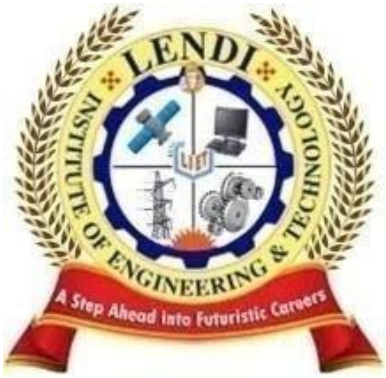
COURSE STRUCTURE (R23) AND
DETAILED SYLLABUS (IV YEAR)

COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

For

B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2023-24)



LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
Accredited by NAAC with "A" Grade and NBA (CSE, ECE, EEE & ME)
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COURSE STRUCTURE AND DETAILED SYLLABUS
B.TECH- COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

IV Year I Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CIT-PC4101	Software Testing Methodologies	3	0	0	3
2.	R23BSH-HM4101	Managerial Skills for Engineers	2	0	0	2
3.		**Professional Elective-IV**	3	0	0	3
	R23CIT-PE4101.1	1. Web Services				
	R23CIT-PE4101.2	2. Soft Computing				
	R23CIT-PE4101.3	3. Software Architecture & Design Patterns				
4.		**Professional Elective-V**	3	0	0	3
	R23CIT-PE4102.1	1. Computer Vision				
	R23CIT-PE4102.2	2. Human Computer Interaction				
	R23CIT-PE4102.3	3. Natural Language Processing				
5.		**Open Elective- III**	3	0	0	3
6.		**Open Elective- IV**	3	0	0	3
7.	R23CIT-SC4101	React JS	1	0	2	2
8.	R23BSH-MC4101	Entrepreneurship & Incubation(E&I)	2	0	0	-
9.	R23CIT-SI4101	Evaluation of Industry Internship	-	-	-	2
Total			**20**	**0**	**2**	**21**
Honor /Minor Course-4						

IV Year II Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CIT-PR4201	Internship	-	-	8	4
2.	R23CIT-PR4201	Project	-	-	16	8
Total			-	-	24	**12**

Open Electives Courses

Offering Department: Electronics and Communications Engineering

S.No	Course Code	Course Name	L	T	P	Credits
1	R23ECE-OE0001	Basics of Communication Systems	3	0	0	3
2	R23ECE-OE0002	Micro Processors and Interfacing	3	0	0	3
3	R23ECE-OE0003	Digital System Design using Verilog	3	0	0	3
4	R23ECE-OE0004	Fundamentals of Digital Image Processing	3	0	0	3
5	R23ECE-OE0005	Introduction to Internet of Things	3	0	0	3
6	R23ECE-OE0006	Wireless Sensor Networks	3	0	0	3
7	R23ECE-OE0007	Satellite Communication	3	0	0	3
8	R23ECE-OE0008	Fundamentals of Embedded Systems	3	0	0	3

Offering Department: Electrical and Electronics Engineering

S.No	Course Code	Course Name	L	T	P	Credits
1	R23EEE-OE0001	Renewable Energy Sources	3	0	0	3
2	R23EEE-OE0002	Energy Conservation and Management	3	0	0	3
3	R23EEE-OE0003	Electrical Safety & Standards	3	0	0	3
4	R23EEE-OE0004	Utilization of Electrical Energy	3	0	0	3

Offering Department: Mechanical Engineering

S.No	Course Code	Course Name	L	T	P	Credits
1	R23MEC-OE0001	Operations Research	3	0	0	3
2	R23MEC-OE0002	3D Printing Technology	3	0	0	3
3	R23MEC-OE0003	Statistical quality control	3	0	0	3
4	R23MEC-OE0004	Hybrid Vehicle Technologies	3	0	0	3
5	R23MEC-OE0005	Industrial Robotics	3	0	0	3
6	R23MEC-OE0006	Nano Materials	3	0	0	3
7	R23MEC-OE0007	AI and ML In Manufacturing	3	0	0	3
8	R23MEC-OE0008	Automation in Manufacturing	3	0	0	3

Offering Department: Computer Science and Engineering & Allied Branches

S.No	Course Code	Course Name	L	T	P	Credits
1	R23CSE-OE0001	Python Programming	3	0	0	3
2	R23CSE-OE0002	Data Structures Using C	3	0	0	3
3	R23CSE-OE0003	Operating System Concepts	3	0	0	3
4	R23CSE-OE0004	Introduction to Java Programming	3	0	0	3
5	R23CSE-OE0005	Database Management Systems Concepts	3	0	0	3
6	R23CSE-OE0006	Unix & Shell Programming	3	0	0	3
7	R23CSE-OE0007	Software Engineering	3	0	0	3
8	R23CSE-OE0008	Introduction to Data mining	3	0	0	3
9	R23CSE-OE0009	Fundamentals of Web Technologies	3	0	0	3
10	R23CSE-OE0010	Fundamentals of Computer Networks	3	0	0	3
11	R23CSE-OE0011	Basics of Cloud Computing	3	0	0	3
12	R23CSE-OE0012	Introduction to Machine Learning	3	0	0	3
13	R23CSE-OE0013	Essentials of Cyber Security	3	0	0	3
14	R23CSE-OE0014	Introduction to React JS	3	0	0	3
15	R23CSE-OE0015	Deep Learning	3	0	0	3
16	R23CSE-OE0016	DevOps	3	0	0	3

17	R23CSE-OE0017	Mobile Computing	3	0	0	3
18	R23CSE-OE0018	Java Full Stack Development	3	0	0	3
19	R23CSE-OE0019	Human Computer Interface	3	0	0	3
20	R23CSE-OE0020	Cryptography and Network Security	3	0	0	3
21	R23CSE-OE0021	Quantum Computing	3	0	0	3
22	R23CSE-OE0022	Big data Analytics	3	0	0	3
23	R23CSE-OE0023	Block Chain Technology	3	0	0	3
24	R23CSE-OE0024	Multimedia Application Development	3	0	0	3
25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CSS-OE0001	Operating Systems	3	0	0	3
27	R23CSS-OE0002	Redhat Linux	3	0	0	3
28	R23CSS-OE0003	Cloud Computing	3	0	0	3
29	R23CSS-OE0004	Distributed Operating System	3	0	0	3
30	R23CIT-OE0001	Basics of computer networks	3	0	0	3
31	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
32	R23CIT-OE0003	Mobile Computing	3	0	0	3
33	R23CIT-OE0004	Wireless sensor networks	3	0	0	3
34	R23CSM-OE0001	An Introduction to AI	3	0	0	3
35	R23CSM-OE0002	Introduction to Machine Learning using Python	3	0	0	3
36	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
37	R23CSM-OE0004	Natural Language Processing – Frontiers Approach	3	0	0	3

Honors & Minors Courses

Note: The registered student shall acquire 18 credits through NPTEL/Offline Courses.

Track-I (Networks)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23ECE-MT2201	Introduction to Networks	3	0	0	3
2	III-I	R23CIT-HN3101	Switching, Routing, and Wireless Essentials	3	0	0	3
3	III-II	R23CIT-HN3201	Enterprise Networking, Security, and Automation	3	0	0	3
4	IV-I	R23CIT-HN4101	Wireless Sensor Networks	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							18

Track-II (Ethical Hacking)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CIT-HN2202	Fundamentals of Ethical Hacking	3	0	0	3
2	III-I	R23CIT-HN3102	Network Penetration Testing	3	0	0	3
3	III-II	R23CIT-HN3202	Web Application Penetration Testing	3	0	0	3
4	IV-I	R23CIT-HN4102	Wireless Network Penetration Testing	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							18

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Track-III (Security)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CIT-HN2203	Cyber Security	3	0	0	3
2	III-I	R23CIT-HN3103	Secure Coding	3	0	0	3
3	III-II	R23CIT-HN3203	Vulnerability Assessment & Penetration Testing	3	0	0	3
4	IV-I	R23CIT-HN4103	Malware Analysis	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							18

Track IV (Data Science)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CIT-HN2204	Introduction to Data Science	3	0	0	3
2	III-I	R23CIT-HN3104	Data Analysis and Visualization	3	0	0	3
3	III-II	R23CIT-HN3204	Advanced Data Analysis Techniques	3	0	0	3
4	IV-I	R23CIT-HN4104	Applied Data Science Projects and Specializations	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							18

MINORS COURSE OFFERED BY ECE: Quantum Computing Track

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23ECE-MT2201	Foundations of Quantum Computing: Physics, Engineering, and Mathematics Computing	3	0	0	3
2	III-I	R23ECE-MT3101	Survey of Quantum Technologies and Applications	3	0	0	3
3	III-I	R23ECE-MT3102	Quantum Technology-1 Lab	0	0	3	1.5
4	III-II	R23ECE- MT 3201	Foundations of Quantum Technologies	3	0	0	3
5	III-II	R23ECE-MT 3202	Quantum Technology-2 Lab	0	0	3	1.5
6	IV-I	R23ECE-MT 4101 R23ECE MT 4102	1. Quantum Computation (OR) 2.Quantum Communications	3	0	0	3
6	II Year to IV Year	R23ECE-HM0002	Minors MOOCS-1	0	0	0	3
Total							18

R23CIT-PC4101	SOFTWARE TESTING METHODOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the fundamentals and significance of software testing.
- To impart knowledge of logic-based testing techniques.
- To develop skills in test planning, test case design, execution, defect management, and reporting.
- To provide an understanding of software test automation concepts and processes.
- To equip students with practical skills in using modern software testing tools.

