, Name, Address, Phone)
Write SQL queries to
a) Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc.
b) Get the particulars of borrowers who have borrowed more than 3 books from Jan 2018 to Jan 2019
c) Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.
d) Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.
e) Create a view of all books and its number of copies that are currently available in the Library.

2. Consider the following schema for Order Database:
SALESMAN (Salesman_id, Name, City, Commission)
CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id)
ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id,Salesman_id)
Write SQL queries to
a) Count the customers with grades above Bangalore's average.
b) Find the name and numbers of all salesmen who had more than one customer.
c) List all salesmen and indicate those who have and don't have customers in their cities (Use UNION operation).
d) Create a view that finds the salesman who has the customer with the highest order of a day.
e) Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.

3. Consider the schema for Movie Database:
ACTOR (Act_id, Act_Name, Act_Gender)
DIRECTOR (Dir_id, Dir_Name, Dir_Phone)
MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id)
MOVIE_CAST (Act_id, Mov_id, Role)
RATING (Mov_id, Rev_Stars)
Write SQL queries to
a) List the titles of all movies directed by 'Mani ratnam'.
b) Find the movie names where one or more actors acted in two or more movies.
c) List all actors who acted in a movie before 2010 and also in a movie after 2017 (use JOIN operation).
d) Find the title of movies and number of stars for each movie that has at least one rating. Sort the result by movie title.
e) Update rating of all movies directed by 'Karan Johar' to 4.

4. Consider the schema for College Database:
STUDENT (USN, SName, Address, Phone, Gender)
SEMSEC (SSID, Sem, Sec)
CLASS (USN, SSID)
SUBJECT (Subcode, Title, Sem, Credits)
IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)
Write SQL queries to
a) List all the student details studying in fourth semester 'C' section.
b) Compute the total number of male and female students in each semester and in each section.
c) Create a view of Test1 marks of student USN '1SI20IS001' in all subjects.
d) Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students.
e) Categorize students based on the following criterion:
If FinalIA = 17 to 20 then CAT = 'Outstanding'
If FinalIA = 12 to 16 then CAT = 'Average'
If FinalIA< 12 then CAT = 'Weak'
Give these details only for 8th semester A, B, and C section students.

5. Consider the schema for Company Database:
EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo)
DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate)
DLOCATION (DNo,DLoc)
PROJECT (PNo, PName, PLocation, DNo)
WORKS_ON (SSN, PNo, Hours)
Write SQL queries to
a) Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project.
b) Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.
c) Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department

d) Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).
e) For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs. 6,00,000.

Instructions for Open Ended Project Execution:
Develop a database application using Oracle/MySQL

Please note the following conditions.
1.Mini project should give proper idea about the application for which it is developed.
2.Maximum 3/4 students per team. No team is allowed to do the same project.
3.The front end has to be created with any programming language with proper design.
4.Students must:
   a. Create schema and insert the records for each table. Add appropriate database constraints.
   b. Implement, analyze and evaluate the project developed for an application
   c. Create, update, delete and query on the database
   d. Demonstrate the working of different concepts of DBMS
5. Must be able to generate reports

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	**Analyze** and Create tables for the given relational database schema.
CO2.	**Demonstrate** and analyze the SQL queries for the given relational database schema.
CO3.	**Apply** and design techniques and concepts of DBMS to solve real world problems.

C# and .NET Technology
(Ability Enhancement Course-III-1)

Contact Hours/ Week:	: 1L+2P	Credits:	2
Total Lecture Hours:	: 13+26	CIE Marks:	50
Sub. Code:	: AECIS51	SEE Marks:	50

Course objectives:	
This course will enable students to:	
1.	Gain knowledge in the concepts of the .NET framework as a whole and the technologies that constitute the Framework.
2.	Write simple C# programs to solve real world problems.
3.	Build sample applications, so that the student will get experience and be ready for large-scale projects.
4.	Learn the basics of object oriented programming and get knowledge of windows programming.

List of Laboratory Activities

Introduction of the following concepts:

1. Classes and objects
2. Inheritance
3. Operator overloading
4. Threading
5. Events and delegates
6. Working with windows forms controls
7. Validating data
8. Creating custom dialog box
9. Designing an MDI application with menu
10. Manipulating data in a connected environment

Create the applications using C# and .Net framework for the following tasks:

1. Write a program to C# to find the smallest single digit factor for a given value.
2. Write a program in C# to print a number if it is prime; otherwise display the largest factor of that number.
3. Write a program in C# to find the magnitude of a number.
4. Write a C# program to display the digits of an integer in words.
5. Write a C# program to which reads a set of strings into the rows a two dimensional array and then prints the string having more number of vowels.
6. Write a C# programs to demonstrate the concepts of Structures and Enumerations.
7. Write a C# programs to demonstrate the concepts of Constructors and Inheritance.
8. Write a C# programs to demonstrate the concepts of Polymorphism.
9. Write a C# programs to demonstrate the concepts of Delegates.

