SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF INFORMATIONTECHNOLOGY

B. TECH. INFORMATION TECHNOLOGY

CURRICULUM - 2021 PATTERN W.E.R. 2024-2025

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU, Pune)

D E C L A R A T I O N

We, the Board of Studies **INFORMATION TECHNOLOGY**, hereby declare that, We have designed the Curriculum of **B Tech.** IT of Pattern **2021** w.e.f. A.Y. **2024-2025** as per the guidelines. We are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman

Approved by

Dean Academics **Director**

COURSE STRUCTURE - 2021 PATTERN

FINAL YEAR B. TECH. INFORMATION TECHNOLOGY

SEMESTER - VII

Course		Course Title	Teaching Scheme Hours/ Week			Credits	Evaluation Scheme - Marks					
							Theory		OR	PR	TW	Total
Cat.	Code		L	T	P		CIA	ESE				
PC	IT401	Natural Language Processing	3	-	-	3	40	60	-	-	-	100
PC	IT402	Distributed Systems	4	-	-	4	40	60	-	-	-	100
PC	IT403	Artificial Intelligence	3	-	-	3	40	60	-	-	-	100
PE	IT404	Professional Elective-III	3	-	-	3	40	60	-	-	-	100
PE	IT405	Professional Elective-IV	3	-	-	3	40	60	-	-	-	100
PC	IT406	Artificial Intelligence & Natural Language Processing Laboratory	-	-	4	2	-	-	-	50	50	100
PC	IT407	Distributed Systems Laboratory	-	-	2	1	-	-	-	50	-	50
PRJ	IT408	Project Stage - I	-	-	6	3	-	-	50	-	100	150
MC	MC409	Mandatory Course – VII	1	-	-	0	-	-	-	-	-	Pass/ Fail
		Total	18	-	12	22	200	300	50	100	150	800

MC409	Mandatory Course – VII	Finance related course proposed by Financial Smart

IT404 Professional Elective- III		IT405 Professional Elective- IV	
Course Code	Course	Course Code	Course
IT404A	Software Architecture	IT405A	Cloud Computing
IT404B	Digital Twin	IT405B	Ubiquitous Computing
IT404C	Cognitive Intelligence	IT405C	Business Intelligence

HONORS SPECIALIZATION IN CYBER SECURITY

Course		Course Title	Teaching Scheme Hours/ Week			Credits	Evaluation Scheme-Marks					
							Theory		OR	PR	TW	Total
Cat.	Code		L	T	P		CIA	ESE				
HSIT	IT8104	Ethical Hacking & Digital Forensic Tools	4	-	-	4	40	60	-	-	-	100
HSIT	IT8105	Ethical Hacking & Digital Forensic Tools Lab	-	-	2	1	-	-	-	-	50	50
		Total	4	-	2	5	40	60	-	-	50	150

COURSE STRUCTURE - 2021 PATTERN

FINAL YEAR B. TECH. INFORMATION TECHNOLOGY

SEMESTER - VIII

Course		Course Title	Teaching Scheme Hours/ Week			Credits	Evaluation Scheme - Marks					
							Theory		OR	PR	TW	Total
Cat.	Code		L	T	P		CIA	ESE				
OE	IT411	Open Elective-I	3	-	-	3	40	60	-	-	-	100
OE	IT412	Open Elective-II	3	-	-	3	40	60	-	-	-	100
OE	IT413	Open Elective - III	2	-	0	2	40	60	-	-		100
PRJ	IT414	Professional Internship	-	-	12	6	-	-	50	-	50	100
PRJ	IT415	Project Stage - II	-	-	4	2	-	-	50	-	50	100
		Total	8		16	16	120	180	100	-	100	500

IT411 Open Elective- I		IT412 Open Elective- II		IT413 Open Elective- III	
Course Code	Course	Course Code	Course	Course Code	Course
IT411OE1	Product and Brand Management	IT412OE1	Design & Implementation of Human-Computer Interfaces	IT413OE1	Introduction to Haskell Programming
IT411OE2	Organizational Behaviour	IT412OE2	Ethical Hacking	IT413OE2	Computer Graphics
IT411OE3	E-Business	IT412OE3	Introduction to Industry 4.0 And Industrial Internet of Things	IT413OE3	Google Cloud Computing Foundations
IT411OE4	Management Information System	IT412OE4	Object Oriented System Development Using UML, JAVA and Patterns	IT413OE4	Cloud Computing and Distributed Systems
		IT412OE5	Employment Communication – A Lab-Based Course		

HONORS SPECIALIZATION IN CYBER SECURITY

Course		Course Title	Teaching Scheme Hours/ Week			Credits	Evaluation Scheme-Marks					
							Theory		OR	PR	TW	Total
Cat.	Code		L	T	P		CIA	ESE				
HSIT	IT8106	Mobile Hacking	4	-	-	4	40	60	-	-	-	100
		Total	4	-	-	4	40	60	-	-	-	150

B. Tech. Information Technology

Semester VII

2021 PATTERN

WEF 2024-25

IT401 : Natural Language Processing

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Discrete Mathematics, Theory of computation, Foundation of Data Science.

Course Objectives

1. To introduce the Natural language processing basics and basics of linguistics.
2. To introduce the statistics for NLP and language model.
3. To apply text dependency parsing and LLM on textual data.
4. To apply sentiment analysis and information retrieval.
5. To apply various NLP tools and techniques.
6. To apply linguistic features and its application using NLP.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand concept and processing of Natural Language Processing.	2	Understand
CO2	Understand the statistics for NLP and Language modeling.	2	Understand
CO3	Apply Dependency Parsing and Large Language Model on text.	3	Apply
CO4	Apply the information retrieval and sentiment analysis on textual data.	3	Apply
CO5	Apply various NLP tools and techniques.	3	Apply
CO6	Apply Spacy language model for various text applications.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	1	-	-	-	-	-	0	2	-	-
CO2	2	2	1	1	1	1	0	-	-	-	-	1	1	-	-
CO3	2	1	2	1	2	1	1	-	-	-	-	1	1	-	1
CO4	1	3	2	1	2	1	-	-	-	-	1	1	2	-	-
CO5	2	2	2	1	3	-	1	-	-	-	-	2	2	-	2
CO6	1	1	2	1	3	-	1	-	-	-	2	2	2	-	1

Course Contents			
Unit-I	**INTRODUCTION TO NATURAL LANGUAGE PROCESSING (NLP)**	**No. of Hours**	**COs**
	Introduction: Natural Language Processing(NLP), Ambiguity in NLP, Finite autometa for NLP, Stage of NLP, Challenges and issues in NLP. Basics of Text Processing: language stop words, Tokenization, Stemming, Lemmitization, Part of speech Tagging(PoS Tagging).	8	CO1
Unit-II	**LANGUAGE MODELING AND EMBEDDING**	**No. of Hours**	**COs**
	Probabilistic Language Modeling, Markov models, N-gram models: estimation parameters and smoothing. Word Embedding / Vector Semantics: Bag-of-words, TF-IDF, word2vec, doc2vec, Glove, Contextualized representations (BERT), Topic Modeling: Latent Semantic Analysis.	7	CO2
Unit-III	**DEPENDENCY PARSING AND LARGE LANGUAGE MODEL**	**No. Of Hours**	**COs**
	Dependency Parsing: Dependency Grammar and Dependency Structure, Transition-Based Dependency Parsing, Neural Dependency Parsing, Dependency parsing for sentence structure, Large Language Model: Foundation Models and ChatGPT, Introduction to GPT, GPT-3, GPT 4,ChatGPT, BioGPT and Prompt engineering.	8	CO3
Unit-IV	**INFORMATION RETRIEVAL AND SENTIMENT ANALYSIS**	**No. of Hours**	**COs**
	Named Entity Recognition: NER System Building Process, Evaluating NER, System Entity Extraction, Relation Extraction, Reference Resolution, Coreference resolution, Cross Lingual Information Retrieval, Custom NER tag design, Regular Expression(RegEx) for s	7	CO4
Unit-V	**NLP TOOLS AND TECHNIQUES**	**No. of Hours**	**COs**
	Prominent NLP Libraries: Natural Language Tool Kit (NLTK), SpaCy, Gensim etc. Language model using Spacy library for English language, Spacy Language model for Indian Language. CoreNLP: Stanford CoreNLP and its features,	8	CO5
Unit-VI	**APPLICATIONS OF NLP**	**No. of Hours**	**COs**
	Text Classification, Text Summarization, Question answering model, Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR, Custom Tag Spacy model.	7	CO6