Course Outcomes:

- Understand the fundamental concepts, principles, software testing life cycle, and verification & validation activities used in software testing.(L2)
- Apply black box testing techniques to design the test cases to check the functionality of software.(L3)
- Apply White box testing techniques to design the test cases to check the structural aspects of software. (L3)
- Apply validation and regression testing techniques to evaluate software quality during different phases of testing. (L3)
- Analyze test suite management strategies and select appropriate automation testing tools for efficient software testing. (L4)

Unit I:

Software Testing: Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing. Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, relating test life cycle to development life cycle Software Testing Methodology

Verification and Validation: Verification & Validation Activities, Verification of Requirements, High level and low level designs, How to verify code, Validation

Learning Outcomes: After the end of unit students will be able to

- Understand the purpose of Testing.
- Understand software testing knowledge and engineering methods.
- Verify and validate the test process

Unit II:

Static Testing: inspections, Structured Walkthroughs, Technical reviews

Dynamic Testing I: Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table based testing, Cause-Effect Graphing based testing, Error guessing

Learning Outcomes: After the end of unit students will be able to

- Perform the static testing
- Design test cases using black box testing techniques

Unit III:

Dynamic Testing II: White-Box Testing: need, Logic coverage criteria, Basis path testing, Loop testing, data flow testing, mutation testing

Graph matrices and Applications: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm

Learning Outcomes: After the end of unit students will be able to

- Design test cases using white box testing techniques
- Design test cases with 100% coverage.

Unit IV:

Validation activities: Unit testing, Integration Testing,. Function testing, system testing, acceptance testing.

Regression testing: Progressives Vs regressive testing, Regression testability, Objectives of regression testing, When regression testing done?, Regression testing types, Regression testing techniques

Learning Outcomes: After the end of unit students will be able to

- Design the test cases for regression testing.
- Perform system testing

Unit V:

Efficient Test Suite Management: Test case design Why does a test suite grow, Minimizing the test suite and its benefits, test suite prioritization, Types of test case prioritization, prioritization techniques, measuring the effectiveness of a prioritized test suite

Automation and Testing Tools: need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing.

Learning Outcomes: After the end of unit students will be able to

- Design the test suite effectively
- Automate the testing process

Text Books:

- Software Testing, Principles and Practices, Naresh Chauhan, Oxford
- Software testing techniques - Baris Beizer, International Thomson computer press, second edition.

- Foundations of Software testing, Aditya P Mathur, 2ed, Pearson

Reference books:

- Software Testing- Yogesh Singh, CAMBRIDGE
- Software Testing, Principles, techniques and Tools, M G Limaye, TMH Effective Methods for Software testing, Willian E Perry, 3ed, Wiley

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

SNO	PO 1	PO 2	PO 3	P O	P O5	P O6	P O7	P O8	P O9	P 10	PO 11	PO 12	PS O1	PS O2	PS O3
CXXX.1	3	2		2					2	2		3	3		3
CXXX.2	3	3	3	3	3				3	3	2	3	3	3	3
CXXX.3	3	3	3	3	3				3	3	2	3	3	3	3
CXXX.4	3	3	3	3	3				3	3		3	3	3	3
CXXX.5	3	3	3	3	3				3	3	2	3	3	3	3
CXXX.*	3	3	3	3	3				3	3	2	3	3	3	3

R23BSH-HM4101	MANAGERIAL SKILLS FOR ENGINEERS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- Provide fundamental knowledge on Management, Administration, Organizational methodologies
- Equip with the knowledge of long term business value for the organization
- Explain basics of human resource management & marketing required for organization
- Identify issues and challenges In project selection criteria.
- Analyses the PERT/CPM techniques for better Projec tManagement.

COURSE OUTCOMES:

- Apply principles of management &designs of organization inpractical world.
- Realize concepts of business value development for organizational growth.
- Provided awareness of human resource management and marketing concepts.
- Determine effective project selection based on organizational needs.
- Develop PERT/CPM Charts for projects of enterprise and estimate time & cost of project.

UNIT I:

INTRODUCTION TO MANAGEMENT: Management-Concept-Nature-Functions Evolution of Management Thought - Motivational theories- Decision making Process-Leadership styles-Principles of Organization- Features and types organizational structures. **Applications:** Divide the class into two teams' old employees and new joiners and motivate the work environment with respect to excellent management and the supportive.

UNIT II:

BUSINESS ENVIRONMENT: Building business value through modernization; principles of value engineering; approaches and methods of business value development; SWOT analysis of business; and strategies for enhancing business value. **Applications:** Analyse a company's potentialities and business value

UNIT III:

HUMAN RESOURCES MANAGEMENT & MARKETING MANAGEMENT

Human Resource Management: Definition and meaning; managerial and operative functions; job evaluation; and merit rating.

Marketing Management: Concept, meaning, nature, and functions of marketing; marketing mix; channels of distribution; and marketing strategies based on the product life cycle.

Applications: Apply human resource and marketing aspects in professional decision-making.

UNIT IV:

PROJECTS ELECTION: Project Selection and criteria of choice –Nature of project selection models-Types of project selection models-analysis under uncertainty

Applications: Estimation of perspectives of project and choose the correct one among available choices.

UNIT V:

PROJECT MANAGEMENT: Project planning and control- Project life cycle-Development of Network- Difference between Program Evaluation Review Technique and Critical Path Method- Identifying critical path.

Application: Analyze various parameter soft he project like critical path, crashing `etc. For best cost decisions according to operations of the project.

TEXT BOOKS:

1. P. Subba Rao, *Organizational Behaviour*, Himalaya Publishing House, Mumbai, 2nd Edition, 2023.
2. Aryasri, *Management Science*, Tata McGraw-Hill, 2009.
3. M. Prasad, *Principles and Practice of Management*, 10th Edition, 2022.

Reference Books:

1. Fred Luthans, *Organizational Behaviour*, Tata McGraw-Hill (TMH), New Delhi.
2. Stephen P. Robbins, *Fundamentals of Management*, Pearson Education, India.
3. Philip Kotler and Kevin Lane Keller, *Marketing Management*, 12th Edition, PHI, 2007.
4. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 6th Edition, Tata McGraw-Hill (TMH), 2007.
5. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2007.

R23CIT-PE4101.1	Web Services	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand web services and Service oriented architecture (SOA).
- Implement java generic classes and annotations.
- Implement java persistence using JSON and XML Parsers.
- Implement XML Web services using WSDL and JAX-WS.
- Implement RESTFul Web Services using JAX-RS.

Course Outcomes:

- Understand the importance of Web Services and Service Oriented Architecture.(L2)
- Implement Java Generic data Structures and Annotations.(L3)
- Implement object persistence using different APIs. (L3)
- Apply XML Web Services using JAX-WS APIs. (L3)
- Apply RESTFul Web Services using JAX-RS APIs. (L3)

UNIT 1

Introduction to Web Services - Client Server Distributed Computing, Web Services, Features and characteristics of web services, Web service architecture, WS Components, Soap Web Services, Rest Web services, Soap vs Rest, Service Oriented Architecture, Micro services, Web Services vs Micro Services.

Learning Outcomes: student will be able to

- Understand Web Service Architecture. (L2)
- Understand Soap and Rest Web services. (L2)
- Understand Web Services architecture and its role in services. (L2)

UNIT 2

Generics & Annotations: Generics in Java, Advantages of generics, Generic Classes, Type Parameters, Wild Cards, Nested Collections, Annotations, Annotation Elements, Built-in Annotations, Custom Annotations.

Learning Outcomes: student will be able to

- Understand java generics and annotations (L2).
- Implement Wild cards for generic types and classes (L4).
- Implement Custom annotations and for complex java classes. (L4).

UNIT 3

Object Persistence: XML, Rules of XML Document, XML Schema and Name Space, Marshalling and UnMarshalling XML document using JAXB, DOM Parser, JSON Object, JSON

Array, Serializing and De-serializing JSON, JSON Parsing using Jackson APIs.

Learning Outcomes: Student will be able to

- Understand structure of XML document(L2).
- Implement XML parsers using JAXB APIs and DOM (L4).
- Implement JSON binding using JACKSON APIs (L4).

UNIT 4

SOAP Web Services: Introduction to SOAP, SOAP Architecture, WSDL, Structure of WSDL, WSDL Document Elements: Definitions, Types, Message, Operation, portType, binding, port & services, Schema Types and Binding styles, Publishing SOAP Web Services, Consuming Web Services, Exploring javax.xml.ws.*.

Learning Outcomes: Student will be able to

- Understand the structure of SOAP and WSDL. (L2)
- Implement WSDL using JAX-WS APIs. (L4)

UNIT 5

RESTFul Web Services: Introduction to RESTFul Web Services, HTTP Request & Response Header, HTTP Methods, Publishing and Consuming Rest based XML Web Services, Publishing and Consuming REST based JSON web services, Exploring JAX-RS through Jersey APIs: javax.ws.rs.*.

Learning Outcomes: Student will be able to

- Understand RESTFul Web Services and its structure. (L2)
- Analyze end point Web Services using JAX-RS. (L4)

Applications:

- Amazon Web Services
- Currency Converter Applications
- Movie Rating Web Services
- Client Server Applications.
- Online Transportation Applications like Uber, OLA etc.
- Project Deployment Models

Text Books:

- Java, How to Program, 9th Edition, Dieitel & Deitel, 2012.
- Java Web Services: Up and Running, 2nd Edition by Martin Kalin, 2013, Orielly Media.
- Java XML and JSON, 2nd Edition, Jeff Friesen, Apress.

Reference Books:

- XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.
- Building web Services with Java, 2nd Edition, S. Graham and others, Pearson Education. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2								1	1	1	1
CO2	3	2	2	1	3				1			1	2	3	3
CO3	3	2	2	1	3				1			1	2	3	3
CO4	3	2	2	2	3				1			1	2	3	3
CO5	3	2	2	2	3				1			1	2	3	3
CO*	3	2	2	2	3				1			1	2	3	3

R23CIT-PE4101.2	Soft Computing	L	T	P	C
		3	0	0	3

Course Objectives:

- To make the students to be familiar with the concept of classification techniques to solve real problems.
- To Familiarize with Soft computing concepts.
- To have a detailed study of neural networks, Fuzzy Logic and uses of Heuristics based on human experience.
- To introduce the concepts of genetic algorithm and its applications to soft computing using some applications.
- To make the students to have general overview on selection and decision making strategies.