10. Write a C# programs to demonstrate the concepts of Label, Text Box and Button controls.
11. Write a C# programs to demonstrate the concepts of Combo Box and List Box controls.
12. Create a Windows application in C# for registration form and fill the details and when you click the submit button it display the details in the message box.
13. Create a Windows application in C# having two text boxes and three buttons named as factorial, prime, factorial series. When you click any button the resultant value will be displayed on the second textbox.

REFERENCE BOOKS		
1	Christian Nagel, Jay Glynn, Morgan Skinner	Professional C# .Net, Wrox Publication, 1st Edition, 2014
2	Matthew Macdonald and Robert Standefer	ASP.NET Complete Reference, TMH, 2016
3	Jon Skeet	C# in Depth, Fourth Edition, , Manning Publications, 2019
4	https://dotnet.microsoft.com/en-us/learn/csharp	
5	https://www.codecademy.com/learn/learn-c-sharp	

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	Gain proficiency in C# by building stand-alone applications in the .NET framework using C#.
CO2:	Write, compile and debug programs in C# language.
CO3:	Create projects using Windows, Forms, Controls, creating Menus, Status bar, Tool bar.
CO4:	Create web-based distributed applications using C#.

Python for Data Science
(Ability Enhancement Course--III-2)

Contact Hours/ Week:	: 1L+2P	Credits:	2
Total Lecture Hours:	: 13	CIE Marks:	50
Total Practical Hours	: 26		
Sub. Code:	: AECIS52	SEE Marks:	50

Course objectives:
This course will enable students to:
1. Understand data science and its importance
2. Understand the data science methodologies and storage for decision making using Python programming
3. Understand and implement Pandas to analyze big data and make conclusions based on statistical theories.

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators.

1. Implement basic Python programs for reading input from console.
2. Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set

2L+6P Hours

Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

3. Apply Python built-in data types: Strings, List, Tuples, Dictionary, Set and their methods to solve any given problem
4. Handle numerical operations using math and random number functions
5. Create user-defined functions with different types of function arguments.

3L+6P Hours

Optimizing storage: data types
Introduction To Numpy
6. Installing Numpy and create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
7. Implement Data Science Operations: Filter, Order, Aggregate.
8. Create manipulating Images with Matplotlib.

3L+8P Hours

Data Manipulation With Pandas :
Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries-
Indexing, Selection, and Filtering- Function Application and Mapping- Sorting

and Ranking.

9. Create Pandas Series and Data Frame from various inputs.
10. Import any CSV file to Pandas DataFrame and perform the following:
(a) Visualize the first and last 10 records
(b) Get the shape, index and column details
(c) Select/Delete the records(rows)/columns based on conditions.

3L+6P Hours

TEXT BOOKS		
1	Y. Daniel Liang	Introduction to Programming using Python, Pearson, 2012.
2	Wes McKinney	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly, 2nd Edition, 2018.
3	Jake VanderPlas	Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.

REFERENCE BOOKS		
1	Wesley J. Chun	Core Python Programming, Prentice Hall,2006
2.	Mark Lutz	Learning Python, O'Reilly, 4th Edition, 2009.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Identify the need for data science and solve basic problems using Python built-in data types and their methods.
CO2: Employ efficient storage and data operations using NumPy arrays
CO3: Apply powerful data manipulations using Pandas for big data.

Natural Language Processing
(Ability Enhancement Course--III-3)

Contact Hours/ Week:	: 1L+2P	Credits:	2
Total Lecture Hours:	: 13+26	CIE Marks:	50
Sub. Code:	: AECIS53	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.
2.	Describe the various approaches to understand syntax and semantics in NLP.
3.	Use and apply language related tools that are available to efficiently study and analyze large collections of text data.
4.	Demonstrate understanding of the relationship between NLP and statistics & machine learning.
5.	Familiarize with various NLP software libraries and data sets publicly available.
6.	Illustrate how language technology relies on formal models to capture Knowledge.

Lab Programs /Topics Covered

I Introduction to Natural language processing

- Introduction to Python
- Introduction to Natural Language Toolkit (NLTK)
- Python quick overview;
- Lexical analysis: Word and text tokenizer; – n-gram and collocations;
- NLTK corpora (Publicly available);

II Write programs for the following (Use input the English language text sample input text files may be copied from newspaper/ Online articles):

1. Create a small text file, and write a program to read it and print it with a line number at the start of each line. (Make sure you don't introduce an extra blank line between each line).
2. Write a function named word_freq() that takes a word as input and compute the frequency of the occurrence of the word in that section of the corpus. Test your result with the help of a frequency distribution library function (FreqDist ()) in NLTK.
3. Define a function percent (word, text) that calculates how often a given word occurs in a text and expresses the result as a percentage.
4. Find all the four-letter words from the given text file. Show these words in

decreasing order of frequency.
5. Implementing simple problems related to word disambiguation.
6. Implementation of tokenization of text
7. Implementation of stop word removal, Stemming of text and Lemmatization
8. Implementation of n-gram model
9. Implementation of PoS tagging
10. Implementation and demonstration of Named entity recognition.