Text Books:

1. Jurafsky, David, and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech Recognition‖, ,PEARSON Publication.
2. Manning, Christopher D., and nrich Schütze , "Foundations of Statistical Natural Language Processing", Cambridge, MA: MIT Press.
3. Allen James, Natural Language Understanding, Pearson India, 2nd Edition, ISBN: 9788131708958, 8131708950.
4. James H. Martin, Daniel Jurafsky, "Speech and Language Processing", Pearson, 1st Edition, ISBN:

9789332518414, 8131716724.
Reference Books:
1. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit", O'Reilly Publication. 2. Dipanjan Sarkar , "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data", Apress Publication ISBN: 9781484223871 3. Alexander Clark, Chris Fox, and Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley Blackwell Publications. 4. Jacob Eisenstein, "An Introduction to Information Retrieval", Cambridge University Press.
eLearning Resources:
1. https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf 2. https://www3.cs.stonybrook.edu/~cse521/L16NLP.pdf 3. https://nptel.ac.in/courses/106101007 4. https://nptel.ac.in/courses/106106211

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT402 : Distributed Systems

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: System Programming & Operating System, Computer Network.

Course Objectives

1. To learn the principles, architectures and programming models used in distributed systems.
2. To understand the fundamentals and knowledge of the Middleware of distributed systems.
3. To gain knowledge of distributed shared memory and resource management in distributed systems.
4. To gain knowledge of working components and fault tolerance of distributed systems.
5. To make students aware about distributed and multimedia file systems and web systems.
6. Create an awareness of Emerging trends in distributed computing.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand the core concepts of distributed systems & Middleware.	2	Understand
CO2	Apply Inter-process communication methods and analyze different coordination algorithms.	3	Apply
CO3	Apply the Concepts of Distributed Shared Memory and Resource Management in Distributed System.	3	Apply
CO4	Apply the importance of replication to achieve fault tolerance in distributed systems.	3	Apply
CO5	Apply the design and functioning of existing distributed file systems, distributed multimedia, and distributed web-based systems.	3	Apply
CO6	Understand various Recent Trends & Tools in distributed systems.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	2	2	-	-	-	-	1	2	3	-
CO2	3	2	2	2	1	1	2	-	-	1	-	1	2	3	-
CO3	3	2	2	2	1	1	2	-	-	1	-	1	2	3	-
CO4	3	1	2	2	1	1	2	-	-	1	-	1	2	3	-
CO5	3	1	1	1	2	1	2	-	-	-	-	1	2	3	-
CO6	1	1	1	1	1	2	2	-	-	-	-	1	2	3	-

Course Contents			
Unit-I	**INTRODUCTION TO DISTRIBUTED SYSTEMS**	**No. of Hours**	**COs**
	Defining Distributed Systems, Characteristics, Middleware and Distributed Systems.Design goals,Challenges of Distributed Systems, Examples of Distributed Systems. Types of Distributed Systems: High Performance Distributed Computing, Distributed Information Systems, Pervasive Systems. Architectural styles: Layered architectures, Object based architectures, Publish Subscribe architectures. Distributed Computing Models: Physical, Architecture and Fundamental models. Introduction to middleware, middleware Framework, Role of middleware, Examples of Middleware. Case Study of Middleware System that includes Design, Architecture and Application.	10	CO1
Unit-II	**COMMUNICATION AND CO-ORDINATION**	**No. of Hours**	**COs**
	IPC: Introduction, Layered protocols, RMI, CORBA, API for internet protocols, IPC through shared memory, external data representation and marshaling, Types of communication, inter process communication, multicast communication, message-oriented communication, MPI, network virtualization, overlay networks Coordination: Clock synchronization, logical clocks, mutual exclusion, election algorithms, Gossip based coordination. Case Study: IBM WebSphere Message Queuing.	10	CO2
Unit-III	**DISTRIBUTED SHARED MEMORY & RESOURCE MANAGEMENT IN DISTRIBUTED SYSTEM**	**No. Of Hours**	**COs**
	DSM:General architecture of DSM systems, Design and implementation issues of DSM, Granularity, Structure of shared memory space, Consistency models, Replacement strategy, Thrashing. Resource Management in Distributed System: Types of resources, issues of resource sharing, Task assignment, Types of distributed load balancing algorithms, load estimation policy, process transfer, location policy, state information exchange policy, priority assignment policy, process migration.	10	CO3
Unit-IV	**CONSISTENCY, REPLICATION AND FAULT TOLERANCE**	**No. of Hours**	**COs**
	Replication: Data-Centric Consistency Models,Client-Centric Consistency Models, Reasons for replication. Replica management: Finding the best server location, Content replication and placement, Content distribution, Managing replicated objects. Consistency protocols: Primary based protocols, replicated write protocols. Fault Tolerance: Introduction to fault tolerance, Reliable client server communication, Reliable group communication, distributed commit, Recovery – Check pointing, Message logging. Case Study: Caching and replication in web.	10	CO4

Unit-V	DISTRIBUTED FILES, MULTIMEDIA AND WEB BASED SYSTEM	No. of Hours	COs
	Distributed Files: Introduction, File System Architecture, Sun Network File System and HDFS. Distributed Multimedia Systems: Characteristics of Multimedia Data, Quality of Service Management, Resource Management. Distributed Web Based Systems: Architecture of Traditional Web-Based Systems, Apache Web Server, Web Server Clusters, Communication by Hypertext Transfer Protocol, Synchronization, Web Proxy Caching. Case Study: The Global Name Service, The X.500 Directory Service, Bit Torrent.	10	CO5
Unit-VI	**DISTRIBUTED SYSTEM MONITORING TOOLS & RECENT TRENDS**	**No. of Hours**	**COs**
	Distributed Computing: Document classification,Frameworks – Kuberbets, GPU Applications,Parallel Computing for AI/ ML. Parallel Virtual Machine (PVM), Jini, Service Oriented Architecture, The Future of Recent Trends. Tools for Distributed System Monitoring: Prometheus, Zabbix, Nagios. Case Studies: Mach, Chorus.	10	CO6

Text Books:

1. George Coulouris, J Dollimore and Tim Kindberg, "Distributed Systems: Concepts and Design", Pearson Education, ISBN: 9789332575226, 5th Edition, 2017.
2. Distributed Systems, Maarten van Steen, Andrew S. T,ThirdeditionVersion.
3. Distributed Operating Systems: Concepts and Design by P. K. Sinha, PHI, ISBN: 978-0780311190.

