SEMESTER VIII - B.TECH. (INFORMATION TECHNOLOGY)

TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours) TH – P – TUT	Total	Credits Assigned TH – P – TUT	Total	Course Category
1UITC801	Big Data Analytics	3 – 0 – 0	03	3 – 0 – 0	03	PC
1UITDLC802	Department Level Elective – V	3 – 0 – 0	03	3 – 0 – 0	03	PE-DLC
1UITDLC803	Department Level Elective – VI	3 – 0 – 0	03	3 – 0 – 0	03	PE-DLC
1UILC804	Institute Level Elective – II	3 – 0 – 0	03	3 – 0 – 0	03	OE-ILC
1UITL801	Big Data Analytics Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
1UITL805	DevOps Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
1UITDLL802	Department Level Elective – V Lab	0 – 2 – 0	02	0 – 1 – 0	01	PE-DLC
1UITPR86	PBL – Major Project B	0 – 12 – 0	12*	0 – 6 – 0	06	PBL
Total		**12 – 18 – 0**	**30**	**12 – 9 – 0**	**21**	

*Load of learner, not the faculty.

EXAMINATION SCHEME

Course Code	Course Name	CA T1	CA T2	CA IA	ESE	TW	O	P	P&O	Total
1UITC801	Big Data Analytics	15	15	10	60	-	-	-	-	100
1UITDLC802	Department Level Elective – V	15	15	10	60	-	-	-	-	100
1UITDLC803	Department Level Elective – VI	15	15	10	60	-	-	-	-	100
1UILC804	Institute Level Elective – II	15	15	10	60	-	-	-	-	100
1UITL801	Big Data Analytics Lab	-	-	-	-	25	-	-	25	50
1UITL805	DevOps Lab	-	-	-	-	25	-	-	25	50
1UITDLL802	Department Level Elective – V Lab	-	-	-	-	25	-	-	25	50
1UITPR86	PBL – Major Project B	-	-	-	-	50	-	-	100	150
Total		**60**	**60**	**40**	**240**	**125**	**-**	**-**	**175**	**700**

Abbreviations: TH – Theory, P – Practical, TUT – Tutorial, PC – Professional Core Course, PE-DLC – Professional Elective - Department Level Elective Course, OE-ILC – Open Elective - Institute Level Elective Course, PBL – Project-Based Learning, CA – Continuous Assessment, T1 – Test 1, T2 – Test 2, IA – Internal Assessment, ESE – End Semester Exam, TW – Term Work, O – Oral Exam, P – Practical Exam, P&O – Practical & Oral Exam.

Professional Electives - Department Level Elective Courses & Labs (PE-DLC – V & PE-DLC – VI)

Group A: Artificial Intelligence	Group B: Network & Security	Group C: Multimedia	Group D: Optimization
Natural Language Processing (1UITDLC8021)	Cloud Security (1UITDLC8022)	Computer Vision (1UITDLC8023)	Robotics Process Automation (1UITDLC8024)
Natural Language Processing Lab (1UITDLL8021)	Cloud Security Lab (1UITDLL8022)	Computer Vision Lab (1UITDLL8023)	RPA Lab (1UITDLL8024)
Explainable AI & Responsible AI (1UITDLC8031)	Edge Computing (1UITDLC8032)	Augmented Reality - Virtual Reality (1UITDLC8033)	Optimization Techniques (1UITDLC8034)

Open Electives - Institute Level Elective Courses (OE-ILE – II)

Courses
Project Management (1UILC8041)
Finance Management (1UILC8042)
Entrepreneurship Development and Management (1UILC8043)
Human Resource Management (1UILC8044)
Professional Ethics and CSR (1UILC8045)
Research Methodology (1UILC8046)
IPR and Patenting (1UILC8047)
Digital Business Management (1UILC8048)
Environmental Management (1UILC8049)

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UITC801	Big Data Analytics	03	-	-	03

Prerequisites:	Database Management System.
Course Objectives (COBs):	1. To provide an overview of an exciting growing field of Big Data Analytics. 2. To discuss the challenges traditional data mining algorithms, face when analyzing Big Data. 3. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce. 4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. 5. To introduce to the students several types of big data like social media, web graphs and data streams. 6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world. 2. Explain the frameworks like Hadoop, NoSQL to efficiently store, retrieve and process Big Data Analytics. 3. Implement several Data Intensive tasks using the Map Reduce Paradigm. 4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data. 5. Apply algorithms to analyze Big Data like streams, Web Graphs and Social Media data. 6. Analyze complex real-world problems in various applications like recommender systems, social media applications, page ranking, etc.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Big Data	Introduction to Data Mining, Database System and Algorithms, Introduction to Big Data, Big Data Characteristics, Types of Big Data, Traditional versus Big Data Business Approach.	CO1	02	03
	Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications.	CO1	01	
2. Introduction to Big Data Frameworks	Introduction to Hadoop, Core Hadoop Components, Hadoop Ecosystem.	CO2	01	08
	Overview of Pig, Hive, HBase, Sqoop, Databricks Architecture Overview, Workspace to Access Databricks Assets, Interfaces, Introduction to Apache Spark- Requirements, Spark Interfaces, Apache Spark Application, Databricks Datasets,	CO2	05	

	Notebooks, Data Management, Computational Management, Model Management, Authentication and Authorization.			
	NoSQL Data Architecture Patterns: Key-Value Stores, Graph Stores, Column Family (Bigtable) Stores, Document Stores, Mongo DB.	CO2	02	
3. MapReduce Paradigm	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping with Node Failures.	CO3	02	09
	Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce.	CO3	03	
	Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step.	CO3	03	
	Illustrating use of MapReduce with use of real-life databases and applications.	CO3	01	
4. Mining Big Data Streams	The Stream Data Model: A DataStream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing.	CO5	02	07
	Sampling Data in a Stream: Sampling Techniques, Filtering Streams: The Bloom Filter.	CO5	01	
	Counting Distinct Elements in a Stream: The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements, Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-IndykMotwani Algorithm, Query Answering in the DGIM Algorithm.	CO5	04	
5. Big Data Mining Algorithms	Frequent Pattern Mining: Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu, The SON Algorithm and MapReduce.	CO4	03	06
	Clustering Algorithms: Canopy Clustering, Clustering with MapReduce.	CO4	01	
	Classification Algorithms: Parallel Decision Trees, Parallel SVM, One Nearest Neighbour.	CO4	02	
6. Big Data Analytics Applications	Link Analysis: PageRank Definition, Structure of the Web, Dead Ends, Using Page Rank in a Search Engine, Efficient Computation of Page Rank: PageRank Iteration Using MapReduce, Topic Sensitive Page Rank, Link Spam, Hubs and Authorities, HITS Algorithm.	CO4, CO6	03	06
	Mining Social- Network Graphs: Social Networks as Graphs, Types, Clustering of Social Network	CO4. CO6	02	

	Graphs, Direct Discovery of Communities, Counting Triangles using Map-Reduce.			
	Recommendation Engines: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	CO4, CO6	01	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01

Text Books:	1. R. Shankarmani and M. Vijayalakshmi, Big Data Analytics, Wiley. 2. A. Rajaraman and J. Ullman, Mining of Massive Datasets, Cambridge University Press. 3. D. McCreary and A. Kelly, Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press. 4. A. Holmes, Hadoop in Practice, Manning Press, Dreamtech Press. 5. K. Chodorow and M. Dirolf, MongoDB: The Definitive Guide Paperback, O'Reilly.
Reference Books:	1. B. Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley. 2. V. Prajapati, Big Data Analytics with R and Hadoop, Paperback, Packt Publishing. 3. T. White, Hadoop: The Definitive Guide, O'Reilly. 4. S. Tiwari, Professional NoSQL, Paperback, Dreamtech Press.
Useful Links:	1. https://nptel.ac.in/courses/106/104/106104189/ 2. https://www.coursera.org/learn/big-data-essentials 3. https://www.coursera.org/learn/introduction-to-data-analytics 4. https://www.udemy.com/course/data-analysis-with-pandas/ 5. http://cse20-iiith.vlabs.ac.in/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UITDLC8021	Natural Language Processing	03	-	-	03

Prerequisites:	Fundamentals of Mathematics, Probability Theory, Data structure & Algorithms, Theory of Computer Science.
Course Objectives (COBs):	1. To understand Natural Language Processing and to learn how to apply basic algorithms in this field. 2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics. 3. To design and implement applications based on Natural Language Processing 4. To implement various language Models. 5. To design systems that uses Natural Language Processing techniques .
Couse Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe the components of Natural Language Processing. 2. Apply the word level analysis for morphemes, using finite automata, lemmatization, etc. 3. Explain approaches to syntax and linguistic phenomena with formal grammars. 4. Analyze the approaches to semantics for English sentence in natural language processing. 5. Apply the discourse generation in Natural Language Processing 6. Apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction, etc.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Natural Language Processing (NLP)	History of Natural Language Processing, Generic NLP System, Levels of NLP.	CO1	01	03
	Knowledge in Language Processing, Ambiguity in Natural Language, Stages in NLP.	CO1	01	
	Challenges of NLP, Applications of NLP.	CO1	01	
2. Word Level Analysis	Morphology Analysis – Survey of English Morphology, Inflectional Morphology & Derivational Morphology.	CO2	03	08
	Lemmatization, Regular Expression, Finite Automata, Finite State Transducers (FST), Morphological Parsing with FST, Lexicon Free FST Porter Stemmer.	CO2	03	
	N–Grams, N-Gram Language Model, N-Gram for Spelling Correction.	CO2	02	
3. Syntax Analysis	Part-of-Speech Tagging (POS)- Tag Set for English (Penn Treebank), Rule based POS Tagging, Stochastic POS Tagging.	CO3	03	08
	Issues - Multiple Tags & Words, Unknown Words.	CO3	01	
	Introduction to Context Free Grammar CFG.	CO3	01	

			CO	Hrs	
	Sequence Labelling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).	CO3	03	
4. Semantic Analysis	Lexical Semantics, Attachment for Fragment of English - Sentences, Noun Phrases, Verb Phrases, Prepositional Phrases.	CO4	03	09
	Relations Among Lexemes & Their Senses – Homonymy, Polysemy, Synonymy, Hyponymy.	CO4	03	
	WordNet, Robust Word Sense Disambiguation (WSD), Dictionary Based Approach.	CO4	03	
5. Pragmatics	Discourse Reference Resolution, Reference Phenomenon.	CO5	03	05
	Syntactic and Semantic Constraints on Co-reference.	CO5	02	
6. Applications and Case Studies	Implementation of Applications like Machine Translation, Information Retrieval, Question Answers System, Categorization, Summarization, Sentiment Analysis, Named Entity Recognition.	CO6	04	06
	Case Studies and Recent Researches in Natural Language Processing.	CO6	02	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. D. Jurafsky, J. Martin Speech and Language Processing, PHI. 2. T. Siddiqui and U. Tiwari, Natural Language Processing and Information Retrieval, Oxford University Press. 3. S. Bird, E. Klein, Natural Language Processing with Python, O'Reilly 4. C. Manning and H. Schutze, Foundations of Statistical Natural Language Processing, MIT Press.
Reference Books:	1. D. Bikel and I. Zitouni, Multilingual Natural Language Processing Applications, Pearson. 2. A. Clark, C. Fox, S. Lappin, The Handbook of Computational Linguistics and Natural Language Processing, Wiley. 3. T. Davies, The Book of R, No Starch Press. 4. N. Roux, S. Lubbe, A Step-by-Step Tutorial: An Introduction into R Application and Programming, BookBoon.
Useful Links:	1. https://www.coursera.org/learn/natural-language-processing-tensorflow 2. https://nptel.ac.in/courses/106/105/106105158 3. https://www.udemy.com/course/complete-nlp-course 4. https://onlinecourses.nptel.ac.in/noc19_cs56/preview
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UITDLC8022	Cloud Security	03	-	-	03