REFERENCES:

1.	Christopher D. Manning and Hinrich Schutze,	"Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
2.	Daniel Jurafsky and James H. Martin	"Speech and Language Processing", Prentice Hall, 3rd Edition 2009
3.	https://www.geeksforgeeks.org/natural-language-processing-overview	
4.	https://www.geeksforgeeks.org/python-word-similarity-using-spacy/?ref=rp	
5.	https://pub.towardsai.net/natural-language-processing-nlp-with-python-tutorial-for-beginners-1f54e610a1a0	
6.	https://www.analyticsvidhya.com/blog/2021/02/basics-of-natural-language-processing-nlp-basics/	
7.	https://towardsdatascience.com/free-hands-on-tutorials-to-get-started-in-natural-language-processing6a378e24dbfc.	

Course Outcomes:

Upon completion of this course the student will be able to:

CO1.	Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis
CO2.	Describe the semantics and pragmatics for text processing
CO3.	Apply and compare natural language processing with manual and automated approaches.
CO4.	Apply Part-of-speech (POS) tagging for a given natural language and suitable modeling technique based on the structure
CO5.	Apply the state of the art algorithms and techniques for text-based processing of natural language with respect to morphology

SYLLABUS

OF

VI SEMESTER B.E.

INFROMATION SCIENCE AND ENGINEERING

FOR THE A.Y: 2023-24

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week: Lecture L	Tutorial T	Practical/ Drawing P	Self-Study Component S	Examination: Duration in hrs.	CIE Marks	SEE Marks	Total Marks	Credits
1.	IPCC	N6ISI01	Computer Networks (Integrated)	ISE	3	0	2	--	3	50	50	100	4
2.	HSMC	N6HS06	Management and Entrepreneurship	ME,IM,MBA	3	0	0	--	3	50	50	100	3
3.	PEC	N6ISPE1x	Professional Elective Course-I	ISE	3	0	0	--	3	50	50	100	3
4.	OEC	NOExx	Open Elective Course-I		3	0	0	--	3	50	50	100	3
5.	PCC	N6ISL01	Machine Learning Laboratory	ISE	0	0	2	--	3	50	50	100	1
6.	MP	N6ISMP	Mini Project	ISE	1 full day per week					100	--	100	2
7.	Internship	N6INT2	Internship –II (4 weeks)					--		100	--	100	3
8.	AEC	ARAS	Aptitude Related Analytical Skills	T&P	36 Hrs. for the entire semester				2	50	50	100	1
			Total							**500**	**300**	**800**	**20**
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									

Professional Elective Course - I

NIS6PE11	Neurocomputing and Deep Learning	NIS6PE13	Cloud Computing
NIS6PE12	Mobile Application Development	NIS6PE14	Big Data Analytics

Note: **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **PEC** – Professional Elective Course; **OEC**- Open Elective Course; **MP**-Mini Project; **AEC** –Ability Enhancement Courses, **NCMC** – Non Credit Mandatory Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

Professional Elective Courses (PEC):

A Professional Elective Course (PEC) is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of four courses. The minimum students' strength for offering professional electives is 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department.

However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. Selection of an open elective shall not be allowed if,

i) The candidate has studied the same course during the previous semesters of the program.

ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

iii) A similar course, under any category, is prescribed in the higher semesters of the program.

The minimum students' strength for offering open electives is 20.

Mini-project work:

Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. **Departments shall allocate one full day for Mini-project in the Time Table.**

CIE procedure for Mini-project:

(i) **Single discipline:** The CIE marks shall be awarded by a committee, DPEC - consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of Project Report, Project Presentation skill, Question & Answer session and Guide Assessment in the ratio of 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

(ii) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project be based on the evaluation of Project Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates. **No SEE component for Mini-Project.**

VII semester Classwork and Research Internship / Industry Internship (INT3)

Swapping Facility

Departments can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester. Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the Department so that students have ample opportunity for internship. In other words, a good percentage of the students shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. There will be both CIE and SEE for the internship (INT3).

Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent examination after satisfying the internship requirements.

INT3 Research Internship/ Industry Internship/Rural Internship

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them to learn how to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. Institute shall not bear any expenses incurred in respect of internship.