Course Outcomes:

- Understand basics of soft computing .(L2)
- Apply the Learning Process of Soft Computing in real world problems.(L3)
- Apply various Fuzzy sets in real world problems.(L3)
- Analyze the concepts of Genetic algorithm and its applications.. (L4)
- Analyze decision tree algorithms(L4)

UNIT I

Introduction to Soft Computing: Evolutionary Computing, "Soft" computing versus "Hard" computing,Soft Computing Methods, Recent Trends in Soft Computing, Characteristics of Soft computing,Applications of Soft Computing Techniques.

Learning Outcomes: Student will be able to

- Familiarize with soft computing concepts.(L1)
- Understand the Applications of Soft Computing Techniques.(L2)

UNIT II

Learning Process: Error Correction learning, Memory based learning, Hebbian learning, Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process.

Learning Outcomes: Student will be able to

- Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications.(L2)
- Recognize the feasibility of applying a soft computing methodology for a particular problem.(L3)

Unit III:

Classical & Fuzzy Sets: Introduction to classical sets – properties, operations and relations; Fuzzy sets – memberships, uncertainty, operations, properties, fuzzy relations, cardinalities, membership functions.

Learning Outcomes: Student will be able to

- List the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.(L2)
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic(L2)

Unit IV

Genetic Algorithms: Basic Concepts, Basic Operators for Genetic Algorithms, Crossover and Mutation Properties, Genetic Algorithm Cycle, Fitness Function, Applications of Genetic Algorithm.

Learning Outcomes: Student will be able to

- Learn the concepts of Genetic algorithm and its applications.(L1)
- Discuss the ideas of Basic Concepts, Basic Operators and Crossover and Mutation Properties.(L2)

Unit V

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning

Learning Outcomes: Student will be able to

- Apply neural networks to pattern classification and regression problems.(L3)
- Effectively use existing software tools to solve real problems using a soft computing approach.(L3)
- To be able to solve Engineering problems using decision tree learning algorithms.(L3)

Text Books

- Soft Computing – Advances and Applications - Jan 2015 by B.K. Tripathy and J. Anuradha –Cengage Learning. Neural networks A comprehensive foundations, Simon Haykin, Pearson Education2nd edition2004
- Neural Networks, Fuzzy Logic, Genetic Algorithms: Synthesis and Applications byRaja sekharan and Pai, PHI Publications
- Machine Learning, Tom M. Mitchell, MGH.

Reference Books

- S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", 2nd edition, Wiley India, 2008.
- David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine learning",Pearson Education. Simon Haykin , "Neural Networks: A Comprehensive Foundation ", PHI Publication.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	1				1		2	2	2	1
CO2	3	3	2	2	2	1				1		1	3	3	2
CO3	3	3	2	1	2	1				1		1	2	3	2
CO4	3	3	3	2	3	1				1		2	3	3	3
CO5	3	3	3	2	2	1				2		2	3	3	2
CO*	3	3	2	2	2	1				1		2	3	3	2

R23CIT-PE4101.3	Software Architecture & Design Patterns	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand interrelationships, principles, and guidelines governing architecture and evolution over time.
- To understand various architectural styles of software systems.
- To understand design patterns and their underlying object-oriented concepts.
- To understand the implementation of design patterns and provide solutions to real-world software design problems.
- To understand patterns with each other and understand the consequences of combining patterns on the overall quality of a system.

Course Outcomes:

- Understand the importance of Software Architecture with various reference models and documenting architectures.(L2)
- Analyze of architectures with appropriate decision-making by the system architect.(L4)
- Analyze how problems can be solved using design patterns. (L4)
- Apply the structural design patterns for various real-time examples(L3)
- Analyze the case study of design patterns to solve the complex problems(L4)

UNIT-I

Envisioning Architecture: The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures, and views.

Creating and Architecture: Quality Attributes, Achieving qualities, Architectural styles andPatterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.

Learning Outcomes: Students will be able to

- Understand the necessity of the Architecture Business Cycle and the importance of Software Architecture.
- Understand software architecture with various reference models.
- Understand documenting software architectures. Analyze the Quality Attributes.

Applications:

- Architectures are influenced by ABC System stakeholders
- Developing organization

UNIT-II

Analyzing Architectures: Architecture Evaluation,Architecturedesign, decisionmaking, ATAM, CBAM, SAAM. Moving from One System to Many: Software Product Lines, Building systems from the shelf components, Software architecture in the future.

Learning Outcomes: Students will be able to

- Understand Architecture Evaluation.
- Understand different analysis models.
- Analyze Architecture design decision-making.
- Analyze how software architectures can be used in different software applications.

Applications:

Analyzing Architecture is influenced by MVC architecture etc.,

UNIT-III

Patterns: Pattern Description, Organizing catalogs, role in solving design problems, Selection, and usage.

Creational Patterns: Singleton Pattern, Factory method Pattern, Abstract factory Pattern, Builder Pattern, Prototype Pattern.

Learning Outcomes: Students will be able to

- Understand what the use of design patterns is.
- Analyze how problems can be solved using design patterns.
- Analyze how to use creational design patterns for different problems.
- Evaluate whether the product design can be independent or not.

Applications:

Selection & Usage of Design patterns can be solved by Usage of MVC architecture for developing web applications.

UNIT-IV

Structural Patterns: Adapter, Bridge, Composite, Decorator, Façade, Flyweight, & PROXY.

Learning Outcomes: Students will be able to

- Understand the structure of design patterns.
- Analyze how classes and objects are composed to form large structures.
- Understand the logic of design patterns.

UNIT-V

Behavioral Patterns: Chain Of Responsibility, Iterator, Mediator, Memento, Observer, State, Strategy, &Visitor. The World Wide Web - a case study in Interoperability, The Nightingale System: A Case Study in Applying the ATAM, Celsius Tech – a case study in Product line development.

Learning Outcomes: Students will be able to

- Analyze responsibilities between objects of classes.
- Apply complex control flow in applications.
- Analyze various dependencies between objects with respect to classes.

Applications:

The implementation of various Case Studies can be done by Quality of application (for various Real – Time Examples) can be observed in web and desktop applications.

Contemporary Topics: Command, Interpreter, Template Method

Text Books

- Software Architecture in Practice, 4th edition, Len Bass , Paul Clements, Rick Kazman , Published by Addison-Wesley Professional (December 15th 2021) - Copyright © 2022.
- Design Patterns, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides , Published by Pearson Education, 1January 2008..

Reference Books

- Beyond Software architecture, Luke Hohmann, Addison Wesley, 2003.
- Software architecture, David M. Dikel, David Kane and James R. Wilson, PrenticeHall PTR, 2001
- Software Design, David Budgen, second edition, Pearson education, 2003
- Head First Design patterns, Eric Freeman & Elisabeth Freeman, O'REILLY, 2007.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3; MEDIUM: 2; LOW: 1):

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1	PO 1	PO 1	PS O	PS O	PS O
CO1	3	2	2	2	2				2			2	2	2	
CO2	3	2	2	3	2				2			2	2	2	
CO3	3	2	2	2	2				2			2	2	2	
CO4	3	2	2	3	2				3			2	2	2	2
CO5	3	2	2	2	2				3			2	2	2	2
CO*	3	2	2	2	2				3			2	2	2	2

R23CIT-PE4102.1	COMPUTER VISION	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce students to the fundamentals of image formation.
- To introduce students to the major ideas, methods, and techniques of computer vision and pattern recognition.
- To develop an appreciation for various issues in the design of computer vision and object recognition systems.
- To provide students with programming experience through the implementation of computer vision and object recognition applications.

Course Outcomes: At the end of this course, the student will be able to:

- Understand image processing techniques required for computer vision. (L2)
- Describe image formation models. (L2)
- Understand feature extraction and motion estimation techniques. (L2)
- Apply segmentation algorithms for shape analysis. (L3)
- Implement image classification applications using object recognition methods. (L3)

UNIT-I: (10 Hours)

Introduction to Computer Vision, Relationship between Computer Vision, Image Processing and Artificial Intelligence, Basics of Digital Images and Pixels, Human Visual System, Applications of Computer Vision in Face Recognition, Medical Imaging, Autonomous Vehicles, Robotics and AR/VR, Introduction to Python and OpenCV Basics.

UNIT-II: (10 Hours)

Image Formation Process, Pinhole Camera Model, Basics of Light and Color, RGB and HSV Color Models, Orthographic and Perspective Projection, Camera Calibration Basics, Introduction to Stereo Vision, Depth Estimation Concepts, Basics of 3D Reconstruction from Images**.**

UNIT-III: (10 Hours)

Image Enhancement and Filtering, Edge Detection using Sobel and Canny Operators, Corner Detection. Introduction to Feature Extraction Techniques: SIFT, SURF and ORB.Texture Analysis Basics, Feature Matching, Optical Flow, Motion Detection and Motion Estimation, Introduction to Structure from Motion.

UNIT-IV: (10 Hours)

Image Segmentation: Thresholding, Edge-based and Region-based Segmentation, Watershed Segmentation, Morphological Operations, Contour Representation, Active Contours, Introduction to Fourier and Wavelet Descriptors, Basics of Semantic Segmentation.

UNIT-V: (08 Hours)

Image Classification, Object Detection using You Only Look Once, Introduction to U-Net and Mask R-CNN, Basics of Vision Transformers, Applications in Face Recognition and Autonomous Driving.

TEXT BOOKS:

1. D. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*, Pearson, 2nd Edition, 2015.
2. E. Trucco and A. Verri, *Introductory Techniques for 3D Computer Vision*, Prentice Hall, 3rd Edition, 2016.