Prerequisites:	Computer Networks, Cryptography and Network Security, Cloud Computing.
Course Objectives (COBs):	1. To understand fundamental of cloud computing and security. 2. To describe the concepts of virtualization. 3. To understand cloud data security in different cloud computing services. 4. To understand importance of network security. 5. Aware about cloud security. 6. To discuss security risks within the cloud environment.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain different cloud computing services and security aspects involved therein. 2. Describe infrastructure security for cloud. 3. Analyze cloud data security. 4. Apply different components of cloud network security. 5. Apply cloud application security. 6. Discuss legal and compliance domain in cloud security.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Cloud Architecture	Introduction to Cloud Computing, NIST cloud Model, Introduction & Cloud Architecture, Cloud Essential Characteristics, - Cloud Service Models, Cloud Deployment Models.	CO1	03	04
	Benefits and Challenges of Cloud Computing, Overview of Virtualization.	CO1	01	
2. Infrastructure Security for Cloud	Cloud Infrastructure Components, Physical Environment, Networking, Computing, Virtualization, Management Plane Risks Associated with Cloud Infrastructure, Risk Assessment and Analysis, Virtualization Risks, Countermeasure Strategies.	CO2	04	08
	Design and Plan Security Controls, Physical and Environmental Protection, System and Communication Protection, Virtualization Systems Protection, Management of Identification, Authentication, and Authorization, Auditing, Disaster Recovery and Business Continuity Management Planning.	CO2	04	
3. Cloud Data Security	Cloud Data Lifecycle, Design and Implement Cloud Data Storage Architectures.	CO3	02	05
	Design and Apply Data Security Strategies, Data Discovery and Classification Techniques.	CO3	03	
4. Network	Differences from Traditional IT, Concepts and	CO4	03	07

Security	Definitions: Whitelists and Blacklists, DMZs, Proxies, Software-Defined Networking, Network Features, Virtualization, Overlay Networks and Encapsulation, Virtual Private Clouds, Network Address Translation, IPv6.			
	Sample Application: Encryption in Motion, Firewalls and Network Segmentation, Allowing Administrative Access, Web Application Firewalls and RASP, Anti-DDoS, Intrusion Detection and Prevention Systems, Egress Filtering, Data Loss Prevention, Introduction to AAA framework.	CO4	04	
5. Cloud Application Security	Awareness in Application Security, Cloud Software Assurance and Validation, Verified Secure Software, Understanding the Software Development Lifecycle, Applying the Secure Software Development Lifecycle.	CO5	05	07
	Cloud Application Architecture, Identity and Access Management (IAM) Solutions.	CO5	02	
6. Legal and Compliance Domain for Cloud Services	Legal Requirements and Unique Risks Within the Cloud Environment: International Legislation Conflicts, Appraisal of Legal Risks Specific to Cloud Computing, Legal Controls.	CO6	03	08
	Privacy Issues and Jurisdictional Variation: Audit Processes, Methodologies, and Required Adaption, Internal and External Audit Controls.	CO5	03	
	Impact of Requirements Programs by the Use of Cloud, Assurance Challenges of Virtualization and Cloud, Types of Audit Reports.	CO6	02	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	-	01	01
Text Books:	1. D. Carter, Certified Cloud Security Professional, McGraw Hill. 2. C. Dotson, Practical Cloud Security, O' Reilly Media,			
Reference Books:	1. M. Liyanage, A. Gurtov, M. Ylianttila, Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture, Wiley. 2. B. Sosinsky, Cloud Computing Bible, Wiley. 3. K. Jayaswal, J. Kallalurchi, D. J. Houde, Dr. D. Shah, Cloud Computing Black Book, Dreamtech Press. 4. T. Erl, R. Cope, A. Naserpour, Cloud Computing Design Patterns, Pearson.			
Useful Links:	1. https://www.coursera.org/learn/cloud-computing-security 2. https://www.udemy.com/course/azure-cloud-security 3. https://www.coursera.org/learn/cloud-security-basics 4. https://www.coursera.org/learn/cloud-computing-security 5. https://www.coursera.org/learn/cloud-application-security			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field			

	studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UITDLC8023	Computer Vision	03	-	-	03

Prerequisites:	Image Processing, Artificial Intelligence.
Course Objectives (COBs):	1. To review image processing techniques for computer vision. 2. To understand shape and region analysis. 3. To understand Hough Transform and its applications to detect lines, circles, ellipses. 4. To understand three-dimensional image analysis techniques. 5. To understand motion analysis. 6. To implement computer vision algorithms for real-world problems.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain and apply fundamental image processing techniques required for computer vision. 2. Analyze shapes and regions using suitable algorithms. 3. Apply Hough Transform for line, circle, and ellipse detections. 4. Describe and analyze 3D vision techniques. 5. Describe motion analysis. 6. Describe applications using computer vision techniques.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Image Processing Foundation	Review of Image Processing Techniques, Comparison between Image Processing and Computer Vision.	CO1	02	04
	Corner and Interest Point Detection, Texture And Co-Occurrence Matrix.	CO1	02	
2. Shapes and Regions	Binary Shape Analysis, Connectedness, Object Labelling and Counting, Size Filtering, Distance Functions, Skeletons and Thickening and Thinning, Hole Filling.	CO2	04	08
	Deformable Shape Analysis, Boundary Tracking Procedures, Active Contours, Shape Models and Shape Recognition, Centroidal Profiles, Handling Occlusion, Boundary Length Measures, Boundary Descriptors, Fourier Descriptors, Region Descriptors.	CO2	04	
3. Hough Transforms	Line Detection, Hough Transform (HT) for Line Detection, Foot-of-Normal Method, Line Localization, Line Fitting, RANSAC for Straight Line Detection, HT Based Circular Object Detection, Accurate Centre Location, Speed Problem, Ellipse Detection.	CO3	04	07
	Case study: Human Iris Location, Hole Detection, Generalized Hough Transform (GHT), Spatial Matched Filtering, GHT for Ellipse Detection, Object Location,	CO3	03	

			CO	Hrs	
	GHT for Feature Collation.				
4. 3D Vision	Methods For 3D Vision, Projection Schemes, Shape from Shading, Photometric Stereo, Shape from Texture, Shape from Focus.	CO4	04	08	
	Active Range Finding, Surface Representations, Point-Based Representation, Volumetric Representations, 3D Object Recognition, 3D Reconstruction, SIFT Algorithms.	CO4	04		
5. Introduction to Motion	Triangulation, Bundle Adjustment, Translational Alignment, Parametric Motion.	CO5	03	06	
	Spline-Based Motion, Optical Flow, Layered Motion.	CO5	03		
6. Applications and Case studies	Implementation of Application Like Face Recognition, Specific Examples on Surveillance, Foreground-Background Separation.	CO6	03	06	
	Human Tracking and Image and Video Occlusion, Human Gait Analysis, Locating Roadway, Road Markings, Identifying Road Signs.	CO6	03		
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01	

Text Books:	1. D. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson. 2. J. Solem, Programming Computer Vision with Python: Tools and algorithms for analyzing images, O'Reilly. 3. S. Prince, Computer Vision: Models, Learning, and Inference, Ambridge University Press. 4. M. Sonka, Image Processing Computer Vision, Elsevier.
Reference Books:	1. M. Nixon and A. Aquado, Feature Extraction & Image Processing for Computer Vision, Academic Press. 2. R. Jain, R. Kasturi, B. SchunckSahni, Machine Vision, Indo American Books. 3. R. Szeliski, Computer Vision: Algorithms and Applications, Springer.
Useful Links:	1. https://nptel.ac.in/courses/106/105/106105216/# 2. https://www.coursera.org/learn/computer-vision-basics
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UITDLC8024	Robotics Process Automation	03	-	-	03

Prerequisite:	Basic Programming skills.
Course Objectives (COBs):	1. To understand the process mining and need of RPA. 2. To understand basic concepts of Robotic Process Automation and to learn how to apply it. 3. To build on these concepts and introduces key RPA Design and Development strategies. 4. To understand tools and techniques for RPA solution. 5. To understand the methodologies specifically in context of UiPath products. 6. To design and develop a robot for a defined process.
Couse Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe basic programming concepts and its operation from RPA perspective. 2. Describe the basic concepts of Robotic Process Automation and its applications. 3. Develop familiarity and deep understanding of UiPath tools. 4. Apply automation to image, text, data tables, citrix, pdf, email, etc., execute exception handling and apply various functionalities of orchestrator. 5. Analyze opportunities of research in Artificial Intelligence with respect to RPA. 6. Design robots for business processes automation.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Programming Fundamentals	Understanding the application, Basic Web Concepts, Protocols, Email Clients, Data Structures, Data Tables, Algorithms, Software Processes, Software Design, SDLC, Scripting.	CO1	02	04
	Net Framework, .Net Fundamentals, XML, Control Structures and Functions, XML, HTML, CSS, Variables & Arguments.	CO1	02	
2. RPA Concepts	Fundamentals: History of Automation, Introduction to RPA, RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, Processes and Workloads that can be Automated, Types of Bots.	CO2	02	06
	Advanced Concepts: Standardization of Processes, RPA Development Methodologies, Difference from SDLC, Robotic Control Flow Architecture, RPA Business Case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and Emerging Ecosystem.	CO2	04	
3. UiPath Introduction & Exploration	Introduction: Installing UiPath Studio Community Edition, The User Interface, Keyboard Shortcuts about Updating, About Automation Projects.	CO3	04	10

			CO	Hrs	Total
		Introduction to Automation Debugging, Managing Activation Packages, Reusing Automations Library.	CO3	03	
		Installing the Chrome Extension, Variables, Control Flow, Data Manipulation, Recording and Advanced UI Interaction, Selectors.	CO3	03	
4.	UiPath Advanced Automation	Image, Text & Advanced Citrix Automation, Excel Data Tables & PDF, Email Automation, Debugging and Exception Handling, Project Organization.	CO4	05	09
		Orchestrator: Tenants, Authentication, Users, Roles, Robots, Environments, Queues & Transactions, Schedules.	CO4	04	
5.	Artificial Intelligence and RPA	Research on Application of RPA for Machine Learning.	CO5	02	05
		Agent Awareness, Natural Language Processing, Computer Vision, etc.	CO5	03	
6.	Applications and Case Studies	Case Studies and Projects on Applying RPA for Designing and Developing Robots for Real-World Problems – Financial Domain.	CO6	03	05
		Case Studies and Projects on Applying RPA for Designing and Developing Robots for Real-World Problems – Non-Financial Domain.	CO6	02	
ii.	Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. A. Tripathi, Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots with the leading RPA tool – UiPath, Packt Publishing. 2. K. Wibbenmeyer, The Simple Implementation Guide to Robotic Process Automation (RPA): How to Best Implement RPA in an Organization, iUniverse.
Reference Books:	1. S. Merianda, Robotic Process Automation Tools, Process Automation and Their Benefits: Understanding RPA and Intelligent Automation, Createspace. 2. M. Lacity, L. Willcocks, Robotic Process and Cognitive Automation: The Next Phase, Steve Brookes Publishing.
Useful Links:	1. https://www.udemy.com/topic/robotic-process-automation/ 2. https://www.uipath.com/rpa/academy
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UITDLC8031	Explainable AI and Responsible AI	03	-	-	03