Evaluation components of CIE marks for Internship –III is as follows

Evaluation by the supervisor under whom the training was carried out		30 marks
Evaluation by DSEC		
(i)	Report	20 marks
(ii)	Presentation and Viva-voce	50 marks
Total		**100 marks**

Evaluation components of SEE marks for Internship –III is as follows

(i)	Quality of Report	20 marks
(ii)	Presentation and Demonstration	60 marks
(iii)	Viva-voce	20 marks
Total		**100 marks**

Computer Networks
(Integrated course)

Contact Hours/ Week:	3+2 (3L+2Lab)	Credits:	4
Total Lecture Hours:	40	CIE Marks:	50
Total Practical Hours	26		
Sub. Code:	N6ISI01	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Understand the working of network layer and routing algorithms.
2. Compare the IPV4 and IPV6 network layer protocols.
3. Design subnet for any organization requirements
4. Understand the transport layer protocols, flow control techniques etc.
5. Understand the MAC layer protocols and functionalities.

UNIT-I

MEDIA ACCESS CONTROL (MAC): Random Access- Aloha, CSMA, CSMA/CD, CSMA/CA. Controlled Access-Reservation, Polling, Token Passing. Channelization-FDMA, TDMA, CDMA.

NETWORK LAYER: Network-Layer Services- Packetizing, Routing and Forwarding, Other Services, Packet switching. Datagram Approach-Connectionless Service. Virtual-Circuit Approach-Connection-Oriented Service.

8 Hours

UNIT-II

Network layer performance-Delay, Throughput, Packet Loss, Congestion Control.

IPV4 ADDRESSES: Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution (NAT).

8 Hours

UNIT-III

FORWARDING OF IP PACKETS: Forwarding Based on Destination Address, Forwarding Based on Label, Routers as Packet Switches.

NETWORK LAYER PROTOCOLS: Internet Protocol (IP), Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams.

8 Hours

UNIT-IV

UNICAST ROUTING: Introduction, General Idea, Least-Cost Routing, Distance-Vector Routing, Link-State Routing, Path-Vector Routing.

Unicast Routing Protocols, Internet Structure, Routing Information Protocol

(RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4).

8 Hours

UNIT-V

NEXT GENERATION IP: IPv6 Addressing, Representation, Address Space, Address Space Allocation, Autoconfiguration, Renumbering, The IPv6 Protocol, Packet Format, Extension Header, Transition from IPv4 to IPv6-Strategies.
TRANSPORT LAYER PROTOCOLS: Introduction, Services, Port Numbers, User Datagram Protocol, User Datagram, UDP Services, UDP Applications, Transmission Control Protocol, TCP Services, TCP Features.

8Hours

TEXT BOOKS

1	Behrouz A. Forouzan	Data Communications and Networking, 5th edition, McGraw-Hill, 2013.

REFERENCE BOOKS:

1	Larry L Peterson and Bruce S Davie	Computer Networks: A Systems Approach, 5th Edition, Elsevier, Elsevier, 2012
2.	Alberto Leon-Garcia and Indra Widjaja	Communication Networks, 2nd edition, McGraw-Hill, 2003

Sl. No.	List of Programs for laboratory
1.	a) Capture the live packets using Wireshark. Monitor, analyze and visualize the characteristics of HTTP, TCP, UDP and DNS packet. b) Write a program to implement Link state routing algorithm to build a routing table for the given nodes.
2.	a) Configure and analyze the working of basic router/gateway setup using the packet tracer. b) Write a program to implement Distance Vector routing algorithm to build a routing table for the given node.
3.	a) Configure the network of 4 nodes and update the port security using the packet tracer. b) Using TCP/IP sockets, write a client – server program, the client sends the file name and the server sends back the content of requested text file if present.
4.	a) Write a program for error detecting code using CRC algorithm.

	b) Configure LAN with Hub's and Switches using Packet Tracer.
5.	a) Write a client server echo program using UDP socket and analysis the UDP packets by capturing the data using Wireshark. b) Illustrate the DoS attack using the LOIC tool.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Design** subnet by applying IP addressing concepts.

CO2: **Apply** different routing protocols to select a best path in the network.

CO3: **Analyze** and **adopt** different internet protocols with their protocol formats and usage.

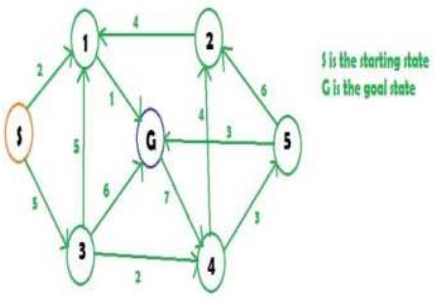
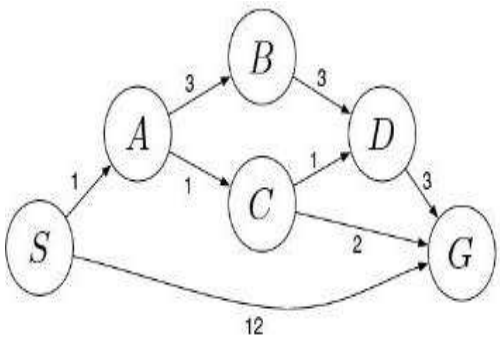
CO4: **Analyze** the performance and services provided by UDP and TCP protocols.