Reference Books:

1. Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University.
2. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition, HagitAttiya and Jennifer Welch, Wiley India.
3. Tool for Distributed Systems Monitoring, Łukasz KUFEL, Foundation of Computing and Decision Sciences, Vol 41(4), 2016, e-ISSN 2300-3405, DOI:10.1515/fcdc-2016-0014.

eLearning Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs87/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs15/preview
3. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/distributed-systemssurvey.pdf
4. http://home.mit.bme.hu/~meszaros/edu/oprendszerek/segedlet/elosztott/DisSysUbiCompReport.html

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT403 : Artifitial Intelligance

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Data Structures and Files

Course Objectives

1. To understand the basic principles of Artificial Intelligence
2. To provide an understanding of uninformed search strategies.
3. To provide an understanding of informed search strategies.
4. To study the concepts of Knowledge based system.
5. To learn and understand use of fuzzy logic and neural networks.
6. To learn and understand various application domain of Artificial Intelligence.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents capable of problem formulation.	2	Understand
CO2	Apply different uninformed search algorithms on well formulates problems along with stating valid conclusions that the evaluation supports.	3	Apply
CO3	Apply informed search algorithms on well formulated problems.	3	Apply
CO4	Apply the knowledge-based system for solving the problems.	3	Apply
CO5	Apply planning and neural network learning for solving AI problems.	3	Apply
CO6	Understand use of fuzzy logic and reasoning for non-monotonic AI problems.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	1	1	2	1	1	1	1	3	2	1
CO2	2	2	3	2	2	1	1	2	1	1	1	1	3	2	1
CO3	2	2	3	2	2	1	1	2	1	1	1	1	3	2	1
CO4	2	2	3	2	2	1	1	2	1	1	1	1	3	2	1
CO5	2	2	3	2	2	1	1	2	1	1	1	1	3	2	1
CO6	2	2	3	2	2	1	1	2	1	1	1	1	3	2	1

Course Contents			
Unit-I	**FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE**	**No. of Hours**	**COs**
	Introduction, A.I. Representation, Non-AI &AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	7	CO1
Unit-II	**UNINFORMED SEARCH STRATEGIES**	**No. of Hours**	**COs**
	Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensor-less problems, Contingency problems.	8	CO2
Unit-III	**INFORMED SEARCH STRATEGIES**	**No. Of Hours**	**COs**
	Generate& test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence.	7	CO3
Unit-IV	**KNOWLEDGE REPRESENTATION**	**No. of Hours**	**COs**
	Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forwardand Backward Chaining.	8	CO4
Unit-V	**INTRODUCTION TO PLANNING AND ANN**	**No. of Hours**	**COs**
	Blocks world, STRIPS, Implementation using goal stack, Introduction to Neural networks:- basic, comparison of human brain and machine, biological neuron, general neuron model, activation functions, Perceptron learning rule, applications and advantages of neural networks. Brief introduction to single layer and multiplayer networks.	7	CO5
Unit-VI	**UNCERTAINTY**	**No. of Hours**	**COs**
	Non Monotonic Reasoning, Logics for Non Monotonic Reasoning, Justification based Truth Maintenance Systems, Semantic Nets, Statistical Reasoning, Fuzzy logic: fuzzy set definition and types, membership function, designing a fuzzy set for a given applic.	8	CO6

Text Books:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence" Tata McGraw Hill.
2. Stuart Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition.

Reference Books:

1. Ivan Bratko, "Prolog Programming For Artificial Intelligence", 2nd Edition, Addison Wesley, 1440.
2. Eugene, Charniak, Drew Mcdermott, "Introduction to Artificial Intelligence", Addison Wesley.
3. Patterson, “Introduction to AI and Expert Systems”, PHI.
4. Nilsson, “Principles of Artificial Intelligence”, Morgan Kaufmann.
5. Carl Townsend, “Introduction to turbo Prolog”, Paperback, 1483.

6. Jacek M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publication.

eLearning Resources:

1. An Introduction to Artificial Intelligence by Prof. Mausam, IIT Delhi, NPTEL Course.
2. AI for Everyone by Andrew Ng, Coursera Course.
3. http://www.eecs.qmul.ac.uk/~mmh/AINotes/AINotes4.pdf
4. https://www.slideshare.net/JismyKJose/conceptual-dependency-70129647

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT404A : Software Architecture (Professional Elective –III)

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Software Engineering Modeling and Design

Course Objectives

1. To understand the Software architecture for various software systems.
2. To recognize and derive Quality attributes for software architectures.
3. To understand the use of different architectural styles and frameworks.
4. To understand systems requirement with the help of different UML diagrams.
5. To understand documentation for architectural patterns.
6. To understand the role of architecture in Software Enterprise.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the Software architecture for various software systems.	2	Understand
CO2	Recognize and derive Quality attributes for software architectures.	3	Apply
CO3	Demonstrate the use of different architectural styles and frameworks.	3	Apply
CO4	Depict systems requirement with the help of different UML diagrams.	3	Apply
CO5	Demonstrate documentation for architectural patterns.	3	Apply
CO6	Understand the role of architecture in Software Enterprise.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	-	1	2	-	1	-	-	1	1	2	3	-
CO2	1	1	2	0	1	2	0	1	-	-	1	1	2	3	-
CO3	1	1	2	0	1	2	0	1	-	-	1	1	2	3	-
CO4	1	1	2	0	1	2	-	1	-	-	1	1	2	3	-
CO5	1	1	2	0	1	2	-	1	-	-	1	1	2	3	-
CO6	1	1	2	-	1	2	-	1	-	-	1	1	2	3	-

Course Contents			
Unit-I	**INTRODUCTION**	**No. of Hours**	**COs**
	Introduction: Introduction – Software architecture and requirements – Architecture diagrams - UML Component Diagram – UML Package Diagram – UML Deployment Diagram – UML Activity Diagram – Architecture structure – ABC (Architecture Business Cycle).	8	CO1
Unit-II	**UNDERSTANDING QUALITY ATTRIBUTES AND ACHIEVING QUALITY**	**No. of Hours**	**COs**
	Introduction to Quality Attributes – Need of quality attributes – Understanding quality attributes – architecture and quality attributes – achieving quality attributes. Case study of quality attributes in software architecture templates – Deriving Quality Attributes for software architectures.	7	CO2
Unit-III	**ARCHITECTURAL VIEWS**	**No. Of Hours**	**COs**
	Introduction – Definitions – Structures and views - Representing viewsavailable notations – Standard views – 4+1 view of Rational Unified Process, Siemens 4 views, SEI's perspectives and views – Case studies Architecture in the agile projects – Architecture and requirements – Implementation and testing – Architecture reconstruction and conformance.	8	CO3
Unit-IV	**ARCHITECTURAL STYLES**	**No. of Hours**	**COs**
	Introduction – Data flow styles – Call-return styles – Shared Information styles - Event styles – Case studies for each style. Architectural styles – Pipes and filters – Data abstraction and object-oriented organization – Eventbased – implicit invocation.	7	CO4
Unit-V	**DOCUMENTING THE ARCHITECTURE**	**No. of Hours**	**COs**
	Guidelines and practices – Documenting the Views using UML – Pros and cons of using visual languages–Need for formal languages - Architectural Description Languages–ACME–Designing and documentation, Case studies.	8	CO5
Unit-VI	**ADVANCED TOPICS**	**No. of Hours**	**COs**
	Software Architecture in the future-The Architecture Business Cycle Revisited – Role of architecture in Software Engineering Enterprise Architectures – Zachman's Framework – Opportunities and Advances in Software Architectures.	7	CO6

Text Books:

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson, ISBN 978-81-775-8996-2.
2. Erich Gamma, Design Patterns
3. Ramesh Gopalaswamy, “Managing and global Software Projects”, Tata Mc Graw Hill. Tenth Reprint 2011.(Revised)
4. Roger S.Pressman, “Software Engineering - A Practitioner’s Approach”, 7th Edition McGraw Hill, 2010.(Revised).