REFERENCE BOOKS:

1. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, Addison Wesley Longman, Inc., 2nd Edition, 1992.
2. Richard Szeliski, *Computer Vision: Algorithms and Applications (CVAA)*, Springer, 2nd Edition, 2010.
3. Sonka, Hlavac, and Boyle, *Image Processing, Analysis, and Machine Vision*, Thomson, 4th Edition, 2011.
4. E. R. Davies, *Computer and Machine Vision*, Academic Press, 4th Edition, 2012.
5. Simon J. D. Prince, *Computer Vision: Models, Learning, and Inference*, Cambridge University Press, 2012.
6. Mark Nixon and Alberto S. Aguado, *Feature Extraction and Image Processing for Computer Vision*, Academic Press, 3rd Edition, 2012.

7. **COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)**

CO PO PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	1		1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	1		1	1	1		2	3	3	2
CO3	3	3	2	2	3	1			1		1	2	3	3	2
CO4	3	3	3	3	3			1	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1			2	2	2	3	3	3	3

R23CIT-PE4102.2	Human Computer Interaction	L	T	P	C
		3	0	0	3

Course Objectives:

- To get student to think constructively and analytically about how to design and evaluate user Interface.
- Describe the various styles and interactive devices in designing.
- Analyze the quality and different strategies in language processing.
- Study the HCI Evaluation through expert analysis.
- Apply different search patterns on data.

Course Outcomes:

- Understand the capabilities of user Interface. (L2)
- Understand the human–computer interaction (HCI) models (L2)
- Apply an interactive design process and universal design principles to designing HCI systems. (L3)
- Understand HCI Evaluation through expert analysis. (L2)
- Analyzed tasks and dialogs of relevant HCI systems based on task analysis and dialog design. (L4)

Unit 1

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

Learning Outcomes: Student will be able to

- Describe the basic concepts of user Interface.(L1)
- Analyze the basic good design and development methods.(L2)

Unit 2

Menu Selection, Form Fill-In and Dialog Boxes: Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus: Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays.

Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and large.

Learning Outcomes: Student will be able to

- Describe utilisation of menus &dialog boxes.(L1)
- Analyse the interactive devices.(L2)

Unit 3

Command and Natural Languages: Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing

Quality of Service: Introduction, Models of Response-Time impacts, Expetations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences

Learning Outcomes: Student will be able to

- Describe structure & strategies of natural language computing.(L2)
- Analyse working quality of designed applications.(L2)

Unit 4

HCI in the software process, The software life cycle Usability engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction

Learning Outcomes: Student will be able to

- Analyze and design Software life cycle methods.(L3)
- Analyze the HCI Evaluation through expert analysis .(L3)

Unit 5

Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Searching Interfaces Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization

Learning Outcomes: Student will be able to

- Analysis of information search in textual documentation.(L3)

Text Books:

- The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
- Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education.

Reference Books:

- Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
- .Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
- Human Computer, Interaction Dan R.Olsan, Cengage ,2010.
- Designing the user interface. 4/e, Ben Shneidermann , PEA.
- User Interface Design, Soren Lauesen , PEA.
- Interaction Design PRECE, ROGERS, SHARPS, Wiley

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	2	2	2	2	2	1	2	2	2	2
CO2	3	2	2	2	2	2	2	3	2	2	2	2	3	2	2
CO3	3	3	3	2	3	2	2	3	3	3	2	3	3	3	2
CO4	2	3	2	3	3	2	2	2	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	2	3	3	2	3	3	3	2
CO*	3	3	2	2	3	3	3	2	2	2	1	3	2	2	2

R23CIT-PE4102.3	**Natural Language Processing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- Explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
- Discuss approaches to syntax and semantics in NLP.
- Examinecurrentmethodsforstatisticalapproachestomachinetranslation.
- Explore machine learning techniques used in NLP.

Course Outcomes :

- Understand basics of NLP techniques (L2)
- Analyze top-down and bottom-up parsing approaches (L4)
- Analyze various grammars on NLP(L4)
- Analyze semantic interpretation models and language models(L4)
- Apply machine translation, multilingual information retrieval, and summarization techniques (L3)

UNIT I

Introduction to Natural language

The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax.

Learning Outcomes: At the end of the module, students will be able to:

- Classify various NLP Applications(L2)
- Outline the Linguistic Background(L2)

Unit II

Grammars and Parsing

Grammars and Parsing- Top- Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayees Rule, Shannon game, Entropy and Cross Entropy.

Learning Outcomes: At the end of the module, students will be able to:

- Demonstrate the Top-Downand Bottom-Up Parsing techniques(L2)
- Apply Bayes Rule, Shannon game, Entropy and Cross Entropy. (L3).
- Develop game playing strategies using Shannon game. (L3)

UNIT III

Grammars for Natural Language

Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.

Learning Outcomes: At the end of the module, students will be able to:

- Classify Grammars for Natural Language(L2)
- Explain Hold Mechanisms in ATNs.(L2)
- Explain Human Preferences in Parsing.(L2)

UNIT IV

Semantic Interpretation

Semantic &Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts & embedded sentences, Defining semantics structure model theory.

Language Modeling

Introduction-Gram Models,Language model Evaluation,Parameter Estimation,Language Model Adaption, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross lingual Language Modeling.

Learning Outcomes: At the end of the module, students will be able to:

- Distinguish Language model Evaluation(L4)
- List the types of Language Models(L1)

UNIT V

Machine Translation

Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges.

Multilingual Information Retrieval

Introduction,DocumentPreprocessing,MonolingualInformationRetrieval,CLIR,MLIR, Evaluation in Information Retrieval, Tools, Software and Resources.Multilingual Automatic Summarization Introduction,ApproachestoSummarization,Evaluation,HowtoBuildaSummarizer, Competitions and Datasets.

Learning Outcomes: At the end of the module, students will be ableto:

- Apply Machine Translation techniques. (L3)
- Elaborate Multilingual Information Retrieval and MultilingualAutomatic Summarization. (L6)

Textbooks:

- James Allen, Natural Language Understanding, 2ndEdition, 2003,Pearson Education.
- Multilingual Natural Language Processing Applications: From Theory To Practice Daniel M.Bikel and Imed Zitouni, Pearson Publications.
- Natural LanguageProcessing, A Panini an perspective, AksharBharathi, Vineet chaitanya,Prentice –Hall of India.

References books:

- Charniack, Eugene, Statistical Language Learning, MIT Press,1993.
- Jurafsky, Danand Martin, James,Speech and Language Processing,2nd Edition,Prentice Hall, 2008.
- Manning, Christopher and Henrich, Schutze, Foundations of StatisticalNaturalLanguage Processing, MIT Press, 1999.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	1	2	2	2	2	3	3	3	2
CO2	3	3	2	3	3	1	1	2	2	2	2	3	3	3	2
CO3	3	2	2	2	2	1	1	2	2	2	2	2	2	2	2
CO4	3	3	3	2	3	1	2	2	2	2	2	3	3	3	2
CO5	3	3	3	2	3	2	2	2	3	3	2	3	3	3	2

R23CIT-SC4101	React JS Framework	L	T	P	C
		1	0	2	2

Course Objectives:

- To learn essential React JS skills for front-end development.
- To explore client-side JavaScript application development and the React library.
- To implement React components, hooks, and state management for building interactive UIs.
- To gain experience with React.js, JSX, HTML, CSS, and JavaScript.
- To create a functional front-end web application using React.

Course Outcomes:

- Understand the anatomy of React Java Script. (L2)
- Understand the life cycle methods of React JS. (L2)
- Implement React components for building applications. (L3)
- Apply React hooks for component reusability and monitoring. (L3)
- Implement React rendering for interactive applications. (L3)

UNIT 1

React JS: Introduction to React JS, React vs Angular, React Version History, Architecture of the React Application, Installation, Creating and Running React App, Anatomy of React Project.

Templating using JSX: Expressions, Operators, Attributes, Fragments.

Learning Outcomes: Student will be able to

- Understand react framework for building applications. (L2)
- Understand the installations of react packages. (L2)
- Implement templates in react applications. (L3)

UNIT 2

React Core: Props, State, Event Handling, Lists and Keys, Styling, Pagination, React Life Cycle, Life Cycle Methods, State Management, Mounting Life Cycle.

Learning Outcomes: Student will be able to

- Understand event handling in React. (L2).
- Implement life cycle methods in react. (L3).
- Implement props and states in building react apps. (L3)

UNIT 3

React Components: Pure Components, memo, Refs, Portals, Higher Order Components (HOC), Context, HTTP requests (POST & GET).

Learning Outcomes: Student will be able to

- Understand http request methods in handling end points. (L2)
- Implement components to handle react requests. (L3)
- Implement higher order components and refs in react. (L3)

UNIT 4

React Hooks: Introduction to Hooks, useState, useEffect, Run Effects, Fetching Data, useContext, useReducer, useCallBack, useMemo, useRef, Custom Hooks

Learning Outcomes: Student will be able to

- Understand react hooks. (L2)
- Apply hooks and custom methods for handling components. (L3)
- Implement context and callback methods in hooks. (L3)

UNIT 5

React Render: Introduction to Rendering, useState, useReducer, State Immutability, Parent & Child, Memo, Context, useCallBack.