Prerequisites:	Concepts of Artificial Intelligence.
Course Objectives (COBs):	1. To understand the need of explainable and responsible AI and introduce to the concept of Interpretability. 2. To design an Interpretable Models. 3. To use Model Agnostic Methods to achieve explain-ability. 4. To deduce explain-ability with the help of example-based explanations. 5. To achieve responsible AI with the help of ethical decision making. 6. To implement responsible AI using TensorFlow.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the need of explainable AI and responsible AI and the concept of Interpretability. 2. Implement an Interpretable Models. 3. Use Model Agnostic Methods to achieve explain-ability. 4. Infer explain-ability with the help of example-based explanations. 5. Explain responsible AI through the ethical decision making. 6. Implement responsible AI using TensorFlow.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction of Explainable AI	Need of explaining AI Models, Need of Responsible AI Introduction to Interpretability: Importance of Interpretability, Taxonomy of Interpretability Methods.	CO1	03	06
	Scope of Interpretability, Evaluation of Interpretability, Properties of Explanations, Human Friendly Explanations.	CO1	03	
2. Interpretable Models	Deriving Explanation from Linear Regression, Logistic Regression, GLM, GAM.	CO2	03	07
	Deriving Explanation from Decision Tree, Decision Rules, RuleFit.	CO2	02	
	Deriving Explanation from other Interpretable Models: Naïve Bayes Classifier, K-Nearest Neighbor.	CO2	02	
3. Model-Agnostic Methods	Partial Dependence Plot, Individual Conditional Expectation, Accumulated Local Effects Plot.	CO3	03	06
	Feature Interaction, Permutation Feature Importance, Global Surrogate, Local Surrogate (LIME) Scoped Rules (Anchors), Shapely Values, Eli5.	CO3	03	
4. Example Based Explanations	Counterfactual Explanations, Adversarial Examples.	CO4	03	07
	Prototypes and Criticism, Influential Instances.	CO4	04	
5. Ethical	Expectations in the Impact of AI.	CO5	03	06

Decision Making	Responsibility in AI, Responsible AI Challenges.	CO5	03	
6. Ensuring Responsible AI in Practice	Need of Responsible AI, Principles of Responsible AI.	CO6	03	07
	Designing Responsible AI, Responsible AI using TensorFlow.	CO6	04	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. C. Molnar, Interpretable Machine Learning, Creative Commons License, Lulu.com. 2. W. Samek, G. Montavon, A. Vedaldi, L. Hansen and K. Muller, Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Springer. 3. V. Dignum, Responsible Artifical Intelligence, Springer.
Reference Books:	1. D. Rothman, Hands-on Explainable AI (XAI) with Python, Packt Publishing. 2. P. Hall and R. Chowdhury, Responsible AI, O'Reilly.
Useful Links:	1. https://christophm.github.io/interpretable-ml-book/ 2. https://youtu.be/2nUiVJiVchw
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UITDLC8032	Edge Computing	03	-	-	03

Prerequisites:	Internet of Things, Artificial Intelligence Fundamentals.
Course Objectives (COBs):	1. To understand the core fundamentals of edge computing. 2. To learn about the key technologies and platforms for edge, fog computing. 3. To learn technical terms related to edge computing. 4. To discuss network slicing. 5. To discuss application of edge computing.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain computing paradigms and their features. 2. Describe middleware for edge & fog computing. 3. Explain importance of orchestration of network slices in 5G. 4. Analyze computing problems in edge & fog computing. 5. Describe optimization problem in edge & fog computing. 6. Apply the various edge computing applications.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. IoT and New Computing Paradigms	Introduction, Relevant Technologies, Fog and Edge Computing Completing the Cloud.	CO1	02	04
	Advantages of FEC, How FEC Achieves These Advantages, Hierarchy of Fog and Edge Computing.	CO1	02	
2. Integrating IoT, Fog, Cloud Infrastructures	Introduction, Analytical Models, Petri Net Models, Integer Linear Programming, other Approaches.	CO2	03	05
	Energy Consumption, Performance, Resource Consumption.	CO2	02	
3. Management & Orchestration of Network Slices in 5G	Networking Challenges in a Federated Edge Environment, Background, Network Slicing in 5G.	CO3	02	06
	Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Software-Defined Clouds, Edge and Fog Computing.	CO3	04	
4. Optimization Problems in Edge and Fog Computing	Background, The Case for Optimization in Fog Computing, Metrics.	CO4	02	06
	Optimization Opportunities along the Service Life Cycle.	CO4	02	
	Optimization Opportunities along the Fog Architecture, Optimization Techniques.	CO4	02	
5. Middleware for Edge and Fog Computing	Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures, System Model, Proposed Architecture Case Study Example.	CO52	03	06
	A Lightweight Container Middleware for Edge Cloud	CO2	03	

	Architectures, Clusters for Lightweight Edge Clouds, IoT Integration, Security Management for Edge Cloud Architectures.				
6. Edge Computing Application	Need of Environmental Care, IoT Data Analytics Techniques for: Fire Detection, Air Pollution Prediction, Earthquake Early Detection.	CO6	03		12
	Recent Research in IoT Data Analytics for Smart Environmental Care, Introduction and Need of Smart Travelling.	CO6	03		
	IoT Data Analytics techniques for: Self-Driving Cars, Travel Route Optimization, Smart Traffic Management.	CO6	03		
	Recent Research in IoT Data Analytics For Smart Travelling.	CO6	03		
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01	

Text Books:	1. A. Zomaya, A. Abbas and S. Khan, Fog Computing Theory & Practice, Wiley. 2. R. Buyya and S. Srirama, Fog, Edge Computing: Principles and Paradigms, Wiley. 3. T. Andrew, Distributed System Principal & Paradigm, PHI.
Reference Books:	1. N. Wilkins, Internet of Things: What You Need to Know about IoT, Big Data, etc., Independent Publishers. 2. H. Geng, Internet of Things and Data Analytics Handbook, Wiley.
Useful Links:	1. https://onlinecourses.nptel.ac.in/noc19_cs64/preview 2. https://www.udemy.com/course/edge-computing-a-complete-guide-on-computing-at-the-edge/ 3. https://nptel.ac.in/courses/106/104/106104182/ 4. https://www.coursera.org/lecture/iot-wireless-cloud-computing/5-10-edge-computing-pOK8T
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UITDLC8033	Augmented Reality - Virtual Reality	03	-	-	03

Prerequisites:	Fundamentals of Image Processing.
Course Objectives (COBs):	1. To present a review of current Virtual Reality (VR). 2. To provide a detailed analysis of the engineering, scientific and functional aspects of VR. 3. To familiarize with development of VR and AR applications. 4. To explain virtual environments and simulators.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe the various components in VR and its applications. 2. Explain different visual perception and concept of Rendering. 3. Interpret the software technologies used in VR and interactive techniques in VR. 4. Apply design guidelines for interactive techniques in VR. 5. Describe the AR technologies and various methods of AR. 6. Explain different tools and applications to design and develop AR/VR industrial applications and future technologies.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Virtual Reality and Virtual Environments	The Historical Development of VR, Fundamental Concept and Components of Virtual Reality, Hardware and Software Requirements for VR, Benefits of Virtual Reality, Primary Features and Present Development on Virtual Reality, Key Elements of Virtual Reality Experience, Virtual Environments.	CO1	04	08
	Virtual Reality Applications: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.	CO1	02	
	Multiple Models of Input and Output Interface in Virtual Reality: Input-Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -Visual /Auditory / Haptic Devices.	CO1	02	
2. Visual Perception & Rendering Visual Perception	Perception of Depth, Perception of Motion, Perception of Colour, Combining Sources of Information, Visual Rendering.	CO2	03	06
	Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates.	CO2	03	
3. Software Technologies	Database-World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and	CO3	02	06

		other Attributes.			
		VR Environment-VR Database, Tessellated Data, LODs, Cullers and Occludes, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface.	CO3	03	
		Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR Toolkits, SDKs.	CO3	01	
4.	Interactive Techniques in Virtual Reality	3D Interaction Techniques: 3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Design Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding.	CO4	03	07
		User Centred Wayfinding Support, Environment Centred Wayfinding Support, Evaluating Wayfinding Aids.	CO4	02	
		Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Multimodal System Control Techniques.	CO4	01	
		Case Study: Mixing System Control Methods, Symbolic Input Tasks, and Symbolic Input Techniques, Beyond Text and Number entry.	CO4	01	
5.	Introduction of Augmented Reality (AR)	Augmented and Mixed Reality, Taxonomy, Technology and Features of Augmented Reality, Difference between AR and VR.	CO5	02	06
		System Structure of Augmented Reality, Key Technology in AR, Challenges With AR, AR Systems and Functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Wireless Displays in Educational Augmented Reality Applications.	CO5	02	
		Mobile Projection Interfaces, Marker-Less Tracking for Augmented Reality, Enhancing Interactivity in AR Environments, Evaluating AR Systems, Marker based AR.	CO5	02	
6.	Applications and Development Tools	Designing and Developing 3D user Interfaces. Application of VR in Digital Entertainment: VR Technology in Film & TV Production, VR Technology in Physical Exercises and Games.	CO6	03	06
		Demonstration of Digital Entertainment by VR tools: Development Tools in VR.X3D Standard, Vega, MultiGen, Virtools, Blender, Unity and Maya.	CO6	03	
ii.	Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. A. Craig, W. Sherman and J. Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann. 2. D. Bowman, E. Kuijff, J. LaViola, I. Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley. 3. A. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann.
Reference Books:	1. B. Grigore and P. Coiffet, Virtual Reality Technology, Wiley - Inderscience. 2. W. Sherman and A. Craig, Understanding Virtual Reality: Interface, Application and Design, Morgan Kaufmann. 3. T. Parisi, Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, O'Reilly.
Useful Links:	1. https://www.coursera.org/learn/ar 2. https://nptel.ac.in/courses/106/106/106106138/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UITDLC8034	Optimization Techniques	03	-	-	03