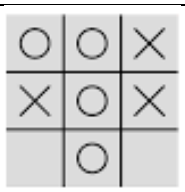
CO5: **Develop and analyze** the code for network algorithms and protocols using any programming language/simulators.

Machine Learning Laboratory

Contact Hours/ Week:	: 2	Credits:	1
Total Lecture Hours:	: 26	CIE Marks:	50
Sub. Code:	: N6ISL01	SEE Marks:	50

Course objectives: This course will enable students to:	
1.	Understand fundamental concepts in Artificial Intelligence.
2.	Be familiar with basic principles of AI such as problem solving, searching, knowledge representation and learning.
3.	Explain the role of agents in AI and structure of the agents.
4.	Analyze and identify significant characteristics of data sets.
5.	Understand and implement the training, testing, and validation phases of learning algorithms.

Sl. No.	Lab Programs /Topics Covered
1	a) Write a Python Program to perform Linear Search. b) Write a Python Program to perform Binary Search. c) Write a python program to read from lists and merge the two lists to contain only unique numbers. d) Write python programs for the following tasks: Reading text and Text manipulations e) Write the python programs: Read and print Matrix and Operations on it.
2	Write a python program to implement the following Uninformed search algorithms: • Breadth First Search algorithm • Depth First Search Algorithm
3	Write a python program to implement the following Uninformed Uniform Cost Search Algorithm for the following graphs. a) b)  
4	Write a python program to implement the Tic-Tac-Toe game and demonstrate the steps. Consider 3X3 board and minimum of two players.

	
5	Write a python program to implement Map coloring problem using either Constraint Satisfaction problem method or by applying Graph coloring algorithm. Also apply the same algorithm to the following Map and validate the answers. a) Australian Map with three colors 
6	Demonstrate the implementation of the supervised probability based naïve Bayesian classifier and demonstrate the performance of the model with clear interpretation of confusion matrices and other performance metrics. Use IRIS dataset for demonstration of the Model performance.
7	Consider Diabetes dataset downloaded from sklearn repository. Implement a Simple supervised Linear Regression model using the training data set. Assume the appropriate dependent and independent variables for regression analysis. Predict the scores on the test data. Print the MSE and R Squared Score (Coefficient of determination). Interpret the results.
8	Consider an USER-DATA dataset downloaded from Kaggle repository. Implement a supervised Logistic Regression model using the training data set. Assume the appropriate dependent and independent variables for regression analysis. Predict the scores on the test data. The output should include Confusion Matrix, Accuracy, Error rate, Interpret the results.
9	Demonstrate the implementation of Linear discriminant analysis (LDA) technique for dimensionality reduction. Consider IRIS dataset from Kaggle repository.
10	Demonstrate the implementation of Principal component analysis (PCA) technique for dimensionality reduction. Consider IRIS dataset from Kaggle repository.
11	Demonstrate the implementation of the decision tree based ID3 algorithm. Consider the data set of your choice. Demonstrate the performance of the model. Interpret the significance of Entropy and Information gain on model performance. Plot the complete tree constructed.
12	Demonstrate the implementation of the k-Means algorithm. Use IRIS dataset for demonstration. Use appropriate metrics to analysis of model performance. Interpret the results.

13	Demonstrate the implementation of k-Nearest Neighbor algorithm to classify the IRIS data set. Use appropriate metrics to analysis of model performance. Interpret the results.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1.	Understand and apply searching strategies and agents followed in solving various problems in Artificial intelligence.
CO2.	Demonstrate the working of the various dimensionality reduction techniques.
CO3.	Apply the supervised machine learning algorithms for solving real world problems.
CO4.	Apply the unsupervised machine learning algorithms for solving real world problems.

Neurocomputing and Deep Learning
(Professional Elective Course-1)

Contact Hours/ Week:	: 3	Credits:	3
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: NIS6PE11	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Understand the evolution of artificial neural networks.
2. Use & comprehend different models of ANN to solve the problems.
3. Understand the philosophy and working of Deep Forward Neural Networks.
4. Discuss the salient features and benefits of Associative Neural Networks.
5. Acquire the knowledge of the significance of Competitive and SOFM nets.