Learning Outcomes: Student will be able to

- Understand the working react rendering. (L2)
- Implement userReducer and context for rendering react apps. (L3

CONTEMPORARY TOPICS:

- React - Http client programming
- React - Form programming
- React - Routing

- React - Redux
- React – Animation

APPLICATIONS:

- Online Web Applications
- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

Text Books:

- React.js Book: Learning React JavaScript Library From Scratch by Greg Sidelnikov, Learning Curve.
- React: Quickstart Step-By-Step Guide To Learning React Javascript Library (React.js, Reactjs, Learning React JS, React Javascript, React Programming) by Lionel Lopez

Reference Books:

- Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, 2nd Edition by Shama Hoque, Packt

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3				1		1	1	2	3	3
CO2	3	2	2	1	3				1		1	1	2	3	3
CO3	3	3	3	2	3				1		1	2	3	3	3
CO4	3	3	3	2	3				1		1	2	3	3	3
CO5	2	2	2	2	2				1		1	1	2	2	2

R23BSH-MC4101	ENTREPRENEURSHIP AND INCUBATION	L	T	P	C
		2	0	0	-

Course Objectives:

- Outline an environment to inculcate entrepreneurial skills.(L2)
- Develop innovative products, services, processes and techniques.(L3)
- Planto prepare financial proposals and start-ups.(L3)
- Analyse the ideas to collaborate entrepreneur skills in establishment of start-ups.(L3)
- Explain the financial resource existing in government and private sectors.(L2)

Course outcomes:

- Explain the knowledge of Entrepreneurial behavior and skill development.(L2)
- Choose business ideas that have value in the end-market.(L2)
- Identify the validity of idea and it unique selling proportion.(L3)
- Comprehend opportunity and challenges of-startup(L2)
- Analyze various Government and non-Government financial resource.(L3)

Unit-I: Fundamentals of Entrepreneurship

Entrepreneurship- Concept, Importance, Characteristics –Myths of Entrepreneurship -Role of Entrepreneurs in Indian economy–Distinguish between professional entrepreneurs Vs Family entrepreneurs - Social and Ethical Perspectives of Entrepreneurship.

Application: Case lets: Business cases of young entrepreneurs.

Unit-II: Ideation and Evaluation of Business Ideas

Opportunity identification–Ideations process- Sources of business ideas –Role of creativity– Sources of Innovation –Technological Innovation and Entrepreneurship - Product/ Service design – Design Thinking.

Case lets : Business cases of OYO.

Activity: Collection of novel business ideas.

Unit-III: Feasibility Analysis and Business plan

Thrust areas of entrepreneurship- Techno-economic feasibility assessment- Financial feasibility – Market feasibility – Preparation of Business plan – Business canvas & Lean canvas.

Activity:

- Preparation of business plan(draft)
- Analysis on TED program Talks

Unit-IV: Business Incubation and startups

Fundamentals of business incubation-Services of incubators -Start-ups-meaning, significance - start up strategy-Present scenario of startups.

Activity:

- Evaluating new start- ups in India
- Analysis on Shark Tank India program

Unit-V: Financial resources

Sources of finance–Bootstrapping-Government Support–MSMEs-Crowd Funding–Venture Capitalists & Angel Investors - Schemes for women entrepreneurs
Activity: Business plan final version

Contemporary Topics:

1. Green Business
2. Niche Markets
3. New perspectives in rural enterprises

Text Books:

- T.V Rao, Donald F.Kuratko, Entrepreneurship, A South-Asian Perspective, Cengage Learning, 1st edition, 2012.
- Datsy Davies, Indian Startups, Amazon Asia- Pacific Holdings Private Limited, 1st Edition, 2016

Reference Books:

1. P.N.Rath,Sarjue Pandita, Entrepreneurship :Startup India & Standup India, Lexicon Publishing House, 2018
2. MadhurimaLall, ShikhaSahai, Entrepreneurship, Excel Books(P)Ltd.2008
3. Rajeev Roy, Entrepreneurship, Oxford Higher Education.2011
4. H.Nandan, Fundamentals of Entrepreneurship, PHIL earning(P)Ltd,2013

B.Tech IV Year - I Semester Honors Course-4

Course code	Course Title	L	T	P	Credits
R23CIT-HN4104	**Applied Data Science Projects and Specializations**	3	0	0	3

Course Objectives

1. To apply data science methodologies to solve real-world problems across multiple domains
2. To guide students in executing complete data science projects from problem definition to deployment
3. To explore specialized areas of data science including NLP, computer vision, and time series analysis
4. To develop skills in data storytelling, dashboarding, and result communication for stakeholders
5. To promote ethical and responsible data science practices

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Design and execute end-to-end data science projects aligned with real-world use cases
2. Apply specialized data science techniques in targeted domains such as healthcare, finance, and e-commerce
3. Develop models for classification, prediction, segmentation, and anomaly detection based on data characteristics
4. Communicate results effectively using visualizations, reports, and dashboards
5. Integrate ethical considerations and responsible AI practices in data-driven solutions

UNIT I

Data Science Lifecycle and Project Structuring

Problem scoping, Stakeholder requirements, Dataset identification and exploration, Data cleaning and preparation, Feature engineering strategies, Evaluation metric selection, CRISP-DM methodology, Agile practices in data science

Learning Outcome:

Students will be able to structure and plan a data science project by applying a standardized methodology and lifecycle model.

UNIT II

Specialized Techniques in Natural Language Processing

Text preprocessing and vectorization, Sentiment analysis, Named Entity Recognition (NER), Topic modeling, Word embeddings, Transformer models, Chatbot workflows, Ethics in NLP applications **Learning Outcome**:
Students will be able to apply NLP techniques to textual datasets and extract insights for use in real-world applications.

UNIT III

Advanced Applications in Computer Vision

Image preprocessing, Feature extraction, Convolutional Neural Networks (CNNs), Transfer learning, Object detection, Image classification use cases, Vision transformers, Model deployment considerations

Learning Outcome:

Students will be able to build and apply image-based machine learning models using computer vision techniques and pre-trained architectures.

UNIT IV

Domain-Specific Case Studies and Specializations

Healthcare analytics, Financial fraud detection, Customer segmentation in marketing, Retail demand forecasting, Geospatial analytics, Sensor data and IoT, Time series forecasting, Real-time data processing

Learning Outcome:

Students will be able to explore and implement domain-specific data science strategies for solving specialized problems in various sectors.

UNIT V

Model Deployment, Reporting, and Ethics in Data Science

Model interpretation and explainability, Bias and fairness in models, API development for models, Cloud deployment strategies, Creating dashboards and reports, Data storytelling techniques, Responsible AI practices

Learning Outcome:

Students will be able to interpret and present data science results through reports and dashboards while addressing ethical and deployment considerations.

Textbooks

1. Doing Data Science by Cathy O'Neil and Rachel Schutt
2. Data Science for Business by Foster Provost and Tom Fawcett
3. Applied Data Science with Python by Paul Teetor

Reference Books

1. Practical Statistics for Data Scientists by Peter Bruce
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron
3. Designing Data-Intensive Applications by Martin Kleppmann
4. Responsible Data Science by Peter Cihon and Brent Mittelstadt

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1**):**

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	1	1			1					1	2	
CO2	3	3	2	1	1			1					1	2	
CO3	3	3	2	1	1			1					1	2	
CO4	3	3	2	1	1			1					1	2	
CO5	3	3	2	1	1			1					1	2	
CO*	3	3	2	1	1			1					1	2	

Course code	Course Title	L	T	P	Credits
R23CIT-HN4102	Wireless Network Penetration Testing	3	0	0	3

Course Objectives

1. To understand the working of wireless communication protocols and their vulnerabilities
2. To perform penetration testing of wireless LANs using open-source tools
3. To explore encryption mechanisms and their weaknesses in wireless networks
4. To learn techniques for identifying, analyzing, and exploiting wireless threats
5. To document penetration test results and recommend wireless security solutions

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Explain wireless communication models, protocols, and security mechanisms
2. Detect and analyze vulnerabilities in Wi-Fi networks through hands-on testing
3. Perform wireless reconnaissance, traffic capture, and decryption
4. Conduct real-time attacks such as deauthentication, rogue AP, and WPA cracking
5. Create penetration testing reports with mitigation recommendations

UNIT I

Fundamentals of Wireless Networks and Security

Wireless LAN architecture, IEEE 802.11 protocols, Wireless network components, Wireless encryption standards (WEP, WPA, WPA2, WPA3), Wireless attack surfaces, Wireless network scanning and reconnaissance

Learning Outcome:

Students will be able to describe wireless network protocols and identify key areas of vulnerability in Wi-Fi communication.

UNIT II

Encryption Weaknesses and Traffic Capture

WEP encryption vulnerabilities, WPA/WPA2 PSK cracking, Handshake capture and replay, Dictionary attacks, Rainbow tables, Data sniffing and packet injection

Learning Outcome:

Students will be able to capture and crack wireless authentication handshakes using traffic analysis and password attacks.

UNIT III

Wireless Attacks and Exploitation Techniques

Deauthentication attacks, Evil twin attacks, Rogue access point setup, Man-in-the-middle attacks, Beacon flooding, Karma attacks

Learning Outcome:

Students will be able to simulate and perform real-time wireless attacks using appropriate penetration testing tools.

UNIT IV

Advanced Wireless Security Testing and Defense Evasion

Hidden SSID discovery, MAC spoofing, Channel hopping and jamming, Captive portal bypass, VPN over insecure wireless, IDS/IPS evasion techniques

Learning Outcome:

Students will be able to perform advanced wireless testing techniques and demonstrate how attackers evade basic defenses.

UNIT V

Reporting, Mitigation, and Best Practices

Wireless penetration test reporting, Vulnerability classification (CVSS), Wireless security audit checklist, Access point hardening, Enterprise Wi-Fi security (802.1X, RADIUS), Monitoring and alerting for wireless threats

Learning Outcome:

Students will be able to prepare professional wireless penetration test reports and suggest security best practices.