Prerequisites:	Courses in Information Technology like Networks, Operating Systems, Artificial Intelligence.
Course Objectives (COBs):	1. To introduce various optimization techniques and its fundamental concepts. 2. To explain the concepts of Linear Programming and its application for optimization. 3. To explore Constrained and Unconstrained optimization techniques for solving and optimizing real-world problems. 4. To discuss modern optimization methods for solving real-world problems. 5. To discuss applications and suitability of various optimization Problems. 6. To provide knowledge of formulating optimization problem statements for real-world problems.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the fundamental concepts and techniques of optimization. 2. Apply the concepts of Linear Programming for optimization of real-world problem-solutions. 3. Apply Unconstrained optimization and Constrained optimization algorithms for real-world problem-solving. 4. Apply modern algorithms like ACO, PSO, GA, etc. for optimization. 5. Identify the appropriate optimization technique for the given problem and relate key concepts & applications of various optimization techniques. 6. Formulate appropriate objective functions and constraints to solve real-world optimization problems.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Optimization	Introduction to Optimization, Engineering Applications of Optimization, Statement of an Optimization Problem, Optimal Problem Formulation, Classification of Optimization Problems.	CO1, CO5, CO6	03	08
	Classical Optimization Techniques: Single variable Optimization, Constrained and Unconstrained Multivariable Optimization.	CO1	02	
	Optimum Design Concepts: Definition of Global and Local Optima, Optimality Criteria, Review of Basic Calculus Concepts, Global Optimality.	CO1	03	
2. Linear Programming	Introduction to Linear Programming, Formulation of Linear Programming Problems, Applications of Linear Programming in Engineering.	CO2, CO5, CO6	02	08
	Graphical Solution Method, Alternative or Multiple Optimal Solutions, Unbounded, Infeasible Solutions.	CO2	02	
	Maximization - Simplex Algorithm, Minimization -	CO2	02	

	Simplex Algorithm using Big-M Method.			
	Two Phase Method, Duality in Linear Programming, Integer Linear Programming.	CO2	02	
3. Unconstrained Optimization	Unconstrained Optimization Problems and Applications, Introduction to Optimization Algorithms for Solving Unconstrained Optimization Problems.	CO3, CO5, CO6	02	05
	Gradient-based Method: Cauchy's Steepest Descent Method, Newton's Method, Conjugate Gradient Method.	CO3	03	
4. Constrained Optimization	Constrained Optimization Problems and Applications, Introduction to Optimization Algorithms for Solving Constrained Optimization Problems.	CO3, CO5, CO6	02	05
	Direct Methods: Penalty Function Methods, Steepest Descent Method.	CO3	03	
5. Modern Methods of Optimization	Genetic Algorithms for Optimization of Real-World Problem-Solving.	CO4	02	08
	Ant Colony Optimization for Real-World Problem-Solving.	CO4	02	
	Neural-Network based Optimization for Real-World Problem-Solving.	CO4	02	
	Particle Swarm Optimization for Real-World Problem-Solving.	CO4	02	
6. Case Studies	Case Studies and Analysis of Suitable Methods for Optimization.	CO5, CO6	03	05
	Use of MATLAB to Solve Optimization Problems.	CO6	02	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01
Text Books:	1. S. Rao, Engineering Optimization, Theory & Practice, New Age International Publishers. 2. G. Hadley, Linear Programming, Narosa Publishing. 3. K. Deb, Optimization for Engineering Design: Algorithms and Examples, PHI. 4. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI.			
Reference Books:	1. D. Floreano and C. Mattiussi, Bio-inspired Artificial Intelligence, MIT Press. 2. K. Deb, Multi-Objective Optimization using Evolutionary Algorithms, Wiley. 3. D. Marco, S. Thomas, Ant Colony Optimization, PHI.			
Useful Links:	1. https://www.coursera.org/learn/optimization-for-decision-making 2. https://nptel.ac.in/courses/111/105/111105039/ 3. https://www.coursera.org/learn/calculus-and-optimization-for-machine-learning			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.			

Course Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UILC8041	Project Management	03	-	-	03

Course Objectives (COBs):	1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. 2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.				
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Apply selection criteria and select an appropriate project from different options. 2. Explain work break down structure for a project and develop a schedule based on it. 3. Identify opportunities and threats to the project and decide an approach to deal with them strategically. 4. Use earned value technique and determine & predict status of the project. 5. Elaborate lessons learned during project phases and document them for future reference 6. Inculcate leadership qualities and ethics.				

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Project Management Foundation	Definition of a Project, Project versus Operations, Necessity of Project Management, Triple Constraints, Project Life Cycles (Typical & Atypical) Project Phases and Stage Gate Process, Role of Project Manager.	CO1	03	05
	Role of Project Manager, Negotiations and Resolving Conflicts. Project Management in Various Organization Structures, PM Knowledge Areas as per Project Management Institute (PMI).	CO1	02	
2. Initiating Project	How to get a Project Started, Selecting Project Strategically, Project Selection Models (Numeric /Scoring Models and Non-numeric models), Project Portfolio Process.	CO2	03	06
	Project Portfolio Process, Project Sponsor and Creating Charter, Project Proposal, Effective Project Team, Stages of Team Development & Growth (Forming, Storming, Norming & Performing), Team Dynamics.	CO2	03	
3. Project Planning and Scheduling	Work Breakdown Structure (WBS) and Linear Responsibility Chart, Interface Co-ordination and Concurrent Engineering, Project Cost Estimation and Budgeting.	CO3	04	08
	Project Cost Estimation and Budgeting, Top Down and Bottoms Up Budgeting, Networking and Scheduling Techniques, PERT, CPM, Gnatt Chart.	CO3	03	
	Introduction to Project Management Information System.	CO3	01	

		CO		
4. Planning Project	Crashing Project Time, Resource Loading and Leveling, Goldratt's Critical Chain, Project Stakeholders and Communication Plan.	CO4	02	06
	Risk Management in Projects: Risk Management Planning, Risk Identification and Risk Register.	CO4	02	
	Qualitative and Quantitative Risk Assessment, Probability and Impact Matrix, Risk Response Strategies for Positive and Negative Risks.	CO4	02	
5. Executing, Monitoring and Controlling	Executing Projects: Planning Monitoring and Controlling Cycle, Information Needs and Reporting, Engaging with All Stakeholders of the Projects, Team Management, Communication and Project Meetings.	CO5	03	08
	Monitoring and Controlling Projects: Earned Value Management Techniques for Measuring Value of Work Completed, Using Milestones for Measurement, Change Requests and Scope Creep, Project Audit.	CO5	03	
	Project Contracting, Project Procurement Management, Contracting and Outsourcing.	CO5	02	
6. Project Leadership and Ethics and Closing the Projects	Project Leadership and Ethics: Introduction to project Leadership, Ethics in Projects, Multicultural and virtual projects.	CO6	03	06
	Closing the Project: Customer Acceptance, Reasons of Project Termination, Various types of Project Terminations (Extinction, Addition, Integration, Starvation), Process of Project Termination, Completing a Final Report, doing a Lesson Learned Analysis, Acknowledging Successes and Failures, Project Management Templates and Other Resources, Managing Without Authority, Areas of Further Study.	CO6	03	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. J. Meredith, S. Mantel, Project Management: A Managerial Approach, Wiley. 2. M. Gopalan, Project Management, Wiley.
Reference Books:	1. A Guide to Project Management Body of Knowledge, Project Management Institute, USA. 2. G. Clements, Project Management, Cengage Learning. 3. D. Lock, Project Management, Gower Publishing.
Useful Links:	1. https://nptel.ac.in/courses/110/104/110104073/ 2. https://www.coursera.org/search?query=project%20management
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UILC8042	Finance Management	03	-	-	03

Prerequisites:	Fundamentals of Engineering.
Course Objectives (COBs):	1. Overview of Indian financial system, instruments and market. 2. Basic concepts of value of money, returns and risks, corporate finance working capital and its management. 3. Knowledge about sources of finance, capital structure, dividend policy.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the Indian financial system and corporate finance. 2. Describe the take investment, finance as well as dividend decisions. 3. Analyze financial ratio in a corporate environment. 4. Describe the Capital Budgeting and Management. 5. Identify the sources and structure of capital finance. 6. Describe Dividend Policy Theories and Approaches.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Financial System	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System.	CO1	01	06
	Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments, Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.	CO1	02	
	Financial Markets: Meaning, Characteristics and Classification of Financial Markets.	CO1	01	
	Capital Market, Money Market and Foreign Currency Market.	CO1	02	
2. Concepts of Returns and Risks	Concepts of Returns: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio.	CO2	02	06
	Concepts of Risks: Measurement of Historical Risk, Expected Risk of a Single Security and a Two-security Portfolio.	CO2	02	
	Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due, Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due, Continuous Compounding and Continuous Discounting.	CO2	02	
3. Corporate Finance and Financial Ratio	Overview of Corporate Finance: Objectives of Corporate Finance, Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	CO3	03	09
	Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, Cash Flow Statement.	CO3	02	
	Purpose of Financial Ratio Analysis, Liquidity Ratios,	CO3	04	

	Efficiency or Activity Ratios, Profitability Ratios, Capital Structure Ratios, Stock Market Ratios, Limitations of Ratio Analysis.			
4. Capital Budgeting and Management	Capital Budgeting: Meaning and Importance of Capital Budgeting, Inputs for Capital Budgeting Decisions, Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period.	CO4	03	10
	Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR).	CO4	02	
	Working Capital Management: Concepts of Meaning Working Capital, Importance of Working Capital Management, Factors Affecting an Entity's Working Capital Needs.	CO4	03	
	Estimation of Working Capital Requirements, Management of Inventories, Management of Receivables, and Management of Cash and Marketable Securities.	CO4	02	
5. Sources of Finance and Capital Structure	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids, Mezzanine Finance, Sources of Short-Term Finance—Trade Credit, Bank Finance, Commercial Paper, Project Finance.	CO5	02	05
	Capital Structure: Factors Affecting an Entity's Capital Structure, Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach, Traditional Approach, Modigliani-Miller Approach.	CO5	02	
	Relation between Capital Structure and Corporate Value, Concept of Optimal Capital Structure.	CO5	01	
6. Dividend Policy	Dividend Policy: Meaning and Importance of Dividend Policy, Factors Affecting an Entity's Dividend Decision.	CO6	01	03
	Overview of Dividend Policy Theories and Approaches Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach.	CO6	02	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. E. Brigham, J. Houston, Fundamentals of Financial Management, Cengage Publications.
	2. R. Higgins, Analysis for Financial Management; Publishers: McGraw Hill.
Reference Books:	1. M. Khan, Indian Financial System, McGraw Hill Education.
	2. I. Pandey, Financial Management, S. Chand and Sons.
Useful Links:	1. https://edition.cnn.com/business
	2. https://www.cnbc.com/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks).
	• Duration of each Test shall be 45 minutes.
	• Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks.
	• Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UILC8043	Entrepreneurship Development and Management	03	-	-	03