UNIT I

INTRODUCTION TO NEURAL NETWORKS: Neural Processing, Overview of Neural Networks, The rise of neurocomputing, Definition of Neural Network, Introduction to Neural Networks, Historical Developments of Neural Networks, Biological Neural Networks, Comparison between the Brain and the computer, Comparison between Artificial and Biological Neural Networks, Basic Building Blocks of Artificial Neural Network. (Chapter 1, Text Book 1)

8 Hours.

UNIT II

FUNDAMENTAL MODELS OF ANN: McCulloch-Pitts Neuron Mode: Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Competitive Learning Rule, Outstar Learning Rule, Boltzmann Learning Rule, Hebbian Network, Perceptron Networks: Architecture, Algorithm and Application Procedure, Adaline and Madaline Networks:

FEED FORWARD NETWORKS: Structure, Delta rule, generalized Delta Rule, Architecture, Training extensions, Practical considerations, Generalization, Prunning Techniques, advantages and disadvantages, applications. (Reference

8 Hours

UNIT III

DEEP FORWARD NEURAL NETWORKS: Definition of Deep Forward Neural Networks, Brief Survey on Deep Neural Networks, Advantages and Disadvantages of Deep Neural Network, Applications of Deep Neural Networks, Deep Neural Network Architecture, Learning in Deep forward Neural Networks.

(Chapter No.1 and Chapter No. 3 of Text Book 2) **8 Hours**

UNIT IV

ASSOCIATIVE MEMORY NEURAL NETWORKS: Introduction, Algorithms for Pattern Associations, Hetero Associative Memory Neural Networks, Auto Associative Memory Neural Networks, Bi-Directional Associative Memory Neural Networks. (Chapter 6, Text Book 1)

8 Hours

UNIT V

COMPETITIVE AND SELF ORGNIZING NETWORKS: Introduction: general clustering procedures, competitive learning architectures and algorithms, self-organizing feature maps. (Chapter 9, Text Book 1)

8 Hours

TEXT BOOKS

1	S.N.Shivanadam, S Sumathi, S N Deepa	Introduction to Neural Networks using MATLAB 6.0, Second Reprint 2006, ISBN:0-07-059112-1, TMH Publishing House, New Delhi.
2	Dr. Rajiv Chopra	Deep Learning-A Practical Approach using Python. Second Edition, ISBN:978-93-86173-41-6, Khanna Publisher, 2020.

REFERENCE BOOKS

1	James A. Freeman and David M. Skupura	Neural Networks: Algorithms, Applications and Programming Techniques, ISBN 13: 9780201513769, Pearson Education Publications, 2003.
2	Dr. Shivanandam and Deepa	Principles of Soft Computing, Third Edition, Wiley Publication, 2019.
3	Robert J Schalkoff	Artificial Neural Networks, Mc Graw Hill, International Edition, 1997.
4	B. Yegnanarayana	Artificial Neural Networks, PHI 1999.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Apply the fundamental concepts of ANN

CO2: Analyze and apply the different ANN models to solve the real world problem.

CO3: Discuss the fundamental issues with Deep Neural Networks.

CO4: Analyze and Apply training and testing algorithms to Associative NN.

CO5: Explore the salient features and significance of Competitive and SOFM nets.

Mobile Application Development

(Professional Elective Course-3)

Contact Hours/ Week:	: 3	Credits:	3
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: NIS6PE12	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Understand the basic structure, functions, Flutter App development Framework
2.	Analyze the performances by adding interactivity to an app by using gestures
3.	Describe the different animation and navigation effects for a mobile application
4.	Understand the structure and organization of any mobile application
5.	Enhance the user-friendly nature of mobile application by applying the different library functions.

UNIT I

INTRODUCING FLUTTER AND GETTING STARTED: Introducing Flutter, Understanding Widget Lifecycle Events, Understanding the Widget Tree and the Element Tree, Installing the Flutter SDK, Installing on Windows, Installing on Linux, Configuring the Android Studio Editor

CREATING A HELLO WORLD APP: Setting Up the Project, Using Hot Reload, Using Themes to Style Your App, Understanding Stateless and Stateful Widgets, Using External Packages

LEARNING DART BASICS: Why Use Dart?, Commenting Code, Running the main() Entry Point, Referencing Variables, Declaring Variables, Using Operators, Using Flow Statements, Using Functions, Import Packages, Using Classes, Implementing Asynchronous Programming.

8 Hours

UNIT II

CREATING A STARTER PROJECT TEMPLATE:
Creating and Organizing Folders and Files, Structuring Widgets.

UNDERSTANDING THE WIDGET TREE : Introduction to Widgets, Building the Full Widget Tree, Building a Shallow Widget Tree.

USING COMMON WIDGETS: Using Basic Widgets, Using Images and Icons, Using Decorators, Using the Form Widget to Validate Text Fields, Checking Orientation.