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing: Foundations

and Applications Programming", McGraw Hill, ISBN: 978 1259029950, 1259029956.
2. Barrie Sosinsky, "Cloud Computing Bible", Wiley, ISBN: 978 8126529803.
3. Gautham Shroff, "Enterprise Cloud Computing", Cambridge, ISBN: 9781107648890.
4. Ronald L. Krutz and Russell D. Vines, "Cloud Security: A Comprehensive guide to Secure Cloud Computing", Wiley, ISBN: 9788126528097.
5. Scott Adkins, John Belamaric, Vincent Giersch, Denys Makogon, Jason E. Robinson, "OpenStack: Cloud Application Development", Wrox, ISBN :9781119194316.
6. KailashJayaswal, JagannathKallakurchi, Donald J. Houde, "Cloud Computing Black Book",Wiley Dreamtech,ISBN:9789351194187.

eLearning Resources:

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT404B : Digital Twin (Professional Elective-III)

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Basic knowledge of Data Science, Data Analytics, Engineering Physics.

Course Objectives

1. To understand digital twin approach.
2. To gain the knowledge of digital twin development plan.
3. To understand the role of digital twin in industry.
4. To gain knowledge of digital twin framework.
5. To gain azure digital twin installation.
6. To learn digital twin definition language.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	To understand digital twin approach.	2	Understand
CO2	To understand the knowledge of digital twin development plan.	2	Understand
CO3	To apply the role of digital twin in industry.	3	Apply
CO4	To apply the digital twin framework.	3	Apply
CO5	To apply azure digital twin installation.	3	Apply
CO6	To apply digital twin definition language.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	1							1	3	1	1
CO2				3	1	1						1	2	1	1
CO3	1	2	2	2	1							3	2	1	1
CO4	2			2		2			2	1		3	2	1	1
CO5	3	3	3	2	3	1	2		3	1	2	2	1	1	1
CO6	3	3	3	2	3	1	2		3	1	2	2	1	1	1

Course Contents			
Unit-I	**INTRODUCTION TO DIGITAL TWIN**	**No. of Hours**	**COs**
	Origin of the Digital Twin concept, what is a Digital Twin, Entity life cycle and Digital Twin development life cycle. Types of Digital Twins- Discrete versus composite, Product versus facility, Simulation versus operational, Analytics versus physics-based, Characteristics of a Digital Twin.	8	CO1
Unit-II	**DIGITAL TWIN MODEL DEVELOPMENT PLAN**	**No. of Hours**	**COs**
	Key criteria, Expected business outcomes- The manufacturing industry- Discrete manufacturing, Process manufacturing, Smart manufacturing, Supply chain management. Prerequisites for the Digital Twin, Technological needs.	7	CO2
Unit-III	**IDENTIFYING THE FIRST DIGITAL TWIN**	**No. Of Hours**	**COs**
	Evaluating Digital Twin candidates, Industrial conglomerates, Digital twin at digital competency, Digital twin at the LOB, Large enterprises in a single industry sector, public sector, Software and public cloud providers.	8	CO3
Unit-IV	**WORK WITH DIGITAL TWIN**	**No. of Hours**	**COs**
	Project Planning framework, Solution planning framework, Validating the problem statement and outcomes, Exploring the business process for Digital Twin development, Factoring in technology considerations.	7	CO4
Unit-V	**AZURE DIGITAL TWIN**	**No. of Hours**	**COs**
	Technical Requirements, Azure Digital Twin service, MS visual studio, The Window Azure, CLI with windows powershell, Node.JS, Azure digital twin explorer, Creating first Digital twin.	8	CO5
Unit-VI	**DIGITAL TWIN DEFINITION LANGUAGE**	**No. of Hours**	**COs**
	Digital Twin Definitation Language, DT Interface, interface content, schemas, primitive schemas, complex schemas, geospatial schema.	7	CO6

Text Books:

1. Shyam Varan Nath, Pieter van Schalkwyk, Dan Isaacs, "Building Industrial Digital Twins", Packt Publishing, ISBN: 9781839219078.
2. Alexanders Meijers, "Hands on Azure Digital Twins", ISBN-9781801071383, Packt Publishing, March 2022.
3. Gopal Chaudhary, Manju Khari, Mohamed Elhoseny, "Digital Twin Technology", 1st Edition, ISBN 9781003132868, Published October 5, 2021 by CRC press.
4. F Tao, M Zhang, AYC Nee, "Digital twin driven smart manufacturing", Academic Press, ISBN-978-0-12-817630-6.

Reference Books:

1. Christoph Herwig, Ralf Pörtner, Johannes Möller, "Digital Twins Tools and Concepts for Smart Biomanufacturing", Springer, ISBN 978-3-030-71660-8
2. Arup, "Digital Twins towards a meaningful framework", W1T 4BQ, www.arup.com

eLearning Resources:

1. Prof. M. S. Krishnan, University of Michigan, https://www.coursera.org/learn/digital-twins

2. Udemy https://www.udemy.com/course/digital-twin-a-comprehensive-overview/

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT404C : Cognitive Intelligence (Professional Elective-III)

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: To explain cognitive computing and design principles.

Course Objectives

1. To distinguish between NLP and cognitive computing.
2. To apply advanced analytics to cognitive computing.
3. To discuss application of cognitive computing in business.
4. To illustrate various applications of cognitive computing.
5. To provide an understanding of the central challenges in realizing aspects of human cognition.
6. To understand the aspects of human cognition.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	Bloom's Taxonomy	
		Level	Descriptor
CO1	Explain cognitive computing and design principles.	2	Understand
CO2	Distinguish between NLP and cognitive computing.	2	Understand
CO3	Apply advanced analytics to cognitive computing.	3	Apply
CO4	Discuss application of cognitive computing in business.	2	Understand
CO5	Illustrate various applications of cognitive computing.	2	Understand
CO6	Understand the aspects of human cognition.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	0	3	-	2
CO2	3	2	2	2	-	-	0	-	-	-	-	0	3	-	2
CO3	3	2	2	2	-	-	0	-	-	-	-	0	3	-	2
CO4	3	2	2	2	-	-	-	-	-	-	-	0	3	-	2
CO5	3	2	2	2	-	-	-	-	-	-	-	0	3	-	2
CO6	3	2	2	2	-	-	-	-	-	-	-	-	3	-	2

Course Contents			
Unit-I	**FOUNDATION & DESIGN PRINCIPLES**	**No. of Hours**	**COs**
	Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition. Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation and visualization services.	8	CO1
Unit-II	**NLP IN COGNITIVE SYSTEM**	**No. of Hours**	**COs**
	Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems. Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.	7	CO2
Unit-III	**BIG DATA VS COGNITIVE COMPUTING**	**No. Of Hours**	**COs**
	Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data. Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, Using advanced analytics to create value, Impact of open source tools on advanced analytics.	8	CO3
Unit-IV	**COGNITIVE COMPUTING IN BUSINESS**	**No. of Hours**	**COs**
	The Business Implications of Cognitive Computing: Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan f	7	CO4
Unit-V	**APPLICATIONS**	**No. of Hours**	**COs**
	The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing- Building a cognitive health care application- Smarter cities-Cognitive Computing in Government.	8	CO5
Unit-VI	**COGNITIVE MDELS**	**No. of Hours**	**COs**
	Understanding Cognition, IBM's Watson, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamica	7	CO6
Text Books:			

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive computing and Big Data Analytics” , Wiley, 2015.
2. Vijay Raghvan, Venu Govindaraju, C.R. Rao, “Cognitive Computing: Theory and Applications”, Elsevier publications, North Holland Publication, 1st Edition, 2016.
3. Bernadette Sharp, Florence Sedes, Wieslaw Lubaszewski, “Cognitive Approach to Natural Language Processing Hardcover”, 1st Edition May 2017.