Textbooks

1. Hacking Wireless Networks: The Ultimate Hands-On Guide by Kevin Mitnick and Robert Vamosi
2. Penetration Testing by Georgia Weidman
3. Wireless Security Architecture by Jennifer Minella

Reference Books

1. 802.11 Wireless Networks: The Definitive Guide by Matthew Gast
2. Wireshark for Security Professionals by Jessey Bullock and Jeff T. Parker
3. Kali Linux Wireless Penetration Testing Beginner's Guide by Vivek Ramachandran
4. OWASP Testing Guide and Wireless Testing Methodology

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1**):**

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	**3**	**2**	**1**	**2**	**2**	**-**	**-**	**3**	**-**	**1**	**-**	**1**	**1**	**-**	**1**
CO2	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**3**	**-**	**1**	**-**	**1**	**2**	**-**	**1**
CO3	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**3**	**-**	**1**	**-**	**2**	**2**	**-**	**-**
CO4	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**3**	**-**	**1**	**-**	**1**	**1**	**-**	**1**
CO5	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**3**	**-**	**1**	**-**	**1**	**1**	**2**	**-**
CO*	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**3**	**-**	**1**	**-**	**1**	**2**	**2**	**1**

** For Entire Course, PO & PSO Mapping*

Course code	Course Title	L	T	P	Credits
R23CIT-HN4103	Malware Analysis	3	0	0	3

Course Objectives:

- To understand the purpose of computer infection program.
- To implement the covert channel and mechanisms.
- To test and exploit various malware in open source environment.
- To analyze and design the famous virus and worms.
- Understand the Reverse Engineering (RE) Methodology.
- Disassemble products and specify the interactions between its subsystems and their functionality.

Course Outcomes:At the end of the course, student will be able to:

1. Explain the characteristics of Malware and its effects on Computing systems.
2. Predict the given system scenario using the appropriate tools to identify the vulnerabilities and to perform Malware analysis.
3. Analyze the given Portable Executable and Non-Portable Executable files using Static and dynamic analysis techniques.
4. Demonstrate the Malware functionalities.
5. Apply anti-reverse engineering in different applications.

UNIT–I

Malware Basics: General Aspect of Computer infection program, Non Self Reproducing Malware, How does Virus Operate, Virus Nomenclature, Worm Nomenclature, Recent Malware Case Studies.

UNIT–II

Basic Analysis: Antivirus Scanning, x86 Disassembly, Hashing, Finding Strings, Packed Malware, PE File Format, Linked Libraries & Functions, PE Header File & Section.

UNIT–III

Advanced Static & Dynamic Analysis: IDA Pro, Recognizing C code constructs, Analyzing malicious windows program, Debugging, OllyDbg, Kernel Debugging with WinDbg, Malware Focused Network Signatures.

UNIT–IV

Malware Functionalities: Malware Behavior, Covert Malware Launch, Data Encoding, Shell Code Analysis.

UNIT–V

Reverse Engineering Malware (REM): REM Methodology, Resources for Reverse-Engineering Malware (REM), Understanding Malware Threats, Malware Indicators, Malware Classification, Examining Clam AV-Signatures.

Text Books:

1. Michael Sikorski, Andrew Honig, **"Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software"**, William Pollock Publisher.

Reference Books:

1. Erci Filiol, **"Computer Viruses: From Theory to Applications"**, Springer, 1st Edition, 2005.

Course code	Course Title	L	T	P	Credits
R23CIT-HN4101	**Wireless Sensor Networks**	3	0	0	3

Course Objectives:

- Emphasize the basic WSN technology and sensor node architecture with its unique constraints and challenges in design of WSN for different applications.
- Summarize the transceiver design and network technologies used in wireless sensor and networks.
- Explains various key MAC protocols for sensor networks with their merits and demerits.
- Provide knowledge of different routing protocols with their advantages.
- Create awareness on transport layer protocols, security considerations, sensor network platforms and tools with a brief study of different WSN applications.

Course Outcomes:

1. Describe the overview of wireless sensor networks and enabling technologies for wireless sensor networks (L2)
2. Apply the design principles of WSN architectures and operating systems for simulating environment situations.(L3)
3. Apply various concepts for assignment of MAC addresses.(L3)
4. Select the appropriate infrastructure, topology, joint routing and information aggregation for wireless sensor networks. (L4)
5. Analyze the sensor network platform and tools state-centric programming.(L4).

UNIT-I

Overview of Wireless Sensor Networks: Key definitions of sensor networks, advantages of sensor networks, unique constraints and challenges, driving application, enabling technologies for wireless sensor networks.

Architectures:

Single-node architecture - hardware components, energy consumption of sensor nodes, operating system and execution environments, network architecture- sensor network scenarios, optimization goals and figures of merit, gateway concepts.

UNIT - II

Networking Technologies: Physical layer and transceiver design consideration, personal area networks (PANs), hidden node and exposed node problem, topologies of PANs, MANETs, and WANETs.

UNIT - III

MAC Protocols for Wireless Sensor Networks: issues in designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention -Based Protocols, contention - based protocols with reservation mechanism, contention - based MAC protocols with scheduling Mechanisms, MAC protocols that use directional antennas, others MAC protocols.

UNIT - IV

Routing Protocols: introduction, issues in designing a routing protocols for Ad Hoc Wireless Networks, classification of routing protocols, table- driven routing protocols, On-Demand routing protocols, Hybrid routing protocols, routing protocols with efficient

flooding mechanisms, hierarchical routing protocols, power- aware routing protocols, proactive routing.

UNIT-V

Transport Layer and Security Protocols: Introduction, issues in designing a transport layer protocol for Ad Hoc wireless networks, design goals of a transport layer protocol for Ad Hoc wireless networks, Security in Ad Hoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks, key management, secure routing in Ad Hoc wireless Networks.

Sensor Network Platforms and Tools:

Sensor node hardware - Berkeley motes, programming challenges, node- level software platforms, node-level simulators, state - centric programming.

Textbooks

1. Ad Hoc wireless networks: Architectures and protocols - C.Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad - Hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press.
3. Holger Karl & Andreas Willig, Protocol and Architectures for Wireless Sensor Networks, John Wiley, 2005.

References

1. Kazem Sohraby, Daniel Minoli, & Taieb Zanti, "Wireless Sensor Networks - Technology, Protocols and Applications", John Wiley, 2007.
2. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2007.
3. Ad Hoc Mobile Wireless Networks: Protocols & Systems, C.K.Toh, 1ed, Pearson Education.
4. Wireless Sensor Networks - C.S.Raghavendra, Krishna M.Sivalingam, 2004, Springer.

Wireless Sensor Networks - S Anandamurugan, Lakshmi Publications

R23ECE-MT2201	Foundations of Quantum Computing: Physics, Engineering, and Mathematics Computing	L	T	P	C
		3	0	0	3

Course Objectives:

- To develop a strong foundation in linear algebra, essential for quantum states and operators.
- To understand probability and statistics for quantum measurement and noise analysis.
- To explore Hamiltonian and Lagrangian mechanics as a bridge to quantum mechanics.
- To introduce electromagnetic theory relevant to quantum waveguides and optical systems.
- To study classical computing and digital logic as a stepping stone to quantum circuits.

Course Outcomes:

After successful completion of the course, the student should be able to:

- **CO1:** Apply concepts of vector spaces, matrices, and eigenvalue problems to quantum system modeling. (L3)
- **CO2:** Analyze statistical behavior of qubits using probability and interpret quantum measurement outcomes. (L3)
- **CO3:** Apply classical mechanics principles (Hamiltonian/Lagrangian) to understand quantum evolution. (L3)
- **CO4:** Explain EM wave propagation and field quantization for quantum hardware applications. (L2)
- **CO5:** Compare classical digital logic and architecture with quantum gates and processors. (L3)

UNIT – I: Mathematical Foundations for Quantum Systems

- Vector spaces, basis, and dimension
- Inner product, orthogonality, Hilbert spaces
- Complex matrices and linear transformations
- Eigen values, eigenvectors, and diagonalization
- Applications to quantum state representation and gate operations

Learning Outcomes:

- Understand how quantum states are represented in Hilbert space using linear algebra.
- Compute eigenvalues/eigenvectors for describing quantum observables.

UNIT – II: Probability, Statistics, and Classical Mechanics Foundations

- Descriptive statistics and probability basics
- Random variables and common distributions
- Lagrangian and Hamiltonian formulations
- Relation between classical Hamiltonians and quantum operators

Learning Outcomes:

- Apply statistical models to interpret qubit state probabilities and measurement results.
- Describe the transition from classical to quantum systems using Hamiltonian formalism.

UNIT – III: Electromagnetic Theory in Quantum Context

- Maxwell's equations (time and phasor domain)
- Wave propagation in dielectric and conducting media

- EM waves in optical fibers and waveguides
- Energy transport and quantization of EM waves

Learning Outcomes:

- Analyze EM wave behavior in classical and quantum transmission media.
- Relate classical EM theory to quantum field quantization in optics and waveguides.

UNIT – IV: Computer Architecture: Classical vs Quantum

- Von Neumann architecture and CPU design
- Memory hierarchy and instruction cycles
- Comparison with quantum computer models (control and memory)
- Limitations of classical systems for quantum operations

Learning Outcomes:

- Explain the working of classical processors and memory systems.
- Differentiate between classical and quantum architecture principles.

UNIT – V: Digital Logic and Circuit Fundamentals for Quantum Systems

- Number systems and data representation
- Basic logic gates and Boolean algebra
- Combinational circuit design
- Reversible logic and its relevance to quantum computation

Learning Outcomes:

- Design basic digital logic circuits and understand their role in classical computing.
- Explain the need for reversible logic in quantum gates and circuits.

Text Books

1. **Bernard Kolman & David Hill**, Elementary Linear Algebra with Applications, Pearson, 2013.
2. **Ron Larson**, Elementary Statistics: Picturing the World, 8th Edition, Pearson, 2023.

Reference Books

1. **Herbert Goldstein**, Classical Mechanics, 3rd Edition, Addison Wesley.
2. **D.J. Griffiths**, Introduction to Electrodynamics, 4th Edition, Cambridge University Press, 2020.
3. **M. Morris Mano**, Computer System Architecture, Prentice Hall.
4. **Thomas L. Floyd**, Digital Fundamentals, 11th Edition, Pearson.
5. **M. Morris Mano**, Digital Logic and Computer Design, Pearson.