ADDING ANIMATION TO AN APP: Using Animated Container, Using Animated

Cross Fade, Using Animated Opacity, Using Animation Controller.

8 Hours

UNIT III

CREATING AN APP'S NAVIGATION: Using the Navigator, Using Hero Animation, Using the BottomNavigationBar, Using the BottomAppBar, Using the TabBar and TabBarView, Using the Drawer and ListView.

CREATING SCROLLING LISTS AND EFFECTS: Using the Card, Using the ListView and ListTile, Using the GridView, Using the Stack, Customizing the CustomScrollView with Slivers.

BUILDING LAYOUTS: A High-Level View of the Layout, Creating the Layout.

8 Hours

UNIT IV

APPLYING INTERACTIVITY: Setting Up GestureDetector: The Basics, Implementing the Draggable and Dragtarget Widgets, Using the GestureDetector for Moving and Scaling, Using the InkWell and InkResponse Gestures, Using the Dismissible Widget.

WRITING PLATFORM-NATIVE CODE: Understanding Platform Channels, Implementing the Client Platform Channel App, Implementing the iOS Host Platform Channel, Implementing the Android Host Platform Channel.

8 Hours

UNIT V

SAVING DATA WITH LOCAL PERSISTENCE : Understanding the JSON Format, Using Database Classes to Write, Read, and Serialize JSON, Formatting Dates, Sorting a List of Dates, Retrieving Data with the FutureBuilder, Building the Journal App, Adding the Journal Database Classes, Adding the Journal Entry Page, Finishing the Journal Home Page.

ADDING THE FIREBASE AND FIRESTORE BACKEND: What Are Firebase and Cloud Firestore? Structuring and Data Modeling Cloud Firestore, Viewing Firebase Authentication Capabilities, Viewing Cloud Firestore Security Rules, Configuring the Firebase Project, Adding a Cloud Firestore Database and Implementing Security, Building the Client Journal App.

8 Hours

TEXT BOOKS

1	Marco L. Napoli	Beginning Flutter, Published by John Wiley & Sons, Inc. Indianapolis, Indiana 2020

REFERENCE BOOKS

1	Prajyot Mainkar,	Google Flutter Mobile Development,

	Salvatore Giordano	Production reference: 1290319, Published by Packt Publishing Ltd., Birmingham, B3 2PB, UK. March 2019.
2	Rap Payne	Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, Copyright © 2019 by Apress Publications.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1:	**Comprehend** how Flutter framework works behind the scenes and about the benefits of the Dart language.
CO2:	**Create** a new project by organizing files and folders in it and **Apply** widgets to create simple and complex layouts.
CO3:	**Apply** the Navigator widget to manage a stack of routes to move between pages and work on different views.
CO4:	**Develop** interactive android applications with platform native code using gestures.
CO5:	**Comprehend** data persistence over app launches by using the JSON file format and saving the file to the local iOS and Android filesystem using Firebase and Firestore Backend.

Cloud Computing

(Professional Elective Course-2)

Contact Hours/Week	:	3	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Course Code	:	NIS6PE13	SEE Marks	:	50

Course objectives:

This course will enable students to:

1. Learn advanced and cutting-edge state-of-the-art knowledge and implementation in cloud computing.
2. Understand research publications in the technical area of cloud computing, beyond that of the traditional textbook level.
3. Learn advanced services and applications in stacks of cloud.
4. Explore the cloud Infrastructure and understanding Abstraction & Virtualization in cloud computing.

UNIT I

DEFINING CLOUD COMPUTING: Cloud Types, The NIST model, The Cloud Cube Model, Deployment models, Service models, Examining the Characteristics of Cloud Computing, Paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing; Assessing the value proposition: Early adopters and new applications, the laws of cloudonomics, cloud computing obstacles, behavioral factors relating to cloud adoption, measuring cloud computing costs, specifying SLAs

7 Hours

UNIT II

UNDERSTANDING CLOUD ARCHITECTURE: Exploring the Cloud Computing Stack, Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols; Understanding Services and Applications by Type: Defining IaaS, Defining PaaS, Defining SaaS, Defining IDaaS

9 Hours

UNIT III

UNDERSTANDING ABSTRACTION AND VIRTUALIZATION: Using Virtualization Technologies, Load balancing and Virtualization, Understanding Hypervisors; Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling.

8Hours

UNIT IV

UNDERSTANDING SERVICE ORIENTED ARCHITECTURE: Introducing Service Oriented Architecture, Event-driven SOA or SOA 2.0, The Enterprise Service Bus, Service catalogs, Defining SOA Communications, Business Process Execution Language, Business process modeling, Managing and Monitoring SOA, SOA management tools, SOA security, The Open Cloud Consortium, Relating SOA and Cloud Computing.

