

AUTONOMOUS

SYLLABUS

VII & VIII Semesters

B.E in Information Science & Engineering

2023

MITE



Invent Solutions

**MANGALORE INSTITUTE OF
TECHNOLOGY & ENGINEERING**



MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Institute Vision

*“To attain perfection in providing **Globally Competitive Quality Education** to all our Students and also benefit the global community by using our strength in **Research and Development**”*

Institute Mission

*“To establish world class educational institutions in their respective domains, which shall be **Centers of Excellence** in their stated and implied sense. To achieve this objective we dedicate ourselves to meet the challenges of becoming **Visionary and Realistic, Sensitive and Demanding, Innovative and Practical, Theoretical and Pragmatic; ALL at the same time**”*

Department Vision

“To nurture skilled and quality professionals with a strong technical background who will excel in the dynamically changing world of information technology”

Department Mission

- *To provide quality technical education through innovative teaching methods.*
- *To outfit the students with strong programming and problem solving skills.*
- *To foster the students to meet the global competency in the information technology industry.*
- *To provide the best infrastructure and environment to its students and faculty members, to achieve excellence in technical education and research.*

Program Educational Objectives (PEOs)

- *The graduates will be quality professionals, having sound knowledge in mathematical, scientific and Information technologies to analyze and solve the real world problems.*
- *The Graduates will be technically competent to excel in the dynamically changing information technology industry and to pursue higher studies.*
- *The Graduates will have effective communication skills, leadership qualities, desire for learning, and ability to work in multidisciplinary teams to succeed in their professional career.*

Program Specific Outcomes (PSOs)

- *Ability to specify, design, develop, test and manage efficient software systems as per user requirements.*
- *Ability to develop application software that would perform tasks related to Information Management, Web Technology and Mobiles.*

LIST OF COURSES

VII/VIII Semester			
Sl. No.	Course Code	Course Title	Semester
PROFESSIONAL CORE COURSES			
1.	23ISPC401	Parallel Computing	VII
2.	23ISPC402	Big Data Analytics	VII
PROFESSIONAL ELECTIVE COURSES			
3.	23ISPE411	Foundations of Deep Learning	VII
4.	23ISPE412	Information Retrieval System	VII
5.	23ISPE413	Generative AI	VII
6.	23ISPE42X	MOOC (NPTEL/SWAYAM)8/12WEEKS	VIII
OPEN ELECTIVE COURSES			
7.	23ICOE411	IoT for Automation	VII
8.	23AIOE412	Data Visualization and Analytics	VII
9.	23ISOE413	Software Testing	VII
SKILL ENHANCEMENT COURSE			
10.	23ISSE409	Project Phase-II	VII
11.	23ISSE431	Internship	VIII
12.	23ISSE432	Publication / Patenting	VIII
HUMANITIES & SOCIAL SCIENCE COURSES			
13.	23HMCC421	Constitution of India & Professional Ethics	VII



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VII Semester (2023 Scheme): Information Science & Engineering

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23ISPC401	Parallel Computing	Professional Core	ISE	3	0	2	50	50	100	3	4
2	23ISPC402	Big Data Analytics	Professional Core	ISE	3	0	2	50	50	100	3	4
3	23ISPE41X	Professional Elective –III *	Discipline Specific Elective	ISE	3	0	0	50	50	100	3	3
4	23ISOE41X	Open Elective -III**	Open Elective	CSE Allied Branches	3	0	0	50	50	100	3	3
5	23ISSE409	Project Phase-II	Skill Enhancement	ISE	-	-	12	100	100	200	-	6
6	23HMCC421	Constitution of India & Professional Ethics	Humanities & Social Sciences	Humanities/ any Engineering Department	1	0	0	100	-	100	-	1
Total											21	

* Professional Elective -III Course(s):

Sl. No.	Course Code	Course Title
1	23ISPE411	Foundations of Deep Learning
2	23ISPE412	Information Retrieval System
3	23ISPE413	Generative AI

**Open Elective -III Course(s):

Sl. No.	Course Code	Course Title
1	23ICOE411	IoT for Automation
2	23CIOE412	Data Visualization and analytics
3	23ISOE413	Software Testing



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VIII Semester (2023 Scheme): Information Science & Engineering