Reference Books:

1. Arun Kumar Sangaiah, Arunkumar Thangavelu, et al., “Cognitive Computing for Big Data Systems Over IoT: Frameworks, Tools and Applications: Lecture Notes on Data Engineering and Communications Technologies”, 1st Edition 2018.
2. Min Chen and Kai Hwang, “Big-Data Analytics for Cloud, IoT and Cognitive Computing”, Wiley Publication, 1st Edition, 2017.
3. Mallick, Pradeep Kumar, Borah, Samarjeet, “Emerging Trends and Applications in Cognitive Computing”, IGI Global Publishers, 2019.
4. Ron Sun, “The Cambridge Handbook of Computational Psychology”, Cambridge University Press.
5. Hurwitz, Kaufman, and Bowles, “Cognitive Computing and Big Data Analytics”, Wiley.

eLearning Resources:

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT405A : Cloud Computing (Professional Elective-IV)

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Digital Electronics & Computer Organization

Course Objectives

1. To understand the fundamental of Cloud Computing.
2. To gain the knowledge of Cloud IaaS Service.
3. To gain the knowledge of Cloud PaaS Service.
4. To gain the knowledge of Cloud SLA Management.
5. To gain the knowledge of Cloud Security.
6. To introduce the challenges of Cloud which motivates the students towards research.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the need of cloud computing.	2	Understand
CO2	Understand the importance of IaaS service of Cloud computing.	2	Understand
CO3	Understand PaaS service of Cloud computing.	2	Understand
CO4	Understand the role of SLA in cloud computing.	2	Understand
CO5	Understand Cloud Security.	2	Understand
CO6	Understand the issues and challenges of cloud computing which will lead students towards research platform.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	-	1	3	2	-	1	1	3	2	1
CO2	3	2	3	1	2	-	1	3	2	-	1	1	3	2	1
CO3	3	2	3	1	2	-	1	3	2	-	1	1	3	2	1
CO4	3	2	3	1	2	-	1	3	2	-	1	1	3	2	1
CO5	3	2	3	1	2	-	1	3	2	-	1	1	3	2	1
CO6	3	2	3	1	2	-	1	3	2	-	1	1	3	2	1

Course Contents			
Unit-I	**INTRODUCTION TO CLOUD COMPUTING**	**No. of Hours**	**COs**
	Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks.	8	CO1
Unit-II	**INFRASTRUCTURE AS A SERVICE (IAAS)**	**No. of Hours**	**COs**
	Introduction and Inspiration, Background and Related Work, Virtual Machines Provisioning and Manageability, Virtual Machine (VM) Migration Services, VM Provisioning and Migration in Action, Provisioning in the Cloud Context, Future Research Directions.	7	CO2
Unit-III	**PLATFORM AS A SERVICE (PAAS)**	**No. Of Hours**	**COs**
	Introduction, Technologies and Tools for Cloud Computing, Aneka Cloud Platform, Aneka Resource Provisioning Service, Hybrid Cloud Implementation, Visionary thoughts for Practitioners.	8	CO3
Unit-IV	**SLA MANAGEMENT IN CLOUD COMPUTING**	**No. of Hours**	**COs**
	Inspiration, Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud, Automated Policy-based Management.	7	CO4
Unit-V	**SECURITY IN CLOUD COMPUTING**	**No. of Hours**	**COs**
	Introduction Cloud in Information Technology, Cloud General Challenges Security Aspects, Data Security, Data Center Security, Access Control, Encryption and Decryption Virtualization Security, Network Security- Platform-Related Security, Security Issues in Cloud Service Models, Software-as-a-Service Security, Platform-as-a-Service Security Issues, Infrastructure-as-a-Service Security Issues Audit and Compliance, Disaster Recovery, Privacy and Integrity.	8	CO5
Unit-VI	**CHALLENGES AND ISSUES IN CLOUD COMPUTING**	**No. of Hours**	**COs**
	Cloud Computing Challenges: Security Policy Implementation, Virtualization Security Management, Virtual Threats, VM Security Recommendations, VM-Specific Security Techniques, Cloud Computing Scheduling Challenges, Cloud Computing SLA Challenges, Cloud Computing power management challenges.	7	CO6

Text Books:

1. Prof. K. Chandrashekharan, "Essentials of Cloud Computing", CRC Press, Taylor & Francis Group.
2. Rajkumar Buyya, James Broberg, AndrzejGoscinski, "Cloud Computing: Principles and Paradigms", Wiley India, ISBN: 9788126541256.
3. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Elsevier, ISBN :9789381269237, 9381269238, 1st Edition.
4. Thomas Erl, ZaighamMahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Pearson, ISBN :978 9332535923, 9332535922, 1 st Edition.

Reference Books:

eLearning Resources:

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT405B : Ubiquitous Computing (Professional Elective –IV)

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Basic knowledge of Data Science, Data Analytics, Engineering Physics.

Course Objectives

1. To describe ubiquitous computing, its properties applications and architectural design.
2. To explain various smart devices and services used in ubiquitous computing.
3. To teach the role of sensors and actuators in designing real time applications using Ubicomp.
4. To explore the concept of human computer interaction in the context of Ubicomp.
5. To explain Ubicomp privacy and challenges to privacy.
6. To describe Ubicomp network with design issues and Ubicomp management.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand the basics of ubiquitous computing.	2	Understand
CO2	Understand the applications of ubiquitous computing.	2	Understand
CO3	Understand the smart devices and services ubiquitous computing.	2	Understand
CO4	Understand the Human-computer interaction.	2	Understand
CO5	Understand the context aware system.	2	Understand
CO6	Understand the intelligent system.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	0	1	1	-	-	-	-	-	-	1	3	1	1
CO2	0	0	0	1	3	1	0	-	-	-	-	1	2	1	1
CO3	2	1	2	1	2	-	0	-	-	-	-	3	2	1	1
CO4	0	2	0		2	2	-	-	2	1		3	2	1	1
CO5	0	0	0	3	-	-	-	-	-	-	2	2	1	1	1
CO6	2	1	-	3	2	-	-	-	-	-	-	2	1	1	1

Course Contents			
Unit-I	**UBIQUITOUS COMPUTING: BASICS AND VISION**	**No. of Hours**	**COs**
	Living in a Digital World, Modelling the Key Ubiquitous Computing Properties, Architectural Design for UbiCom Systems: Smart DEI Model.	8	CO1
Unit-II	**UBIQUITOUS COMPUTING: APPLICATIONS AND RESEARCH**	**No. of Hours**	**COs**
	Early UbiCom Research Projects- Smart Devices: CCI, Smart Environments, Smart Devices: iHCI and HPI ,Applications in the Virtual, Human and Physical World, Human to Human Interaction (HHI) Applications, Human Physical World Computer Interaction (HPI) and (CPI).	7	CO2
Unit-III	**SMART DEVICES AND SERVICES**	**No. Of Hours**	**COs**
	Introduction, Service Architecture Models, Service Provision Life Cycle, Service Invocation, Virtual Machines and Operating Systems.	8	CO3
Unit-IV	**HUMAN–COMPUTER INTERACTION**	**No. of Hours**	**COs**
	Introduction, User Interfaces and Interaction for Four Widely Used Devices, Hidden UI Via Basic Smart Devices, Hidden UI Via Wearable and Implanted Devices, Human Centered Design (HCD), iHCI Design.	7	CO4
Unit-V	**CONTEXT-AWARE SYSTEMS**	**No. of Hours**	**COs**
	Introduction, Modelling Context Aware Systems, Mobility Awareness, Spatial Awareness, Temporal Awareness: Coordinating and Scheduling, ICT System Awareness.	8	CO5
Unit-VI	**INTELLIGENT SYSTEMS (IS)**	**No. of Hours**	**COs**
	Introduction, Basic Concepts, IS Architectures, Semantic KB IS, Classical Logic IS, Soft Computing IS Models,IS System Operations.	7	CO6

Text Books:

1. Stefan Poslad, "Ubiquitous Computing", Wiley, Student Edition, ISBN:9788126527335.
2. Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert, “Fundamentals of Mobile and Pervasive Computing,” Tata McGraw Hills.