Prerequisites:	Fundamentals of Technology.
Course Objectives (COBs):	1. To acquaint with entrepreneurship and management of business. 2. Understand Indian environment for entrepreneurship. 3. Idea of EDP, MSME. 4. Discuss the government plan for startup business. 5. Analyze the business risk. 6. Discuss the successful business stories.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain the concept of business plan and the role of money and capital markets in entrepreneurial development. 2. Analyze key regulations and legal aspects of entrepreneurship in India. 3. Explain government policies for startup. 4. Describe different government initiatives for startup. 5. Explain issues and problems faced by micro and small enterprises. 6. Describe growth strategies for small businesses.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Overview of Entrepreneurship	Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development.	CO1	01	04
	Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur.	CO1	01	
	Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing Information for Entrepreneurship.	CO1	02	
2. Business Plans and Importance of Capital to Entrepreneurship	Introduction: Preliminary and Marketing Plans, Management and Personnel.	CO2	02	09
	Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur.	CO2	03	
	Entrepreneurship and Business Development: Starting a New Business, Buying an Existing Business.	CO2	02	
	New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations.	CO2	02	
3. Entrepreneurship Development	Women's Entrepreneurship Development, Social Entrepreneurship-Role and Need, EDP Cell.	CO3	02	04

		CO		
	Role of Sustainability and Sustainable Development for SMEs, Case Studies, Exercises.	CO3	02	
4. Indian Environment for Entrepreneurship	Key Regulations and Legal Aspects, MSMED Act 2006 and its Implications, Schemes and Policies of the Ministry of MSME, Role and Responsibilities of various Government Organisations, Departments, Banks etc.	CO4	03	09
	Role of State Governments in Terms of Infrastructure Developments and Support etc.	CO4	04	
	Public Private Partnerships, National Skill Development Mission, Credit Guarantee Fund, PMEGP, Discussions, Group Exercises etc.	CO4	02	
5. Effective Management of Business	Issues and Problems Faced by Micro and Small Enterprises and Effective Management of M and S Enterprises.	CO5	04	08
	Risk Management, Credit Availability, Technology Innovation, Supply Chain Management, Linkage with Large Industries, Exercises, E-Marketing.	CO5	04	
6. Achieving Success in The Small Business	Stages of the Small Business Life Cycle, Four Types of Firm-Level Growth Strategies, Options – Harvesting or Closing Small Business Critical Success Factors of Small Business.	CO6	05	05
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01
Text Books:	1. P. Charantimath, Entrepreneurship Development- Small Business Enterprise, Pearson 2. R. Hisrich and M. Peters, Entrepreneurship, McGraw Hill. 3. D. Kuratko, Entrepreneurship- Principles and Practices, Thomson Publication			
Reference Books:	1. T. Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi. 2. Law and Practice Relating to Micro, Small and Medium Enterprises, Taxmann Publication. 3. L. Maddhurima, S. Shikah, Entrepreneurship, Excel Books. 4. R. Bansal, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad.			
Useful Links:	1. www.msme.gov.in/ 2. www.dcmesme.gov.in/ 3. www.msmetraining.gov.in/			
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.			
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.			

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UILC8044	Human Resource Management	03	-	-	03

Prerequisites:	
Course Objectives (COBs):	1. To introduce the students with basic concepts, techniques and practices of the human resource management. 2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations. 3. To familiarize the students about the latest developments, trends & different aspects of HRM. 4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe the concepts, aspects, techniques and practices of human resource management. 2. Describe the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective. 3. Apply the knowledge about the latest developments and trends in HRM. 4. Analyze the knowledge of Cross-cultural Leadership and Decision Making. 5. Apply the knowledge of behavioral skills learnt and integrate it with in interpersonal and intergroup environment emerging as future stable engineers and managers. 6. Apply the Labor Laws & Industrial Relations and various Act.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction Human Resource Management	Introduction to Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM Functions.	CO1	03	05
	Human Resource Development (HRD): Changing Role of HRM – Human Resource Planning, Technological Change, Restructuring and Rightsizing, Empowerment, TQM, Managing Ethical Issues.	CO1	02	
2. Organizational Behavior (OB)	Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary Issues.	CO2	02	07
	Personality: Meaning and Determinants of Personality, Personality Development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness.	CO2	01	
	Perception: Attitude and Value, Effect of Perception on Individual Decision-making, Attitude and Behavior.	CO2	01	

			CO		
		Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor).	CO2	01	
		Group Behaviour and Group Dynamics: Work groups Formal and Informal Groups and Stages of Group Development. Team Effectiveness: High Performing Teams, Team Roles, Cross Functional and Self-Directed Team, Case Study.	CO2	02	
3.	Organizational Structure & Design	Structure, Size, Technology, Environment of Organization, Organizational Roles & Conflicts: Concept of Roles, Role Dynamics, Role Conflicts and Stress.	CO3	02	06
		Leadership: Concepts and Skills of Leadership, Leadership and Managerial Roles, Leadership Styles and Contemporary Issues in Leadership.	CO3	02	
		Power and Politics: Sources and Uses of Power, Politics at Workplace, Tactics and Strategies.	CO3	02	
4.	Human Resource Planning	Recruitment and Selection Process, Job-Enrichment, Empowerment - Job-Satisfaction, employee morale.	CO4	01	05
		Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning.	CO4, CO6	02	
		Training & Development: Identification of Training Needs, Training Methods.	CO4	02	
5.	Emerging Trends in HR	Organizational Development, Business Process Re-Engineering (BPR), BPR as a Tool for Organizational Development, Managing Processes & Transformation in HR. Organizational Change, Culture, Environment.	CO4	03	06
		Cross Cultural Leadership and Decision Making: Cross Cultural Communication and Diversity at Work, Causes of Diversity, Managing Diversity with Special Reference to Handicapped, Women and Ageing People, Intra Company Cultural Difference in Employee Motivation.	CO5	03	
6.	Strategic HRM	HR & MIS: Need, Purpose, Objective and Role of Information System in HR, Applications in HRD in Various Industries (e.g. Manufacturing R&D, Public Transport, Hospitals, Hotels and Service Industries.	CO6	04	10
		Strategic HRM: Role of Strategic HRM in the Modern Business World, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making, Strategic Intent – Corporate Mission, Vision, Objectives and Goals	CO6	03	
		Labour Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labour Laws in India, Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act.	CO6	03	
ii.	Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. S. Robbins, Organizational Behavior, Pearson Education Limited. 2. V. Rao, Human Resource Management, Excel publishing. 3. K. Aswathapa, Human resource management: Text & cases.
Reference Books:	1. C. Mamoria and S. Gankar, Dynamics of Industrial Relations in India, Himalaya Publishing. 2. P. Rao, Essentials of Human Resource management and Industrial relations, Himalaya Publishing. 3. L. Mullins, Management & Organizational Behavior, Pearson.
Useful Links:	1. https://nptel.ac.in/courses/110/105/110105069/ 2. https://nptel.ac.in/courses/110/102/110102058/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UILC8045	Professional Ethics and Corporate Social Responsibility	03	-	-	03

Prerequisites:	Basic Communication & Ethics.
Course Objectives:	1. To understand professional ethics in business. 2. To recognized corporate social responsibility.
Course Outcomes:	Upon completion of the course, the learners will be able to: 1. Explain rights and duties of business. 2. Explain and understand the ethics in market and towards environment. 3. Solve the problems of consumers and job discrimination ethically. 4. Show corporate and social responsibility. 5. Distinguish different aspects of corporate social responsibility. 6. Explain global aspects of corporate social responsibility.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Professional Ethics and Business	The Nature of Business Ethics, Ethical Issues in Business, Moral Responsibility and Blame.	CO1	02	04
	Utilitarianism: Weighing Social Costs and Benefits, Rights and Duties of Business.	CO1	02	
2. Professional Ethics in the Marketplace and the Environment	Perfect Competition, Monopoly Competition, Oligopolistic Competition, Oligopolies and Public Policy.	CO2	04	08
	Dimensions of Pollution and Resource Depletion, Ethics of Pollution Control, Ethics of Conserving Depletable Resources.	CO2	04	
3. Professional Ethics of Consumer Protection and Job Discrimination	Markets and Consumer Protection, Contract View of Business Firm's Duties to Consumers, Due Care Theory, Advertising Ethics, Consumer Privacy.	CO3	03	06
	Nature of Job Discrimination, Extent of Discrimination, Reservation of Jobs.	CO3	03	
4. Introduction to Corporate Social Responsibility	Potential Business Benefits—Triple Bottom Line, Human Resources, Risk Management, Supplier Relations, Criticisms and Concerns.	CO4	03	05
	Nature of Business, Motives, Misdirection, Trajectory of Corporate Social Responsibility in India.	CO4	02	
5. Corporate Social Responsibility	Articulation of Gandhian Trusteeship.	CO5	02	08
	Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India.	CO5	03	
	Corporate Social Responsibility and Public-Private	CO5	03	

	Partnership (PPP) in India.				
6. Corporate Social Responsibility in Globalizing India	Corporate Social Responsibility Voluntary Guidelines 2009 issued by the Ministry of Corporate Affairs, Government of India.	CO6	02	08
	Legal Aspects of Corporate Social Responsibility - Companies Act, 2013.	CO6	03	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. A. Gupta, Business Ethics: Texts and Cases from the Indian Perspective, Springer. 2. A. Crane, D. Matten, L. Spence, Corporate Social Responsibility: Readings and Cases in a Global Context Routledge. 3. M. Velasque, Business Ethics: Concepts and Cases, Pearson. 4. B. Chakrabarty, Corporate Social Responsibility in India, Routledge.
Reference Books:	1. Wilson, Westport, The New Rules of Corporate Conduct: Rewriting the Social Charter, Quorum Books. 2. N. Tichy, A. McGill, L. Clair, Corporate Global Citizenship, Lexington Books. 3. D. Roy, L. Regelbrugge, D. Logan, D. Washington, Global Corporate Citizenship: Rational and Strategies, Hitachi Foundation. 4. J. Andriof and M. McIntosh, Perspectives on Corporate Citizenship, Greenleaf Publishing.
Useful Links:	1. http://www.business-ethics.com/ 2. http://www.bsr.org/index.cfm 3. http://www.csrwire.com 4. http://www.globalreporting.org/Home 5. http://www.accountability21.net/default.aspx?id=54 6. http://.www.wbcsd.org/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UILC8046	Research Methodology	03	-	-	03

Prerequisite:	Basic level knowledge of research.
Course Objectives (COBs):	1. To infer Research and Research Process 2. To acquaint students with identifying problems for research and develop research strategies 3. To familiarize students with the techniques of data collection, analysis of data and interpretation.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Describe about the methodologies in research. 2. Prepare a preliminary research design for projects in their subject matter areas. 3. Accurately collect, analyze and report data. 4. Present complex data or situations clearly. 5. Review and analyze research findings. 6. Summarize the different aspects and steps in conducting research.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction and Basic Research Concepts	Research – Definition, Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle, Research Methods vs. Methodology.	CO1	02	09
	Need of Research in Business and Social Sciences.	CO1	02	
	Objectives of Research.	CO1	01	
	Issues and Problems in Research.	CO1	02	
	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical.	CO1	02	
2. Types of Research	Basic Research.	CO1, CO2	01	07
	Applied Research.	CO1, CO2	01	
	Descriptive Research.	CO1, CO2	01	
	Analytical Research.	CO1, CO2	01	
	Empirical Research.	CO1, CO2	01	
	Qualitative and Quantitative Approaches.	CO1, CO2	02	
3. Research Design and	Research Design – Meaning, Types and Significance.	CO1	04	07
	Sample Design – Meaning and Significance Essentials	CO1	03	