R23ECE-MT3101	Survey of Quantum Technologies and Applications	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the four foundational verticals of quantum technologies: **computation, communication, sensing, and materials**.
- To provide students with **qualitative understanding** of key quantum physics principles behind modern quantum tech.
- To explore the **real-world hardware platforms** used to build quantum systems.
- To introduce **applications and potential impact** of quantum technologies in real systems.
- To build awareness of India's and global **quantum research directions and strategic roadmaps**.

Course Outcomes:

After successful completion of the course, students will be able to:

- **CO1:** Describe the basic physical principles of quantum phenomena such as superposition, entanglement, and tunneling. (L2)
- **CO2:** Explain different physical implementations of qubits and their applications in quantum computing. (L2)
- **CO3:** Understand the working and application of quantum sensing devices such as atomic clocks and magnetometers. (L2)
- **CO4:** Explain core principles and real-world implementations of quantum communication systems. (L2)
- **CO5:** Discuss recent advances and future directions in quantum technologies across multiple domains. (L2)

UNIT – I: Introduction to Quantum Technologies and Principles of Quantum Physics

- Overview of the four verticals in quantum technology
- Motivation for quantum technologies in India and globally
- Quantum states and wavefunctions
- Measurement and observables, Hermitian operators
- Heisenberg uncertainty, Schrödinger equation
- Key quantum phenomena: Superposition, Entanglement, No-cloning theorem
- Feynman's quantum simulator idea

Learning Outcomes:

- Identify fundamental differences between classical and quantum systems.
- Describe core quantum mechanical concepts necessary for technological applications.

UNIT – II: Quantum Computation: Qubits, Circuits, and Implementations

- What is a qubit? Comparison with classical bits
- Review of classical logic gates
- Di Vincenzo criteria
- Basic quantum gates and circuits
- Hardware implementations (qualitative):

    - Superconducting qubits (charge, flux, phase)
    - Semiconductor qubits (quantum dots, spins)
    - Topological qubits
    - Trapped ions, Rydberg atoms, NV centers, NMR qubits
    - Photonic and integrated photonic qubits
- Applications: RSA breaking with Shor's algorithm, Grover's algorithm
- Quantum error correction overview

Learning Outcomes:

- Identify and describe various types of physical qubits.
- Explain the structure and use of basic quantum circuits.

UNIT – III: Quantum Sensing: Theory and Applications

- Introduction to quantum sensing and metrology
- Single-photon and entangled-photon detection
- Quantum-enhanced measurements
- Gravimetry, Magnetometry, Atomic clocks
- Real-world quantum sensing platforms and global status

Learning Outcomes:

- Explain the working principles of quantum sensors.
- List practical applications of quantum-enhanced measurement systems.

UNIT – IV: Quantum Communication: Principles and Platforms

- Basics of classical digital communication
- Shannon entropy and classical information theory
- Quantum key distribution (QKD) and security principles
- Eavesdropping and no-cloning
- Quantum communication via fiber and satellite
- Overview of major global projects (Micius satellite, India's QKD experiments)

Learning Outcomes:

- Describe how quantum mechanics ensures secure communication.
- Differentiate fiber-based and satellite-based QKD systems.

UNIT – V: Integration, Roadmaps and Future Trends

- Overview of cross-domain quantum technologies
- National and global roadmaps (India Quantum Mission, EU QT Flagship, IBM, Google)
- Research challenges in scaling, error correction, and decoherence
- Interdisciplinary role of quantum materials (brief integration)
- Quantum advantage and commercialization of quantum systems

Learning Outcomes:

- Summarize current national/global strategies in quantum tech development.
- Identify open problems and future research opportunities in quantum systems.

Textbooks:

1. **Manenti R., Motta M.**, Quantum Information Science, 1st Edition, Oxford University Press, 2023

2. **M. A. Nielsen & I. L. Chuang**, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010

Reference Books:

1. **A. Pathak**, Elements of Quantum Computation and Quantum Communication, CRC Press, 2015
2. **Phillip Kaye, Raymond Laflamme, Michele Mosca**, An Introduction to Quantum Computing, Oxford University Press, 2006
3. **David McMahon**, Quantum Computing Explained, Wiley, 2008

R23ECE- MT 3201	Foundations of Quantum Technologies (3:0) – Mandatory	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the key principles of quantum mechanics in a simple and intuitive manner.
- To connect quantum ideas with real-life applications in communication, computing, and sensing.
- To expose students to basic concepts from quantum information, statistical physics, and computational models relevant to emerging technologies.

Unit 1: Introduction to Quantum Ideas

classical to quantum thinking is introduced using experiments like the photoelectric effect and blackbody radiation. Key discoveries such as Planck's quantum hypothesis, Bohr's atomic model, and wave-particle duality (de Broglie) are covered with real-world relevance (e.g., LEDs, solar cells).

Unit 2: Basics of Quantum Mechanics

concept of quantum states, wave functions, and probabilities. Dirac notation (bra-ket), superposition, and measurement. Real-life examples such as electron in an atom, and quantum tunneling,. Simple models like a particle in a box and harmonic oscillator,

Unit 3: Spin, Entanglement, and Quantum Applications

using simple models (like spin-½ particles), and how entanglement plays a role in quantum communication. Quantum teleportation and quantum key distribution,. The no-cloning theorem and quantum superposition, secure data sharing and quantum sensing.

Unit 4: Basics of Quantum Information and Noise

quantum information differs. Shannon entropy, and its quantum counterpart (von Neumann entropy) noise, decoherence, and the challenge of maintaining quantum states in real systems, communication channels and qubit errors.

Unit 5: Introduction to Quantum Computation and Post-Quantum Ideas

quantum computers powerful is provided, including the idea of quantum parallelism. The concept of computational problems (like searching and factoring) ,. Complexity classes such as P, NP, and BQP. The importance of quantum-safe encryption and post-quantum cryptography .

Course Outcomes:

At the end of this course, students will be able to:

1. Explain key differences between classical and quantum systems using real-world examples.
2. Describe quantum mechanical concepts such as superposition, uncertainty, and entanglement.
3. Understand the role of spin and entanglement in modern technologies like quantum communication.
4. Recognize how noise and decoherence impact quantum devices.

5. Appreciate the potential of quantum computing and the need for post-quantum cryptography.

Text/Reference Books:

1. Griffiths, D. J., Introduction to Quantum Mechanics, Cambridge Univ. Press (2024)
2. A. Pathak, Elements of Quantum Computation and Quantum Communication, CRC Press (2015)
3. Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge Univ. Press (2010)
4. Quantum Physics for Beginners – NPTEL Video Lectures, Prof. V. Balakrishnan (IIT Madras)
5. Manenti & Motta, Quantum Information Science, Oxford Univ. Press (2023)

R23ECE-MT 4101	Introduction to Quantum Computation (3:0)	L	T	P	C
		3	0	0	3

Course Objectives:

- Introduce quantum computing concepts in comparison to classical computing.
- Explain how qubits work and how they are physically realized.
- Teach students fundamental quantum algorithms and their applications.
- Familiarize students with current quantum processors and platforms.
- Highlight practical uses and industry trends in quantum computing.

Course Outcomes:

By the end of the course, students will be able to:

1. Understand and differentiate classical bits from qubits.
2. Build simple quantum circuits and simulate them using open-source tools.
3. Implement and explain beginner-level quantum algorithms.
4. Gain awareness of real-world quantum processors and their applications.
5. Recognize the challenges and opportunities in quantum error correction and NISQ devices.

Text reference books:

- Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
- Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10th Anniversary edition, Cambridge University Press (2010)
- A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015)
- Quantum error correction and Fault tolerant computing, Frank Gaitan, 1st edition, CRC Press (2008)
- Quantum computing explained, David McMahon, Wiley (2008)

Unit 1: Introduction to Quantum Information

- Classical vs Quantum bits (Qubits)
- Real-world examples: Spin systems, photon polarisation
- Practical technologies: Trapped ions, superconducting circuits, quantum dots
- Bloch sphere visualization
- One and two-qubit gates (CNOT, Hadamard, Pauli gates)

Unit 2: Quantum Logic and Entanglement

- Basic quantum gates and circuits

- Reversible computation vs classical irreversible logic
- Entanglement explained with simple visual examples
- Bell's inequality and its experimental significance

Unit 3: Quantum Algorithms - Basics

- Deutsch and Deutsch-Jozsa algorithm
- Bernstein-Vazirani algorithm
- Grover's Algorithm: Introduction to quantum search
- Simon's Algorithm: Application in pattern discovery

Unit 4: Quantum Algorithms – Advanced

- Shor's algorithm: Integer factorisation and RSA cracking
- Quantum Fourier Transform (QFT)
- Variational Quantum Eigensolver (VQE) for chemistry problems
- Quantum Approximate Optimization Algorithm (QAOA)

Unit 5: Real-World Quantum Computing

- NISQ era – What does it mean?
- IBM Quantum, Google Sycamore, IonQ – hands-on introduction
- Quantum error correction basics – simple 3-bit code
- Fault-tolerant computing: Intuitive understanding
- Roadmap to future quantum computers

R23ECE-MT 4102	Introduction to quantum Communication	L	T	P	C
		3	0	0	3

Course Objectives

This course aims to:

1. Introduce the fundamental principles of polarization optics and photodetection relevant to quantum communications.
2. Develop an understanding of classical information theory and its extension into quantum information.
3. Familiarize students with fundamental no-go theorems and quantum resources such as entanglement, quantum memories, and repeaters.
4. Provide a deep understanding of quantum communication protocols such as teleportation, dense coding, and QKD.
5. Explore real-world implementations of quantum communication through fiber, free-space, and satellite-based systems.

Course Outcomes

After completing this course, students will be able to:

1. Explain the basics of electromagnetic theory and polarization optics in communication systems.
2. Demonstrate knowledge of linear and square-law photodetectors for quantum communication applications.
3. Apply concepts of classical and quantum information theory to understand data transmission.
4. Analyze and explain key quantum communication protocols including teleportation, dense coding, and QKD.
5. Evaluate and compare hardware implementations of quantum networks and the emerging quantum internet.