Reference Books:

1. Nina Godbole, “Information Systems Security”, Wiley India Pvt. Ltd, ISBN -978-81-265-1692-6.
2. Willaim Stallings, “Computer Security : Principles and Practices”, Pearson Ed. ISBN :978-81-317-3351-6.
3. Mark Merkow, “Information Security-Principles and Practices”, Pearson Ed. 978-81-317-1288-7.
4. CK Shyamala, et al., “Cryptography and Security”, Wiley India Pvt. Ltd, ISBN 978-81-265-2285-9.
5. Berouz Forouzan, “Cryptography and Network Security”, 2nd Edition, TMH, ISBN :9780070702080.

eLearning Resources:

1. Dr. Willian Cope, University of Illinois, Ubiquitous Learning and Instructional Technologies, - https://www.coursera.org/learn/ubiquitouslearning.

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT405C : Business Intelligence (Professional Elective –IV)

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Fundamentals of Database Management System and Data Mining.

Course Objectives

1. To understand the need for data warehouse for large organizations.
2. To apply the data sources to populate data warehouse.
3. To study the Design of data warehouse models using appropriate schema.
4. To apply the Design and Development of data warehouse for a domain using Data warehouse tools.
5. To apply the process modelling and Analysis of Data to meet business objectives.
6. To apply data analysis techniques for building Decision support system.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand the concept and process of Business Intelligence and Decision making.	2	Understand
CO2	Apply practice of the data science and how methodologies are applied to visualize information from raw data.	3	Apply
CO3	Understand and analyze BI concepts and techniques for Importance of data visualization.	2	Understand
CO4	Apply BI Techniques for various performance situations.	3	Apply
CO5	Apply the concept and process modelling and Analysis of Data.	3	Apply
CO6	Apply BI techniques involving predictive and statistical approach.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	2	1	2	-	2	2	2	-	-	2
CO2	2	2	3	2	3	2	1	2	-	2	2	2	-	-	2
CO3	2	2	3	2	3	2	1	2	-	2	2	2	-	-	2
CO4	2	2	3	2	3	2	1	2	-	2	2	2	-	-	2
CO5	2	2	3	2	3	2	1	2	-	2	2	2	-	-	2
CO6	2	2	3	2	3	2	1	2	-	2	2	2	-	-	2

Course Contents			
Unit-I	**INTRODUCTION TO BUSINESS INTELLIGENCE**	**No. of Hours**	**COs**
	BI concept, BI architecture, BI in today's perspective, BI Process, Applications of BI like Financial analysis, statistical analysis, sales analysis. CRM, result pattern and ranking analysis, Balanced Scorecard, BI in Decision Modelling: Optimization, Decision making under uncertainty. Ethics and business intelligence.	8	CO1
Unit-II	**DATA SCIENCE**	**No. of Hours**	**COs**
	The concept, process and typical Tools in Data Science. Example of different Algorithms i.e Segmentation, Classification, Validation, Regressions, recommendations. Exercises using Excel and R to work on Histograms, Regression, Clustering and Text Analysis. Co-relation between Algorithm and Code in Data Science.	7	CO2
Unit-III	**DATA VISUALIZATION AND DASHBOARD DESIGN**	**No. Of Hours**	**COs**
	Responsibilities of BI analysts by focusing on creating data visualizations and dashboards. Importance of data visualization, types of basic and composite charts.	8	CO3
Unit-IV	**PERFORMANCE DASHBOARD**	**No. of Hours**	**COs**
	Measuring, Monitoring and management of Business, KPIs and dashboard, the types of dashboards, the common characteristics of Enterprise dashboard, design of enterprise dashboards, and the common pitfalls of dashboard design.	7	CO4
Unit-V	**MODELLING AND ANALYSIS**	**No. of Hours**	**COs**
	Exploring Excel Modeling capabilities to solve business problems, summarize and present selected data, introduction to business metrics and KPIs, creating cubes using Microsoft Excel.	8	CO5
Unit-VI	**POWER BI**	**No. of Hours**	**COs**
	Overview of Power BI, Sample Reports & Dashboards, Data set modes in the Power BI service, Data Sources, Power Query Editor, Data Shaping & Transformation, Detect Data Type, Replace Value, Transpose, Reverse Rows, First Row As Header, Split Column, Merge	7	CO6

Text Books:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 201
2. "Business Intelligence – Grundlagen und praktische Anwendungen: Eine Einführung in die IT" by Hans-Georg Kemper and Henning Baars

Reference Books:

1. David Loshin Morgan, Kaufman, "Business Intelligence: The Savvy Manager"s Guide", Second Edition, 2012.
2. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003

3. Carlo Vercellis, “Business Intelligence: Data Mining and Optimization for Decision Making”, Wiley Publications, 2009.

eLearning Resources:

1. https://learn.microsoft.com/en-us/power-bi/
2. https://www.coursera.org/projects/power-bi-desktop

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT8104 : Ethical Hacking & Digital Forensic Tools (Honors Specialization Course)

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**CIA:**	**40 Marks**
	ESE:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Foundation for Cyber Security

Course Objectives

1. To understand the basics of ethical hacking.
2. To analyze different Vulnerabilities in a web application and servers.
3. To explore the penetration testing skills
4. To implement Pentest tools.
5. To apply Incidence Response.
6. To implement various digital forensics techniques and its usage for the incident response.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the basics of ethical hacking.	2	Understand
CO2	Analyze different Vulnerabilities in a web application and servers.	4	Analyze
CO3	Explore the penetration testing skills.	2	Understand
CO4	Implement Pentest tools.	3	Apply
CO5	Apply the basics of Incidence Response.	3	Apply
CO6	Implement various digital forensics techniques and its usage for the incident response.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	0	1	--	--	1	--	1	1	--	1	--	3	--
CO2	0	3	0	1	--	--	1	--	2	--	1	2	--	3	--
CO3	0	0	2	0	2	1	0	--	2	--	--	2	--	3	--
CO4	2	0	3	0	3	1	--	2	2	1	2	2	--	3	--
CO5	0	0	0	1	--	--	1	--	1	--	--	1	--	3	--
CO6	--	--	--	1	--	--	1	--	1	1	--	1	--	3	--

Course Contents			
Unit-I	**INTRODUCTION TO ETHICAL HACKING**	**No. of Hours**	**COs**
	Introduction to ethical hacking, Elements of information security, Essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking, Foot printing, Reconnaissance, Scanning, Enumeration, System Hacking, Session Hijacking.	8	CO1
Unit-II	**GAINING ACCESS**	**No. of Hours**	**COs**
	Dark web, Gathering information from networks, Wireless attacks, Post connection attacks, Attacks on user, Social Engineering, Social Media Security, External Network attack, Fake Game website attack, Hacker Methodology, Website Reconnaissance.	7	CO2
Unit-III	**PENETRATION TESTING**	**No. Of Hours**	**COs**
	Introduction to penetration Testing, Phases of Penetration Testing, Planning, Discovery, Attack, Discovery, Network pen testing, System pen testing, Post hacking session, website pen testing, Cross site scripting.	8	CO3
Unit-IV	**SQL INJECTION**	**No. of Hours**	**COs**
	SQL 101, Vulnerability Test, Post Method SQLi, Get Method SQLi, Website pen testing tools- Sqlmap, Zap, Python for ethical Hacking setup, man in the middle, Packet Listener, Keylogger, Backdoor, Packaging & malicious files.	7	CO4
Unit-V	**INCIDENCE RESPONSE**	**No. of Hours**	**COs**
	Introduction, Investigation Preparation, Detection and analysis, Containment, Eradication & Recovery, Post Incident Activities.	8	CO5
Unit-VI	**DIGITAL FORENSICS**	**No. of Hours**	**COs**
	Digital Forensics, Types of investigations & tools, Trends, Challenges, Anti-forensics techniques, Data collection and examination, Analysis and reporting, Data acquisition.	7	CO6

Text Books:

1. Patrick Engebretson,"The Basics of Hacking and Penetration Testing", Elsevier, 2013.
2. Thomas Mathew, EC-Council, "Ethical Hacking: Student Courseware" by International Council of Electronic Commerce Consultants, OSB publisher.
3. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response & Computer Forensics", McGraw-Hill Osborne Media, 3rd edition, 2014.