8 Hours

UNIT V

Understanding Cloud Security: Securing the Cloud, The security boundary, Security service boundary, Security mapping, Securing Data, Brokered cloud storage access, Storage location and tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards, Windows Azure identity standards.

8 Hours

TEXT BOOKS

1	Barrie Sosinsky	"Cloud Computing Bible", Wiley Publishing Inc. 2011.

REFERENCE BOOKS		
1	David S. Linthicum	Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, Addison-Wesley Information Technology Series, 2000.
2	Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra	"Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufman Publishers, 2012.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Analyse** the fundamental concepts of cloud computing to apply it to real world problems

CO2: **Analyse** cloud computing technologies covering cloud infrastructure and platform services.

CO3: **Illustrate** the novelty in different cloud computing frameworks.

CO4: **Identify** different Technologies for data security in cloud computing to resolve real time issues

CO5: **Analyse** application Integration process and compare various security options available for cloud computing.

Bigdata Analytics

(Professional Elective Course-4)

Contact Hours/ Week:	: 3	Credits:	3
Total Lecture Hours:	: 40	CIE Marks:	50
Sub. Code:	: NIS6PE14	SEE Marks:	50

Course objectives:
This course will enable students to:

1.	Provide a basic understanding of the types of digital data, the characteristics of big data, the challenges confronting the enterprises embracing big data.
2.	Understanding the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
3.	Introduce programming tool PIG in Hadoop echo system for storage, analysis and manipulation of data.
4.	Have skills that will help them to solve complex real-world problems for decision support.

UNIT I

GETTING AN OVERVIEW OF BIG DATA : What is Big Data? History of Data Management-Evolution of Big Data, Structuring Big Data-Types of Data, Elements of Data, Big Data Analytics: Advantages of Big Data Analytics, Careers in Big Data, Future of Big Data.

BIG DATA ANALYTICS: Introducing Technologies for Handling Big Data Distributed and Parallel Computing for Big Data, Introducing Hadoop, Cloud Computing and Big Data: Features of Cloud Computing, Cloud Deployment Models, Cloud Delivery Models, Cloud Services for Big Data, Cloud Providers in Big Data Market, In-Memory Computing Technology for Big Data.

8 Hours

UNIT II

UNDERSTANDING HADOOP ECOSYSTEM: Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, MapReduce, Hadoop YARN, Introducing HBase- HBase Architecture, Regions, Storing Big Data with HBase, Interacting with the Hadoop Ecosystem, HBase in Operation-Programming with HBase, Combining HBase with HDFS.

8 Hours

UNIT III

UNDERSTANDING MAPREDUCE FUNDAMENTALS AND HBASE: The MapReduce Framework: Exploring the features of MapReduce, working of MapReduce, Exploring Map and Reduce Functions, Techniques to optimize MapReduce Jobs: Hardware/ Network Topology, Synchronization, File System, Uses of MapReduce, Role of HBase in Big Data Processing:

Characteristics of HBase, Installation of HBase.
8 Hours

UNIT IV
ANALYSING DATA WITH PIG: Introducing Pig: The Pig Architecture, Benefits of Pig, Properties of Pig, running Pig, Getting Started with Pig Latin, Working with Operators in Pig, Debugging Pig, Working with Functions in Pig, Error Handling in Pig.
8 Hours

UNIT V
NOSQL DATA MANAGEMENT: Introducing to NoSQL, Types of NoSQL Data Models, Characteristics of NoSQL, Schema-less Databases, Materialized Views, Distribution Models, CAP theorem, Sharding. **INTRODUCTION TO MANGODB:** What is MongoDB? Why MongoDB? Terms used in RDBMS and MongoDB, Data types in MongoDB, MongoDB query language.
8 Hours

TEXT BOOKS		
1	DT Editorial Services	Big Data: Black Book, Dream Tech Press, Edition 2016.
2	Seema Acharya, Subhashini Chellappan, Infosys Limited	Big Data and Analytics, Wiley India Private Limited, 1st Edition 2015.

REFERENCE BOOKS		
1	Alex Holmes	Hadoop in Practice, Manning Publications Co. September 2014, Second Edition.
2	Alan Gates	Programming Pig, O'Reilly, Kindle Publication.
3	Dean Wampler	Programming Hive, O'Reilly, Kindle Publication

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1.	**Identify** the different types of digital data, sources, challenges, elements and technologies for handling Big Data.
CO2.	**Demonstrate** the big data analytics using Hadoop Ecosystem and have broad comprehension of HDFS, MapReduce Fundamentals and HBase.
CO3.	**Apply** Pig scripts with Hadoop Distributed File System to analyze stored Big Data.
CO4.	**Describe** and apply managing Hadoop jobs using Oozie.
CO5.	**Create** NoSQL Databases and explore MongoDB.