Sample Design	of a Good Sampling Stages in Sample Design Sampling Methods/Techniques Sampling Errors.			
4. Research Methodology	Meaning of Research Methodology.	CO6	01	08
	Stages in Scientific Research Process: Identification and Selection of Research Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis.	CO6	04	
	Formulation of Research Design, Sample Design, Data Collection, Data Analysis, Hypothesis Testing and Interpretation of Data, Preparation of Research Report.	CO6	03	
5. Formulating Research Problem	Considerations: Relevance, Interest, Data Availability, Choice of Data, Analysis of Data, Generalization and Interpretation of Analysis.	CO4 CO5	04	04
6. Outcome of Research	Preparation of the Report on Conclusion Reached.	CO3	02	04
	Validity Testing & Ethical Issues.	CO3	01	
	Suggestions and Recommendation.	CO3	01	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. C. Kothari, Research Methodology-Methods and Techniques, Wiley.
Reference Books:	1. C. Dawson, Practical Research Methods, New Delhi, UBS Publishers Distributors. 2. R. Kumar, Research Methodology-A Step-by-Step Guide for Beginners, Pearson.
Useful Links:	https://libguides.newcastle.edu.au/researchmethods
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UILC8047	IPR and Patenting	03	-	-	03

Prerequisites:	Fundamentals of Technology.
Course Objectives (COBs):	1. To understand intellectual property rights protection system. 2. To promote the knowledge of intellectual property laws of india as well as international treaty procedures. 3. To get acquaintance with patent search and patent filing procedure and applications.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Explain Intellectual Property assets. 2. Explain the enforcements in IPR. 3. Investigate the issues in IPR 4. Apply intellectual property principal to real-time problems. 5. Illustrate basics of patent and explain the patent rules. 6. Apply the procedure of filing patent nationally and internationally.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Intellectual Property Rights (IPR)	Meaning of IPR, Different Category of IPR Instruments Patents, Trademarks, Copyrights, Industrial Designs, Plant Variety Protection, Geographical Indications, Transfer of Technology etc.	CO1	02	04
	Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical Aspects of IPR Laws, Need for IPR, IPR as an Instrument of Development.	CO1	02	
2. Enforcement of Intellectual Property Rights	Introduction, Magnitude of Problem, Factors that Create and Sustain Counterfeiting, Piracy.	CO2	01	07
	International Agreements, International Organizations (e.g. WIPO, WTO) Active in IPR Enforcement	CO2	01	
	Indian Scenario of IPR. Introduction, History of IPR in India, Overview of IP Laws in India, Indian IPR.	CO2	03	
	Administrative Machinery, Major International Treaties Signed by India, Procedure for Submitting patent and Enforcement of IPR at National Level etc.	CO2	02	
3. Emerging Issues in IPR	Challenges for IP in Digital Economy, E-Commerce, Human Genome.	CO3	01	02
	Biodiversity and Traditional Knowledge etc.	CO3	01	
4. Basics of Patents	Definition of Patents, Conditions of Patentability, Patentable and Non-Patentable Inventions, Types of Patent Applications.	CO3	03	09

	Process Patent and Product Patent, Precautions While Patenting, Patent Specification Patent Claims.	CO4	04	
	Disclosures and Non-disclosures, Patent rights and Infringement, Method of Getting a Patent.	CO4	02	
5. Patent Rules	Indian Patent Act, European Scenario, US Scenario, Australia Scenario.	CO5	04	08
	Japan Scenario, Chinese Scenario, Multilateral Treaties where India is a Member.	CO5	04	
6. Procedure for Filing a Patent	Legislation and Salient Features, Patent Search.	CO6	03	09
	Drafting and Filing Patent Applications, Processing of Patent, Patent Litigation.	CO6	03	
	Patent Publication etc., Time Frame and Cost, Patent Licensing, Patent Infringement. Patent Databases: Important Websites, Searching International Databases.	CO6	03	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. R. Adukia, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India. 2. K. Keayla, Patent System and Related Issues at a Glance, National Working Group on Patent Laws. 3. W. Cornish and L. Lewelyn, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right. 4. M. Mathew, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company. 5. K. Bansal and P. Bansal, Fundamentals of IPR for Engineers, BS Publications.
Reference Books:	1. N. Rathore, S. Mathur, P. Mathur and A. Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency. 2. V. Irish, Intellectual Property Rights for Engineers, IET. 3. Entrepreneurship Development and IPR Unit, BITS Pilani, A Manual on Intellectual Property Rights. 4. M. Kumar and M. Ali, Intellectual Property Rights, Serial Publications. 5. K. Bansal and P. Bansal, Fundamentals of IPR for Engineers, BS Publications. 6. R. Krishnan & S.Balasubramanian, Intellectual Property Rights, Excel Books.
Useful Links:	1. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-hs45/. 2. https://www.udemy.com/topic/intellectual-property/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UILC8048	Digital Business Management	03	-	-	03

Prerequisites:	Business Intelligence.
Course Objectives (COBs):	1. To familiarize with digital business concept. 2. To acquaint with E-commerce. 3. To give insights into E-business and its strategies.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Identify drivers of digital business. 2. Reviewing the concepts of E-commerce. 3. Devise the services of Digital Business. 4. Illustrate various techniques of managing E-business. 5. Illustrate various approaches of E-business Strategy. 6. Prepare E-business plan.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Digital Business	Introduction to Digital Business Introduction, Background and Current Status, E-market Places, Structures, Mechanisms, Economics and Impacts.	CO1	03	09
	Difference Between Physical and Digital Economy.	CO1	01	
	Drivers of Digital Business - Big Data & Analytics, Mobile, Cloud Computing, Social Media, BYOD, Internet of Things (Digitally Intelligent Machines/Services).	CO1	04	
	Opportunities and Challenges in Digital Business.	CO1	01	
2. Overview of E-Commerce	E-Commerce Meaning, Retailing in E-Commerce, Products and Services, Consumer Behaviour, Market Research and Advertisement.	CO2	01	06
	B2B E-Commerce Selling and Buying in Private E-Markets, Public B2B Exchanges and Support Services, E-Supply Chains, Collaborative Commerce, Intra Business EC and Corporate Portals.	CO2	02	
	Other E-C Models and Applications, Innovative EC System- from E-Government and Learning to C2C, Mobile Commerce and Pervasive Computing.	CO2	01	
	EC Strategy and Implementation-EC Strategy and Global EC, Economics and Justification of EC, Using Affiliate Marketing to Promote your Ecommerce Business, Launching a Successful Online Business and EC project, Legal, Ethics and Societal Impacts of EC.	CO2	02	
3. Digital Business	Digital Business Support Services: ERP as E-Business Backbone, Knowledge Tope Apps, Information and	CO3	03	06

Support Services	Referral System.			
	Application Development: Building Digital Business Applications and Infrastructure.	CO3	03	
4. Managing E-Business	Managing E-Business-Managing Knowledge, Management Skills for E-business, Managing Risks in E -Business.	CO4	02	06
	Security Threats to E-Business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols Over Public Networks: HTTP, SSL, Firewall as Security Control, and Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications.	CO4	04	
5. E-Business Strategy	E-Business Strategy-E-Business Strategic formulation-Analysis of Company's Internal and External Environment, Selection of Strategy.	CO5	02	04
	E-Business Strategy into Action, Challenges and E-Transition (Process of Digital Transformation).	CO5	02	
6. Materializing E-Business	Materializing E-Business: From Idea to Realization-Business Plan Preparation.	CO6	04	08
	Case Studies and Presentations.	CO6	04	
ii. Course Conclusion	Recap of Modules, Outcome, Applications, and Summarization.	-	01	01

Text Books:	1. E. Mishra and W. Sarwade, A Textbook on E-commerce, Neha Publishers & Distributors. 2. E. Coupey, Digital Business Concepts and Strategy, Pearson. 3. D. Chaffey, Digital Business and E-Commerce Management, Pearson. 4. Perspectives the Digital Enterprise – A Framework for Transformation, TCS Consulting Journal. 5. Measuring Digital Economy - A New Perspective, OECD Publishing.
Reference Books:	1. E. Awad, E-commerce from vision to fulfilment, PHI. 2. C. Combe Introduction to E-Business-Management and Strategy, Elsevier. 3. V. Morabito, Trend and Challenges in Digital Business Innovation, Springer. 4. P. Macmillan, Digital Business Discourse Erika Darics, Palgrave Macmillan. 5. E-Governance - Challenges and Opportunities, Proceedings in 2nd International Conference Theory and Practice of Electronic Governance.
Useful Links:	1. https://cio-wiki.org/wiki/E-Strategy 2. https://www.liferay.com/resources/l/digital-business 3. https://www.coursera.org/specializations/business-technology-managment
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. • Duration of End Semester Exam shall be for 03 Hours.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
1UILC8049	Environmental Management	03	-	-	03

Prerequisite:	General Awareness of environment and factors affecting the environment
Course Objectives (COBs):	1. To learn and identify environmental issues relevant to India and global concerns. 2. To learn concepts of ecology. 3. To familiarize learners about environment related legislations. 4. To learn to protect and sustain our natural resources of land, water, air, and vegetation.
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Interpret the concept of environmental management. 2. Learn the ecosystem and interdependence, food chain etc. and interpret environment related legislations. 3. Identify the environmental issues important to India. 4. Learn the regulating policies of Government in environmental management. 5. Identify solutions to protect the environment from pollution. 6. Examine the quality environmental management.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction and Definition of Environment	Significance of Environment Management for Contemporary Managers.	CO1	02	10
	Career Opportunities.	CO1	01	
	Environmental Issues Relevant to India.	CO1	02	
	Sustainable Development.	CO1	03	
	The Energy Scenario.	CO1	02	
2. Global Environmental Concerns	Global Warming.	CO3	01	06
	Acid Rain.	CO3	01	
	Ozone Depletion.	CO3	01	
	Hazardous Waste and Endangered Life-Species.	CO3, CO5	01	
	Loss of Biodiversity.	CO3, CO5	01	
	Industrial, Man-Made, Disasters, Atomic, Biomedical Hazards etc.	CO3, CO5	01	
3. Concepts of Ecology	Ecosystems and Interdependence between Living Organisms.	CO2	01	05
	Habitats and Limiting Factors.	CO2	01	
	Carrying Capacity.	CO2	01	
	Food Chain.	CO2	01	
	Ecology.	CO2	01	

			CO	Hrs	
4.	Scope of Environment Management	Scope of Environment Management.	CO1	03	10
		Role and Functions of Government as a Planning and Regulating Agency.	CO1, CO4	03	
		Environment Quality Management and Corporate Environmental Responsibility.	CO1, CO4	04	
5.	Quality Environmental Management	Total Quality Environmental Management.	CO6	02	05
		ISO-14000.	CO6	02	
		EMS Certification.	CO6	01	
6.	General Overview of Major Legislations	Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act.	CO4, CO3	03	03
ii.	Course Conclusion	Recap of Modules, Outcome, Applications and Summarization.	-	01	01

Text Books:	1. C. Barrow, Environmental Management: Principles and Practice, Routledge Publishers. 2. J. Lovett and D. Ockwell, A Handbook of Environmental Management, Edward Elgar Publishing. 3. V. Ramachandra and V. Kulkarni, Environmental Management, TERI Press.
Reference Books:	1. Indian Standard Environmental Management Systems Requirements with Guidance for Use, Bureau of Indian Standards. 2. M. Theodore, L. Theodore, Introduction to Environmental Management, CRC. 3. M. Hussain, Environment and Ecology, Access Publishing. 4. S. Chary and V. Vyasulu, Environment Management: An Indian Perspective, Maclillan India.
Useful Links:	1. https://libguides.library.qut.edu.au/EVB302_Environmental_pollution/links 2. https://www.epd.gov.hk/epd/epic/english/epichome.html 3. http://www.ecovacservices.com/Useful-Links-6-5511.html
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 15 Marks, Test 2: 15 Marks, Internal Assessment: 10 Marks). • Duration of each Test shall be 45 minutes. • Internal Assessment shall be based on during-the-lecture quiz / assignments / field studies / course-specific activity.
End Semester Examination (ESE):	• End Semester Exam shall be conducted for Total 60 Marks. Duration of End Semester Exam shall be for 03 Hours.