Unit I – Polarization Optics and Photodetection

- Basics of polarization optics: principles, applications.
- Quarter-wave and half-wave plates.
- Polarizing beam splitters and their role in quantum optics.
- Basics of linear and square-law detectors.
- Photodetection fundamentals: photomultipliers, avalanche photodiodes.

Learning Outcomes:

- Understand polarization states and optical components used in quantum communication.
- Explain the operation and applications of photodetectors.

Unit II – Detection and Modulation Techniques

- Quadrature amplitude modulation.
- Heterodyne and homodyne demodulation.
- Intensity measurements and square-law detectors.
- Noise in photodetection and its impact on measurements.

Learning Outcomes:

- Demonstrate the principles of modulation and detection in optical/quantum systems.
- Compare linear vs square-law detection methods.

Unit III – Information Theory Foundations

- Basics of digital communication and information theory.
- Information entropy and mutual information.
- Noiseless channel encoding.
- Noisy channel encoding and Shannon's theorem.

Learning Outcomes:

- Define entropy and its significance in communication.
- Apply encoding schemes for reliable information transfer.

Unit IV – Quantum Principles and Protocols

- No-cloning theorem.
- Quantum memories and quantum repeaters.
- Entanglement and Bell's Theorems.
- Bell measurements and experimental tests.
- Quantum teleportation protocol.
- Quantum dense coding.

Learning Outcomes:

- Explain the no-cloning principle and its implications for security.
- Analyze entanglement-based communication protocols.
- Demonstrate understanding of quantum teleportation and dense coding.

Unit V – Quantum Cryptography and Quantum Networks

- Quantum key distribution (QKD) protocols: BB84, E91, BBM92, B92, COW, DPS.
- Quantum networks and the concept of the quantum internet.
- Survey of hardware implementations:
    - Free-space quantum communication.
    - Satellite-based quantum links.
    - Fiber-optic-based communication systems.

Learning Outcomes:

- Compare and contrast various QKD protocols.
- Evaluate implementation strategies for large-scale quantum networks.
- Discuss the feasibility and progress toward a quantum internet.

References

1. Nielsen, M. A., & Chuang, I. L., Quantum Computation and Quantum Information, Cambridge University Press, Cambridge (2010).
2. Pathak, A., Elements of Quantum Computation and Quantum Communication, CRC Press, Boca Raton (2015).

R23ECE-MT3102	Quantum Technology Laboratory-1 (QT-LAB)	L	T	P	C
		0	0	3	1.5

Course Objectives

1. To equip students with computational techniques (Python/Julia/Matlab) for solving matrix problems, eigenvalue problems, and data fitting.
2. To enable understanding of quantum mechanical systems through simulations of two-level systems, Rabi oscillations, and the Jaynes–Cummings model.
3. To provide exposure to classical experiments such as the Zeeman effect, RLC circuits, and polarization optics.
4. To introduce finite element and numerical methods for solving electromagnetism-related problems.
5. To integrate hardware and computational experiments to develop problem-solving and analytical skills.

Course Outcomes

After completing this lab, students will be able to:

1. Implement numerical methods (matrix operations, SVD, Monte Carlo methods, least squares fitting) and validate with simulations.
2. Analyze and simulate quantum phenomena like coupled two-level systems, Rabi oscillations, and light–matter interaction models.
3. Perform and interpret classical physics experiments such as the Zeeman effect, diffraction, interference, and polarization optics.
4. Apply computational methods to solve problems in electromagnetism, such as electrostatic charge distributions.
5. Design, build, and test simple electronic and digital circuits (RLC resonance, digital logic circuits).

List of experiments

A. Numerical Techniques (Computational – Python/Julia/Matlab)

1. **Matrix Inverse & Eigenvalue Problem** – Implement numerical methods to compute inverse and eigenvalues of matrices; validate with built-in libraries.
2. **Singular Value Decomposition (SVD)** – Decompose a matrix, demonstrate data compression/denoising applications.
3. **Monte Carlo Sampling & Random Number Generation** – Generate pseudo-random numbers and apply Monte Carlo integration for estimating π or other functions.
4. **Least Squares Fitting & Error Analysis** – Fit experimental/synthetic data to models; analyze errors and residuals.

B. Applications to Quantum Mechanics (Computational Quantum Physics)

5. **Eigen Energies of Coupled Two-Level Systems** – Numerical diagonalization to find eigen energies and eigenstates.
6. **Jaynes-Cummings Model Simulation** – Study eigen energies of a two-level system coupled to an oscillator.
7. **Rabi Oscillations in Driven Two-Level System** – Simulate time evolution of population inversion under resonant drive.
8. **ZEEMAN EFFECT experiment.**

Tools: Zeeman effect kit

C. Applications to Electromagnetism & Optics (Simulation + Bench Experiments)

9. **Electrostatic Charge Distributions (Finite Element Simulation)** – Solve Laplace's equation for simple geometries (parallel plates, spheres).
10. **Diffraction & Interferometry** – Experimental setup for single-slit diffraction and interferometric measurement of wavelength.
11. **Polarization Optics** – Study of Polarizing Beam Splitter (PBS), Half-Wave Plate (HWP), and Quarter-Wave Plate (QWP).

D. Circuits & Digital Systems (Hardware)

12. **Series & Parallel RLC Circuits** – Measure resonance curves, extract quality factor and intrinsic losses.
13. **Digital Circuits with ICs** – Implementation of Adder, Encoder/Decoder, and D Flip-Flop using IC chips.

Suggested Reference Books

1. **Numerical Recipes in C/Python/Fortran**, W.H. Press et al., Cambridge University Press.
2. **Computational Physics**, N. J. Giordano & H. Nakanishi, Pearson Education.
3. **Principles of Quantum Mechanics**, R. Shankar, Springer.
4. **Optics**, Eugene Hecht, Pearson.
5. **Fundamentals of Electric Circuits**, Charles K. Alexander & Matthew N.O. Sadiku, McGraw Hill

R23ECE-MT3202	Quantum Technology-2 Laboratory (QT-2 - LAB)	L	T	P	C
		0	0	3	1.5

Course Objectives

1. To introduce the principles of RF measurements, including transient response, S-parameters, and spectrum analysis.
2. To develop the ability to design and analyze basic digital logic circuits and understand their timing characteristics.
3. To expose students to advanced signal processing techniques such as homodyne and heterodyne detection.
4. To provide hands-on experience with quantum computing simulators, quantum gates, and entanglement.
5. To apply concepts of quantum cryptography through simulation of secure key distribution protocols.

Course Outcomes

After completing this lab, students will be able to:

1. Perform RF characterization using oscilloscope, vector network analyzer, and spectrum analyzer.
2. Design, test, and troubleshoot digital logic circuits for real-world applications.
3. Implement and compare homodyne and heterodyne detection for weak signal recovery.
4. Simulate and analyze quantum states, superposition, measurements, and entanglement using Qiskit.
5. Demonstrate secure communication by implementing the BB84 quantum key distribution protocol.

A. Radio Frequency Technology (Measurement & Analysis)

1. **Oscilloscope-Based Ring-Up & Ring-Down in RLC Circuits** – Study transient response and measure damping.
2. **Vector Network Analyzer (VNA) Characterization** – Transmission/reflection measurements of coaxial cables (open, short, matched); extract S-parameters and plot VSWR.
3. **Spectrum Analyzer—Noise from a Resistor**
   Aim: Measure thermal noise vs temperature/bandwidth; compare theory.
   Tools: Spectrum analyzer, precision resistors, temp control (optional).
4. **Digital Logic: Adder, Decoder & D Flip-Flop**
   Aim: Build/test basic IC logic blocks; timing & hazards.
   Tools: Breadboard, TTL/CMOS ICs, DSO, PSU.
5. **Data Acquisition and Demodulation: Homodyne vs Heterodyne Detection**
   Objective: Compare two demodulation schemes for weak signal recovery
   Tools: ADC, MATLAB/Python, signal generator
   Learning: Quantum signal detection techniques

6. **Introduction to Qiskit and IBM Quantum Lab**
    - Objective: Familiarize with the quantum circuit composer and running circuits on simulators.
    - Tools: Qiskit, IBM Quantum Composer
    - Equipment: PC with internet, Python + Qiskit
7. **Quantum States and Superposition**
    - Objective: Construct single-qubit circuits to observe $|0\rangle$, $|1\rangle$, and superposition states.
    - Tools: Qiskit Statevector simulator
    - Output: Visualize Bloch sphere and probability amplitudes
8. **Measurement and Probability in Quantum Systems**
    - Objective: Implement basic measurement circuits and interpret probabilistic outcomes.
    - Tools: Qiskit Aer
    - Equipment: Online IDE or Jupyter Notebook
9. **Quantum Gates and Reversibility**
    - Objective: Construct and verify effects of X, H, Z, and composite gates.
    - Output: Truth table comparison with classical logic
10. **Entanglement Using Bell States**
    - Objective: Create and measure Bell pairs using H and CNOT gates.
    - Verification: Bell inequality simulation
11. **BB84 Quantum Key Distribution (Quantum Cryptography)** Objective: Simulate BB84 protocol for secure key generation
    Output: Compare error rate with and without eavesdropper

12..QKD with Eavesdropper Detection

Objective: Model Eve in BB84, simulate her measurement, and detect error rate.
Discussion: Quantum no-cloning theorem implications

Reference Books

1. David M. Pozar, Microwave Engineering, Wiley, 4th Edition, 2011.
2. Guillermo Gonzalez, Microwave Transistor Amplifiers: Analysis and Design, Prentice Hall, 2nd Edition, 1996.
3. Michael A. Nielsen & Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
4. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.
5. Robert A. Meyers (Ed.), Encyclopedia of Complexity and Systems Science – Quantum Computing Section, Springer, 2009