Reference Books:

1. Keith J. Jones, Richard Bejtlich, Curtis W. Rose, "Real Digital Forensics: Computer Security and Incident Response", Paperback – Import, 2005.
2. John Sammons, "The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics", Paperback, February 24, 2012.
3. Michael T Simpson, Kent Backman, James Corley, "Hands on ethical hacking and network defense", Cengage Learning, 2 edition, 2010
4. Johnny Long, "NoTech Hacking : A Guide to Social Engineering, Dumpster Diving and Shoulder Surfing", Syngress publishers, 1st edition, 2008

5. https://www.edureka.co/blog/ethical-hacking-tutorial/
eLearning Resources:
1. https://www.udemy.com/course/the-complete-ethical-hacking-course/ 2. https://www.udemy.com/course/fundamentals-of-computer-forensics/ 3. https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics#syllabus

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

B. Tech. Information Technology

Semester VIII

2021 PATTERN

WEF 2024-25

IT406 : Artificial Intelligence & Natural Language Processing Laboratory		
Teaching Scheme	**Examination Scheme**	
Lectures: 4 Hrs./Week	**Oral:**	**NA Marks**
	Practical:	**50 Marks**
	Term Work:	**50 Marks**
Credits: 2	**Total:**	**100 Marks**
Prerequisite Course: Data Structures and Files Laboratory		

Course Objectives

1. To implement Artificial Intelligence ,Non Artificial Intelligence ,uninformed and informed search strategies.
2. To implement Artificial Neural Network
3. To understand and apply the fundamental concepts of natural language processing (NLP).
4. To apply different tools and techniques on textual data.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Apply and implement Artificial ,Non Artificial Intelligence techniques,Use uninformed and informed search strategies for implementation of search algorithms.	3	Apply
CO2	Apply Artificial Neural Network for various learning algorithms.and Fuzzy logic for the implementation of real life problems.	3	Apply
CO3	Apply basic operations on textual data and text pre-processing.	3	Apply
CO4	To Apply different tools and techniques for text processing and 3 information retrieval from textual data.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	2	1	1	1	2	2	2	1	2	2	1
CO2	2	2	3	1	2	1	1	1	2	2	2	1	2	2	1
CO3	1	2	0	-	3	-	-	-	-	0	-	2	3	1	1
CO4	2	3	0	-	3	0	-	-	-	1	2	2	3	2	1

Course Contents

This Artificial Intelligence Laboratory course has Artificial Intelligence as a core subject. The problem statements should be framed based on assignments mentioned in the syllabus. The teacher will frame the problem statements with due consideration that students have three hours to complete that. The practical examination will comprise of implementation and related theory. All assignments are to be performed in C/C++ or Python Language. Use of open source platform and tools is encouraged.

Staff in-charge will suitably frame the above assignments and flexibility may be incorporated. Students will submit term work in the form of journal. Each assignment has to be well documented with problem definition, code documented with comments. Staff in-charge will assess the assignments continuously and grade or mark each assignment on completion date. All the assignments should be conducted in C/C++ or Python Language.

	List of Assignments	No. of Hours	COs
1.	Assignment Based on direct heuristic search techniques.	2	CO1
2.	Implement any one technique from the following a) Best First Search and A* Algorithm b) AO* Algorithm c) Hill Climbing	2	CO1
3.	Implement Perceptron Learning Algorithm.	2	CO2
4.	Implement a real life application in AI libraries Python.	2	CO2
5.	Implement an expert system in Python	2	CO2
6.	Implement any two player game using min-max search algorithm	2	CO2
7.	Design a fuzzy set for shape matching of handwritten character.	2	CO2
8.	Text Pre-processing using NLP operations: perform Tokenization,Lemmitization, Stemming, Stop word removal, Punctuation removal, using SpaCy or NLTK library, Input- use any sample text input file.	2	CO3
9.	Perform bag-of-words approach tf-idf on data. Create embedding using Word2Vec using Gensim or any other python library.	2	CO3
10.	Implement Named Entity Recognition(NER) on textual data using SpaCy library for “English” language.	2	CO3
11.	Implement Bi-gram, Tri-gram word sequence and its count in text inputs or twitter data using NLTK library.	2	CO4
12.	Implement regular expression function to find URL, IP address, Date, PAN number in textual data using python libraries.	2	CO4
13.	Implement and visualize Dependency Parsing of Textual Input using Stanford CoreNLP and Spacy library.	2	CO4

Text Books:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
2. Stuart Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition.
3. Steven Bird, Ewan Klein, Edward Loper, “Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit”, O’Reilly Publication.

Reference Books:

1. Ivan Bratko, “Prolog Programming For Artificial Intelligence", 2nd Edition, Addison Wesley.
2. Jacob Eisenstein, “Natural Language Processing”, MIT Press.
3. Alexander Clark, Chris Fox, and Shalom Lappin, “The Handbook of Computational Linguistics and Natural Language Processing”, Wiley Blackwell Publications.

eLearning Resources:

IT 407 : Distributed System Laboratory

Teaching Scheme	Examination Scheme	
Lectures: 2 Hrs./Week	**Oral:**	**NA Marks**
	Practical:	**50 Marks**
	Term Work:	**0 Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course: System Programming & Operating Systems ,Computer Network

Course Objectives

1. The course aims to provide an understanding of the principles on which the distributed systems are based, their architecture, algorithms and how they meet the demands of Distributed applications.
2. The course covers the building blocks for a study related to the design and the implementation of distributed systems and applications.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Demonstrate knowledge of the core concepts and techniques in distributed systems.	3	Apply
CO2	Apply principles of state-of-the-Art Distributed systems in practical application.	3	Apply
CO3	Design, build and test application programs on distributed systems.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	-	-	1	-	3	2	-	-
CO2	3	3	2	3	2	2	2	-	-	1	0	3	2	-	-
CO3	3	3	2	3	2	2	2	-	-	1	-	3	2	-	-

Course Contents

The laboratory assignments are to be submitted by students in the form of journals. The Journal consists of prologue, Certificate, table of contents, and handwritten/ printed write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, Software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept, algorithms, printouts of the code written using coding standards, sample test cases etc.).

Practical examination will be based on the term work.

Candidate is expected to know the theory involved in the experiment.The practical examination should be conducted if the journal of the candidate is completed in all respects and certified by concerned faculty and head of the department.

Examiners will assess the term work based on performance of students considering the parameters such as timely conduction of practical assignment, methodology adopted for implementation of practical assignment, timely submission of assignment in the form of handwritten/printed write-up along with results of implemented assignment, attendance etc.

Examiners will judge the understanding of the practical performed in the examination by asking some questions.