Lab Code	Course Name	Credits			
		TH	P	TUT	Total
1UITL801	Big Data Analytics Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Virtual Machine, Hadoop Frame work, NOSQL and MongoDb Compilers.
Lab Prerequisites:	Java, Python.
Lab Objectives (LOBs):	1. To introduce the tools required to manage and analyze big data like Hadoop, NoSql. 2. To impart knowledge of Map, reduce paradigm to solve complex problems Map-Reduce. 3. To introduce several new algorithms for big data mining like classification, clustering and finding frequent patterns. 4. To introduce to the students several types of big data like social media, web graphs and data streams. 5. To identify various sources of big data. 6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Demonstrate an ability to use Big Data Frameworks like Hadoop and Apache Spark in data bricks. 2. Develop an application using tools like Hive, Pig, NOSQL and MongoDB for Big Data Applications. 3. Develop a scalable algorithm for large Datasets using Map Reduce techniques. 4. Implement algorithms for Clustering, Classifying and finding associations in Big Data. 5. Implement algorithms to analyze Big data like streams, Web Graphs and Social Media data and construct recommendation systems. 6. Apply the knowledge of Big Data gained to fully develop a BDA applications for real life applications.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	Case study and Installation of Hadoop Ecosystem.	LO1	02
2	Implementation of HDFS Commands.	LO1	02
3	Creation of Hadoop Cluster.	LO2	02
4	Implementation using NoSQL: a. Installation of NoSQL Database: MongoDB. b. Implementation of NoSQL queries on MongoDB.	LO2	02
5	Implementation of word count program using MapReduce technique.	LO3	02
6	Implement Matrix Multiplication and Joins using MapReduce technique.	LO3	02
7	Implement Frequent Item Set using MapReduce technique.	LO4	02
8	Implement Classification using MapReduce technique.	LO4	02
9	Implement PageRank using MapReduce technique.	LO5	02
10	Implementation of Data Processing and Analytics using Databricks.	LO1,	04

		LO6	
11	Mini Project OR Implementation of Big Data Applications (Analytics on data streams/ Social Network Analysis Algorithms / Web Graph Algorithms/ Recommendation Engines).	LO5, LO6	04

Virtual Lab Links:	http://cse20-iiith.vlabs.ac.in/
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of theory course "Big Data Analytics" and "Big Data Analytics Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 15 Marks, Attendance in Lectures and Lab Sessions: 05 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work is based on satisfactory performance of laboratory work and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral 10 Marks).

Lab Code	Course Name	Credits			
		TH	P	TUT	Total
1UITL805	DevOps Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Linux / Windows Operating System, Virtual Box/VMware.
Other Requirements:	Internet Connection for Installing Additional Packages, GitHub account, DockerHub Account.
Prerequisites:	Operating System, Linux Administration, Java / Web Application Programming, and Software Engineering, YAML Scripting.
Lab Objectives (LOBs):	1. To understand DevOps practices which aims to simplify Software Development Life Cycle. 2. To be aware of different Version Control tools like GIT, CVS or Mercurial. 3. To Integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment. 4. To be familiarized with selenium tool, which is used for continuous testing of applications deployed. 5. To Use Docker to Build, Ship and Manage Applications Using Containerization. 6. Learn Serverless Computing & Microservice.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Use Version Control for developing application. 2. Use Jenkins to Build and deploy Software Applications on production environment. 3. Perform Automated Testing. 4. Build Containerized Application. 5. Use Software Configuration, Provisioning & Monitoring Tools. 6. Build Application using of Serverless Computing & Microservice.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	**-**	02
1	Create a Sample Web Page & Upload Source Code on GitLab & Perform different Git Operation. (Study of DevOps, Benefits of DevOps, Version Control System / Source Code Management, Install GitLab and Create a GitHub, Account, Get Familiar with the Concept of Minimum Viable Product (MVP) & Cross-Functional Teams, Git Cheat-Sheet).	LO1	02
2	Create a Jenkins CI/CD pipeline with GitLab Integration Pipeline. (Installation of Gitlab, Introduction to CI/CD, Learn different Stage of Development Commit, Build, Test, Deploy, Installation of GitLab).	LO1, LO2	02
3	Create Jenkins Pipeline for Building Python Project. (Jenkins Master-Slave Architecture and Scale Your Jenkins Standalone Implementation by Implementing Slave Nodes).	LO1, LO2	02
4	Install & Configure Docker. (Docker Architecture and Container Life Cycle, Execute Docker Commands to Manage Images and Interact with Containers, Container and Various Operations	LO1, LO3	02

	Performed on it, Container Life Cycle, Understanding Images and Containers, Create and Implement Docker Images using Docker file, Container Lifecycle and Working with Containers).		
5	Build Docker Image for deploying any Web/Python/Java Application.	LO1, LO3	02
6	Implementation using Ansible: a. Install & Configure Ansible. b. Install LAMP/MEAN using Ansible Playbook. (Study about need of Ansible, YAML Syntax, Playbook).	LO1, LO3, LO4	02
7	Install & Configure Container Orchestration Tools Kubernetes. (Kubernetes Cluster Architecture, Kubctl Commands, Pod Creation).	LO1, LO5	02
8	Deployment of any Web Application on Kubernetes.	LO1, LO5	02
9	To Perform Port, Service Monitoring, Windows/Linux Server Monitoring using Nagios.	LO1, LO6	02
10	Write AWS Lambda Function to Build Python/Java/HTML Application.	LO1, LO6	02
11	Use of AWS/AZURE/GCP Platform to create CI/CD Pipeline.	LO1, LO6	02
12	Create any Microservice using Python/Go Language. (Study of Concepts, Architecture, and Importance of Microservice)	LO1, LO6	02
13	Perform Automation Testing using Selenium. (Introduction to Selenium, Selenium Architecture, Selenium Web Driver).	LO1, LO6	02

Virtual Lab Links:	http://vlabs.iitkgp.ernet.in/se/
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of "DevOps Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 15 Marks, Attendance in Lectures and Lab Sessions: 05 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work is based on satisfactory performance of laboratory work and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral 10 Marks).

Lab Code	Course Name	Credits			
		TH	P	TUT	Total
1UITDLL8021	Natural Language Processing Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Python 3.6 or higher, Jupyter Notebook, Python IDEs.
Lab Prerequisites:	Python Programming Language.
Lab Objectives (LOBs):	1. To formulate the problems and solutions of NLP and establish their relation to linguistics and statistics. 2. To implement various language Models. 3. To implement various, analyze NLP algorithms. 4. To design systems that uses NLP techniques. 5. To train and evaluate empirical NLP systems.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Implement the basic language preprocessing. 2. Model linguistic phenomena with formal grammar. 3. Implement, and analyze NLP algorithms. 4. Implement approaches to syntax, semantics and discourse generation in natural language processing. 5. Apply NLP techniques to design real world NLP applications, such as machine translation, text categorization, text summarization, information extraction, etc. 6. Implement proper experimental methodology for training and evaluating empirical NLP systems.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites	-	02
1	Python IDE installation and environment setup, NLTK, Numpy, Matplotlib etc packages installation.	LO1	02
2	Implementation of basic functions of NLTK, Spacy, Word2Vec, etc.	LO1	02
3	Pre-processing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming).	LO1, LO6	02
4	Analyzing morphological features of a word and generation of word forms from root and suffix information.	LO2, LO6	02
5	Implementation of the morphology of a word by the use of Add-Delete table.	LO2, LO6	02
6	Implementation of bigrams from a given corpus and calculate probability of a sentence.	LO3, LO6	02
7	Implementation of add-one smoothing on sparse bigram table.	LO3, LO6	02
8	Calculation of emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.	LO4, LO6	02
9	Finding POS tags of words in a sentence.	LO4, LO6	02

10	Implementation of chunking and get familiar with the basic chunk tagset.	LO4, LO6	02
11	Selection of proper features for training a model and size of training corpus in learning how to do chunking.	LO4, LO6	02
12	Implementation of any applications like Machine translation, Information retrieval, Question answers system, Categorization, Summarization; Sentiment analysis, Named Entity Recognition.	LO5, LO6	04

Virtual Lab Links:	https://nlp-iiith.vlabs.ac.in/Introduction.html?domain=ComputerScience
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of theory of the course "Natural Language Processing" and "Natural Language Processing Lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 15 Marks, Attendance in Lectures and Lab Sessions: 05 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work is based on satisfactory performance of laboratory work and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UITDLL8022	Cloud Security Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Docker, EC2, Nagios, SonarQube, CISCO packer tracer, Virtual Machine, Ingress & Egress, Q-Radar
Prerequisites:	Computer Network, Operating System, Java Programming.
Lab Objectives (LOBs):	1. To understand and demonstrate infrastructure as service. 2. To perform network analysis. 3. To explain access control and authentication in cloud. 4. To operate code analysis in CI/CD. 5. To study Analyze different tools in cloud for real-time case studies.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Demonstrate infrastructure as service. 2. Demonstrate Network analysis and analyze cloud firewall. 3. Implement authentication in cloud. 4. Operate code analysis in CI/CD. 5. Analyze Q-Radar for real-time case studies. 6. Organize cloud infrastructure using Terraform.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites	-	02
1	Design a web page and deploy it on EC2 instance.	LO1	02
2	Monitor Docker Metrics and generate report based on analysis.	LO2	02
3	Perform Network Analysis using Nagios.	LO2	04
4	Deploy Web Application on Docker & Identify Vulnerabilities.	LO4	02
5	Perform Static Analysis of Code using SonarQube.	LO4	02
6	Exploring Authentication and access control using AAA framework	LO3	02
7	Create a CI/CD pipeline and implement Role-Based Authentication.	LO3, LO4	04
8	Perform Authentication on Virtual Machine using Ingress & Egress.	LO3	02
9	Case Study on Q-Radar SIEM.	LO5	02
10	Case Study on Cloud firewall.	LO2	02
11	Use Terraform to launch virtual machine.	LO6	02

Virtual Lab Links:	1. http://cse29 iiith.vlabs.ac.in/exp10/ 2. https://www.sans.org/webcasts/continuous-security-monitoring-active-defense-cloud-107585 3. https://www.jblearning.com/cybersecurity/labs 4. https://towardsdatascience.com/ci-cd-logical-and-practical-approach-to-build-four-step-pipeline-on-aws-3f54183068ec
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of theory of the course "Cloud Security" and "Cloud Security Lab".