Sl. No	Course Code	Course Title	Category	Teaching Dept.	Teaching Hours /Week			Exam Marks			Duration of Exam (SEE) in Hrs	Credits
					L	T	P	CIE	SEE	Total		
1	23ISPE42X	MOOCs* (NPTEL/SWAYAM) 8/12 WEEKS	Professional Elective	ISE	-	-	-	-	-	100	-	2
2	23ISSE431	Internship	Skill Enhancement	ISE	-			100	100	200	3	12
3	23ISSE432	Publication / Patenting	Skill Enhancement	ISE	-	-	-	100	-	100	-	2
Total											16	

* Massive Open Online Courses (MOOCs) - Identified by the BoS of the department

Guidelines for MOOCs

To promote self-paced, flexible, and industry-relevant learning, a Two-Credit Online professional elective course is introduced in the VIII semester curriculum for all Bachelor of Engineering (B.E.) programs. Students are required to complete an approved online course as per the following guidelines:

1. Registration and Course Completion:

Students must complete any one of the *Board of Studies (BOS)* approved online courses by registering for an 8-week or 12-week course offered through recognized platforms such as NPTEL or SWAYAM. Registration can be done during semester VI or semester VII.



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2. Credit Conversion:

The score obtained in the proctored examination conducted by the respective online platform shall be formally converted into course credits as per institute norms.

3. Provision for students failing to clear the Online Course

If a student fails to successfully complete the selected online course within two consecutive attempts before the commencement of Semester VIII, they must register for an elective course offered by the respective department. This elective will be delivered in online mode by the department.

4. Assessment Pattern for the alternate elective:

- a. All assignments for the alternate elective course must be submitted online.
- b. The Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE) shall be conducted in offline mode.
- c. Students must physically appear for these examinations at the institute.



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PARALLEL COMPUTING			
Semester	VII	CIE Marks	50
Course Code	23ISPC401	SEE Marks	50
Teaching Hrs/Week (L:T:P)	3:0:2	Exam Hrs	03
Total Hrs	42+24	Credits	03
<p>Course Objectives: This course is designed to</p> <ol style="list-style-type: none"> 1. Introduce limitations of sequential computing and need for parallelism. 2. Familiarize methods to achieve parallelism in MIMD systems 3. Impart knowledge on parallel programming using the MPI library 4. Familiarize parallelization using OpenMP pragmas and directives 5. Provide knowledge of CUDA program design for parallel computing 			
Module 1: Introduction		No. of Hrs: 8	
<p>Parallel Hardware: Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory</p> <p>Parallel Software: Caveats, Coordinating the processes/threads, Shared-memory, Distributed-memory</p> <p>Textbook 1: 1, 2.3, 2.4.1-2.4.4</p>			
Module 2: GPU programming		No. of Hrs: 7	
<p>Input and Output: MIMD systems, GPUs,</p> <p>Performance: Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, GPU performance.</p> <p>Textbook 1: 2.5-2.10</p>			
Module 3: Distributed memory programming with MPI		No. of Hrs: 9	
<p>MPI functions, The trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm.</p> <p>Textbook 1: 3</p>			
Module 4: Shared-memory programming with OpenMP		No. of Hrs: 9	
<p>OpenMp pragmas and directives, The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in OpenMp, tasking, tasking, thread safety.</p> <p>Textbook 1: 5</p>			
Module 5: GPU programming with CUDA		No. of Hrs: 9	
<p>GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids Nvidia compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal ruleII: improving performance, CUDA trapezoidal rule III: blocks with more than one warp.</p> <p>Textbook 1: 6.1 - 6.13</p>			