	List of Assignments	No. of Hours	COs
1.	Implement multi-threaded client/server Process communication using Socket & RMI.	2	CO1
2.	Develop any distributed application using CORBA to demonstrate object brokering. (Calculator or String operations).	2	CO2
3.	Develop a distributed system, to find sum of N elements in an array by distributing N/n elements to n number of processors MPI or OpenMP. Demonstrate by displaying the intermediate sums calculated at different processors.	2	CO2
4.	Implement Berkeley algorithm for clock synchronization.	2	CO2
5.	Implement Bully and Ring algorithm for leader election,	2	CO2
6.	To develop any distributed application using Messaging System in Publish-Subscribe paradigm.	4	CO3
7.	Create a simple web service and write any distributed application to consume the web service.	4	CO3
8.	Mini Project (In group): A Distributed Application for Interactive Multiplayer Games.	4	CO3

Text Books:

1. Distributed Systems –Concept and Design, George Coulouris, Jean Dollimore, Tim Kindberg& Gordon Blair,Pearson,5th Edition,ISBN:978-13-214301-1.
2. Distributed Algorithms,Nancy Ann Lynch, Morgan Kaufmann Publishers, illustrated, reprint, ISBN: 9781558603486.

Reference Books:

1. Java Network Programming & Distributed Computing by David Reilly, Michael Reilly.
2. John Cheng,MaxGrossman, and yMcKercher, Professional CUDA CProgramming, John Wiley & Sons, Inc, ISBN: 978-1-118-73932-7.

eLearning Resources:

IT408 : Project Stage-I

Teaching Scheme	Examination Scheme	
Lectures: 6 Hrs./Week	**Oral:**	**50 Marks**
	Practical:	**0 Marks**
	Term Work:	**100 Marks**
Credits: 3	**Total:**	**150 Marks**

Prerequisite Course: Mini-Project, Seminar, Skill based Course, Software Engineering Modeling & Design.

Course Objectives

1. To identify problem and formulate a problem statement.
2. To analyze a problem using requirement analysis.
3. To design a software model for proposed system.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Analyze problem to get software requirement specifications.	4	Analyze
CO2	Design software model for proposed system.	3	Apply
CO3	Develop the software as per the SRS and associated Design.	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	3	3	-	-	-	3	3	3	2	1	2	3
CO2	1	3	3	3	3	-	0	-	3	3	3	2	1	2	3
CO3	1	3	3	3	3	-	-	-	3	3	3	2	1	2	3

Course Contents

1. The Head of the department/Project coordinator shall constitute a review committee for project group; project guide would be one member of that committee by default.
2. There shall be two reviews in Project phase –I in semester-I by the review committee.
3. The Project Review committee will be responsible for evaluating the timely progress of the projects.
4. Student should identify Project of enough complexity, which has at least 4-5 major functionalities.
5. The project should be based on the latest research work published in standard research journals/conferences.
6. Student should identify stakeholders and write detail problem statement for system.
7. Review committee should finalize the scope of the project.
8. If change in project topic is unavoidable then the students should complete the process of Project approval by submitting synopsis along with the review of important papers. This new Project topic should be approved by review committee.
9. Every project group shall maintain a project log-book.
10. The students or project group shall make presentation on the progress made by them before the committee.

    The record of the remarks/suggestions of the review committee should be properly maintained and should be made available at the time of examination.

    Each student/group is required to give presentation as part of review for 10 to 15 minutes followed by a detailed discussion.

	List of Assignments	**No. of Hours**	**COs**
1.	Review I: Literature review and problem identification 1. Literature Survey 2. The precise problem statement/title based on literature survey and feasibility study. 3. Purpose, objectives and scope of the project. 4. List of required tools or equipment for implementing the project, test Environment, cost and human efforts in hours. 5. System overview- proposed system and proposed outcomes. 6. Architecture and initial phase of design using suitable design tools.	24	CO1
2.	Review II: Requirement Analysis & System Design: 1. Requirement Analysis. 2. Detailed architecture (Algorithms/ Techniques/ Methodology). 3. System design(UML Diagrams).	24	CO2
3.	Review III: Implementation: 1. 80% Implementation.	24	CO3

Text Books:

Reference Books:

eLearning Resources:

MC409 : Finance related course proposed by Financial Smart (Mandatory Course - VII)	
Teaching Scheme	**Examination Scheme**
Lectures: 1 Hrs./Week	**Oral: NA Marks**
	Practical: 0 Marks
	Term Work: 0 Marks
Credits: 0	**Total: 0 Marks**
Prerequisite Course:	

Course Objectives

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1			
CO2			
CO3			
CO4			

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

Course Contents			
Finance related course proposed by Financial Smart			
	List of Assignments	**No. of Hours**	**COs**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
Text Books:			
Reference Books:			
eLearning Resources:			

IT8105 : Ethical Hacking & Digital Forensic Tools Lab (Honors Specialization Course).	
Teaching Scheme	**Examination Scheme**
Lectures: 2 Hrs./Week	**Oral: NA Marks**
	Practical: 0 Marks
	Term Work: 50 Marks
Credits: 1	**Total: 50 Marks**
Prerequisite Course: Ethical Hacking & Digital Forensic Tools	

Course Objectives

1. To install different softwares and set up OS for ethical hacking practicals.
2. To analyze different Vulnerabilities in a web application and networks.
3. To implementsecurity and hacking tools with Python.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Install different softwares and set up OS for ethical hacking practicals.	3	Apply
CO2	Analyze different Vulnerabilities in a web application and networks.	4	Analyze
CO3	Implementsecurity and hacking tools with Python.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		--	0		1			2					--	3	--
CO2			0			1	1			1			--	3	--
CO3	2	0	1	--	3			2			2		--	3	--

Course Contents

Guidelines: This Ethical Hacking & Digital Forensic Tools Laboratory course is designed with Ethical Hacking and Digital Forensics as core subjects. The practical problem statements should be framed based on the specific assignments outlined in the syllabus for the practical examination. Each experiment should focus on providing hands-on experience in identifying, analyzing, and mitigating security threats, along with the use of forensic tools for digital evidence collection and analysis.
The teacher will frame the problem statements with due consideration that students have three hours to complete that. The practical examination will comprise of implementation and related theory. All assignments are to be performed in C++ Language.

Term Work: The staff in-charge will frame the assignments based on the core topics of Ethical Hacking and Digital Forensic Tools outlined in the syllabus.
Flexibility may be incorporated in the design of assignments, allowing for real-world case studies, current security challenges, and industry-relevant scenarios.
All assignments should encourage problem-solving skills while focusing on the ethical and legal aspects of hacking and forensics.

	List of Assignments	No. of Hours	COs
1.	Assignment on installation of virtual box	2	CO1
2.	Assignment on installation of Kali Linux	2	CO1
3.	Assignment on Dark Web	2	CO2
4.	Assignment on Network pentesting	2	CO2
5.	Assignment on SQL injection	2	CO4
6.	Assignment on setup of python for ethical hacking	2	CO3
7.	Assignment on keylogger	2	CO6
8.	Assignment on Backdoor	2	CO6
9.	Case study on Incidence Response	2	CO5

Text Books:

1. Patrick Engebretson,"The Basics of Hacking and Penetration Testing", Elsevier, 2013.
2. Thomas Mathew, EC-Council, "Ethical Hacking: Student Courseware" by International Council of Electronic Commerce Consultants, OSB publisher
3. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response & Computer Forensics", McGraw-Hill Osborne Media, 3rd edition, 2014.

Reference Books:

1. Michael T Simpson, Kent Backman, James Corley, "Hands on ethical hacking and network defense", Cengage Learning, 2nd Edition, 2010.
2. https://www.edureka.co/blog/ethical-hacking-tutorial/

eLearning Resources:

1. https://www.udemy.com/course/the-complete-ethical-hacking-course/
2. https://www.udemy.com/course/fundamentals-of-computer-forensics/
3. https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics#syllabus