	• Term work evaluation shall be for Total 25 Marks (Experiments: 15 Marks, Attendance in Lectures and Lab Sessions: 05 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work is based on satisfactory performance of laboratory work and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UITDLL8023	Computer Vision Lab	-	01	-	01

Hardware Requirements:	PC i3 Processor or above.
Software Requirements:	MATLAB / Open CV, Python.
Prerequisites:	Computer Graphics, Image Processing.
Lab Objectives (LOBs):	1. To review image processing techniques for computer vision. 2. To describe shape and region analysis. 3. To explain Hough Transform and its applications to Edge linking lines, circles, ellipses. 4. To describe three-dimensional image analysis techniques. 5. To describe motion analysis. 6. To implement computer vision algorithms for real-world problems.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Implement fundamental image processing techniques required for computer vision. 2. Analyze shapes and regions using suitable algorithms. 3. Apply Hough Transform for edge linking of line, circle and ellipse detections. 4. Apply and analyze 3D vision techniques. 5. Implement motion analysis. 6. Develop applications using computer vision techniques and Team work and communication skills.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites	-	02
1	Implementation of Image Processing fundamentals: Corner and Interest Point Detection	LO1	02
2	Implementation and Processing of Shapes and Regions: a. Skeletons and Thickening and Thinning b. Boundary Detection Procedures.	LO2	02
3	Implementation of Line Detection through Hough Transforms or edge linking to Hough Transforms.	LO3	02
4	Implementation of RANSAC algorithm.	LO3	02
5	Implementation of 3D Vision Methods and conversion of 2D into 3D vision.	LO4	02
6	Implementation of applying texture to 3D image or vision.	LO4	02
7	Implementation of SIFT algorithm.	LO4	02
8	Implementation to measure distance between two Human in motion.	LO5	02
9	Implementation of spline-based motion algorithm.	LO5	02
10	Implementation of face recognition.	LO6	04
11	Application Development: a. Surveillance b. Road Markings c. Object Location d. Hole Detection	LO6	04

Virtual Lab Links:	https://cse19-iiith.vlabs.ac.in/
Term Work (TW):	• Term work should consist of a minimum of 08 experiments. • Journal must include at least 02 assignments on content of theory of the course "Computer Vision" and "Computer Vision lab". • Term work evaluation shall be for Total 25 Marks (Experiments: 15 Marks, Attendance in Lectures and Lab Sessions: 05 Marks, Assignments: 05 Marks). • The final certification and acceptance of term work is based on satisfactory performance of laboratory work and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

Lab Code	Course Name	Credits			
		TH	**P**	**TUT**	**Total**
1UITDLL8024	RPA Lab	-	01	-	01

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	Windows Desktop OS, Citrix environment-XenApp v6.5 or greater, XenDesktop v7.0 or greater, .NET Framework, Web Browsers, Microsoft Office (for projects created in the StudioX profile)
Lab Prerequisite:	Basic Programming Skills.
Lab Objectives (LOBs):	1. To understand knowledge of basic concepts of Robotic Process Automation. 2. To learn the importance, different Products of UiPath. 3. To understand the RPA Design and Development strategies and methodologies specifically in context of UiPath products.
Lab Outcomes (LOs):	Upon completion of the course, the learners will be able to: 1. Install RPA packages and UiPath Studio**.** 2. Create, remove and manage variables, arguments and control flow. 3. Implement the data manipulation and capture the recording and types of recordings. 4. Implement the automation business process with scrapping, invoice automation, automated buying on E commerce, sales order automation, etc. 5. Use selectors to extract and take action on controls. 6. Apply the concepts of Image and text, Excel and Data tables and Email automation etc.

Lab No.	Experiment Title	LOs Mapped	Hours
0	Lab Prerequisites.	-	02
1	Installation of RPA Packages: UiPath – Basics, Installation and Understanding User Interface Components.	LO1	02
2	Hands-on Variables, data types and arguments.	LO2	02
3	Hands-on Control flow: a. Conditional Statements, b. Iteration.	LO2	02
4	Hands-on Data Manipulation - scalar variables, collections, tables, text manipulation.	LO3	04
5	Implementation of Recording - Basic, Desktop, and Web applications.	LO3	02
6	Implementation of Scrapping: a. Screen scrapping, b. Data scrapping.	LO4	04
7	Implementation of Invoice and Sales Order Automation for E-Commerce.	LO4	02
8	Implementation of various selectors available in UiPath to extract and take action on controls.	LO5	02
9	Implementation of Image and Text automation.	LO6	02
10	Implementation of Excel and Data tables Automation.	LO6	02
11	Implementation of Email Automation.	LO6	02

Useful Learning Links:	1. https://www.uipath.com/ 2. https://www.ibm.com/in-en/products/robotic-process-automation
Term Work (TW):	• Term work should consist of a minimum of 08 experiments • Journal must include at least 02 assignments on content of theory course "Robotics Process Automation" and "RPA Lab"

	• Term work evaluation shall be for Total 25 Marks (Experiments: 15 Marks, Attendance in Lectures and Lab Sessions: 05 Marks, Assignments: 05 Marks).
	• The final certification and acceptance of term work is based on satisfactory performance of laboratory work and minimum passing marks in term work evaluation.
Practical & Oral (P&O):	P&O examination will be based on the experiment list for Total 25 Marks (Practical: 15 Marks and Oral: 10 Marks).

PBL Course Code	PBL Course Name	Credits			
		TH	P	TUT	Total
1UITPR86	PBL – Major Project B	-	06	-	06

Hardware Requirements:	PC with i3 Processor or above.
Software Requirements:	JDK 8 or above, Python, DevOps Tools, Web/Android Development Platforms.
Prerequisites:	Programming skills, IT Engineering Core Concepts.
PBL Objectives (PROBs):	1. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used. 2. To practice the process of identifying the needs and converting it into a problem statement. 3. To apply engineering knowledge and modern tools/technologies for deriving solutions to the real-world problems. 4. To inculcate the process of self-learning and research. 5. To be acquainted with solving the problem in a group. 6. To improve communication, management and report-writing skills of the students.
PBL Outcomes (PROs):	Upon completion of the course, the learners will be able to: 1. Identify societal / research needs, formulate problem statements, review research literature, and analyze complex engineering problems. 2. Design suitable solutions for the problems including scope, objectives, timeline, system flow, user interface, algorithms, etc. 3. Gather, analyze, and interpret data and apply knowledge of engineering fundamentals, modern tools / technologies for development of solutions. 4. Analyze sustainability and scalability of the developed solution and its impact in terms of environmental, societal, safety, legal, cultural, health, etc. aspects. 5. Apply ethical principles, excel in written and oral communication, and engage in independent and life-long learning. 6. Interact efficiently and effectively as an individual with the team members or leader for timely and professional management of projects.
Guidelines for Project-Based Learning (PBL):	1. Students should continue and complete the same problem statement started in 7th semester – Major Project A. 2. Students have to develop an IT Application / Service with a proper user interface using any suitable technology. 3. The project should be hosted (at least temporarily) and added to Git. Extensive testing for all use cases is expected. 4. A log book is to be prepared by each group, wherein the group can record weekly work progress and the faculty guide can verify and record notes/comments. 5. Faculty Guide may give inputs to students during major project activity; however, focus shall be on self-learning. 6. The solution is to be validated with proper justification and report (black book) is to be compiled in standard format of the Department. 7. In this semester, students are expected to complete building of working prototype, and perform testing and validation of results based on work completed in an earlier semester. Three reviews will be conducted: First review shall be based on readiness of building working prototypes to be conducted, second shall be for evaluation of work progress and

	technical paper written, and third review shall be based on poster presentation cum demonstration of working model — in last month of the said semester.
	8. Major Project shall be assessed based on some of the following criteria, as applicable:
	• Quality of survey/need identification
	• Clarity of Problem definition based on need.
	• Innovativeness in solutions
	• Feasibility of proposed problem solutions and selection of best solution
	• Cost effectiveness
	• Societal impact
	• Full functioning of working model as per stated requirements
	• Effective use of skill sets
	• Effective use of standard engineering norms
	• Contribution of an individual as member or leader
	• Clarity in written and oral communication
	• Attainment of Course Outcomes
	9. Major Projects shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably approved by the Board of Studies.
	10. All groups have to submit a Technical Paper based on the work done for publication in Conferences / International journals — preferably indexed in Scopus / Web of Science). The papers should have less than 10% plagiarism — checked through Urkund software.
	11. Students should participate in Project Competitions at State, National, and International level like Smart India Hackathon, National Innovation Contest, etc.
	12. Students should attempt for filling a Patent / Copyright from the work done.
	13. Students shall be motivated to establish a start-up based on the project idea.
Useful Learning Links:	1. http://nlp-iiith.vlabs.ac.in/ 2. https://www.coursera.org/specializations/project-management 3. https://nptel.ac.in/courses/110/104/110104073/ 4. https://www.coursera.org/specializations/website-development 5. https://www.udemy.com/course/fullscreen-background-video-for-a-website-dreamweaver-premiere-pro/

Term Work (TW):	• Term Work evaluation shall be for Total 50 Marks.
	 • Total 35 out of 50 Marks shall be from the following evaluation:
	   o Presentation in Review 1: 10 Marks
	   o Presentation in Review 2: 10 Marks
	   o Presentation in Review 3: 10 Marks
	   o Project Report and Log Book: 10 Marks
	 • And, total 15 out of 50 Marks will be based on:
	   o Students' active participation in Technology learning.
	   o Presenting / showcasing learned Technology uses in Social / Outreach / Extension Activities / Events / Idea or Project Competitions / Trainings / Internships / Development Programs, Technical Paper Preparations and Presentations / etc.
	 • Following rubrics may be used for evaluation:

Assessment Rubrics	Not Qualifying	Poor	Acceptable	Good	Excellent
Grades	0	2	3	4	5
Contribution in a Team	No Participation.	Piggybacking on friends.	Participates but no real contribution.	Whole hearted participation, very good team member, resolves conflict / Team leader who fails to resolve conflict.	Good initiative, excellent team leader, Maintains the team dynamics.
Participation in Competitions like PBL Sessions, SIH, Project Competitions, etc.	No Participation.	Participates as a team member but no real contribution.	Participation in 1-2 Events only.	Whole hearted participation in more than few technical events.	Participates and wins in technical events.
Conference / Journal Publication Filling Patent, Creation of Product & Licencing, Start-up	No Publication / Participation.	Participates / Publishes as a team member but no real contribution.	Attempts Publications, Patents, Copyrights, etc.	Submits Papers, Patent Applications, Copyrights, etc. with complete dedication.	Publishes Papers, Patents, etc. / Establishes Start-up, etc.

Practical & Oral (P&O):	P&O examination will be of Total 100 Marks and shall be based on the Project Demonstration, Presentation, and Report.

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