LAB COMPONENT		No of hours: 24
SL. No.	EXPERIMENTS	
1	Write an OpenMP program to sort an array on n elements using both sequential and parallel merge sort (using Section). Record the difference in execution time.	
2	Write an OpenMP program that creates multiple threads in a parallel region and haseach thread print a message displaying its thread ID and total number of Threads.	
3	Write an OpenMP program that divides the Iterations into chunks containing 2 iterations,respectively (OMP_SCHEDULE=static,2). Its input should be the number of iterations, anddits output should be which iterations of a parallelized for loop are executed by which thread. For example, if there are two threads and four iterations, the output might be thefollowing: a. Thread 0 : Iterations 0 — 1 b. Thread 1 : Iterations 2 – 3	
4	Write a OpenMP program to calculate n Fibonacci numbers using tasks.	
5	Write a OpenMP program to find the prime numbers from 1 to n employing parallel fordirective. Record both serial and parallel execution times.	
6	Implement a simple Producer-Consumer using OpenMP where one thread produce integers into a fixed size circular buffer and another consumes them. Use open_lock_t for synchronization.	
7	Write a MPI program for demonstration of deadlock using point to point communication andavoidance of deadlock by altering the call sequence	
8	Write an MPI program to demonstratpoint to point communication using MPI_Send and MPI_Recv between processes.	
9	Write an MPI Program to demonstrate the Broadcast operation.	
10	Write an MPI program to demonstrate the use of MPI_Scatter and MPI_Gather for distributing data from a root process to multiple processes and collecting the results back to the root process.	
11	Write a MPI Program for demonstration of MPI_Reduce and MPI_Allreduce (MPI_MAX,MPI_MIN, MPI_SUM, MPI_PROD)	
12	Design and implement a program to perform addition of two large vectors using both CPU (sequential approach) and GPU (CUDA parallel approach). Measure and compare the execution time of both implementations.	

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

1. Articulate the limitations of sequential programming and the need for parallelism
2. Apply parallel programming concepts to design MIMD architectures
3. Develop parallel programs using MPI and OpenMP.
4. Design and implement GPU-based programs using CUDA
5. Demonstrate the implementation and performance evaluation of parallel programs using MPI, OpenMP, and CUDA.

Textbooks:

1. Peter S Pacheco, Matthew Malensek – An Introduction to Parallel Programming, second edition, Morgan Kaufman.

Reference Books:

1. Michael J Quinn – Parallel Programming in C with MPI and OpenMp, McGrawHill.
2. Barbara Chapman – Using OpenMP: Portable Shared Memory Parallel Programming, Scientific and Engineering Computation
3. William Gropp, Ewing Lusk – Using MPI: Portable Parallel Programing, Third edition, Scientific and Engineering Computation

Web links:

1. Introduction to parallel programming: <https://nptel.ac.in/courses/106102163>

Big Data Analytics			
Semester	VII	CIE Marks	50
Course Code	23ISPC402	SEE Marks	50
Teaching Hrs/Week (L: T: P)	3:0:2	Exam Hrs	03
Total Hrs	42+24	Credits	04
Course Learning Objectives:			
<ol style="list-style-type: none"> 1. Provide knowledge on characteristics of big data. 2. Impart knowledge on Hadoop framework and MapReduce programming model 3. Familiarize MongoDB, Cassandra, Hive ,Pig and Spark used in big data analytics. 4. Provide knowledge on big data analytics using machine learning techniques. 			
Module 1: Introduction to Big Data Analytics			No. of Hrs: 8
Classification of Digital data, Characteristics of Data, Challenges with big data, Typical data warehouse. Classification of Analytics, Importance of Big Data Analytics, Terminologies used in Big data Environments, NoSQL and Hadoop. Text book 1: 1.1,2.1 to 2.5, 2.10, 3.2, 3.5, 3.8, 3.12, 4.1, 4.2			
Module 2: Hadoop and MapReduce			No. of Hrs: 8
Introduction, RDBMS(Relational Database Management Systems) Vs Hadoop, Hadoop Components, Use case of Hadoop, Hadoop Distributed File System (HDFS), Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator). MapReduce: Mapper, Reducer, Combiner, Partitioner, Using MapReduce for Searching, Sorting and Compression. 1. Text book 1: 5.1 to 5.8, 5.10 to 5.12, 8.1 to 8.8			
Module 3: MongoDB and Cassandra for Big Data			No. of Hrs: 8
Concept of MongoDB, Features, RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language. Features of Cassandra, CQL Data types, CRUD, Collections, Alter Commands, Import and export. Text book 1: 6.1 to 6.5, 7.2,7.3,7.6,7.7,7.10,7.11			
Module 4: Hive and Pig			No. of Hrs: 9
Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). Pig Features, Pig on Hadoop, Use case for Pig, Pig Latin Commands, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands in Pig, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive. Text book 1: 9.1 to 9.6, 9.8, 10.1 to 10.15, 10.22			
Module 5: Spark, Text and Web Content Analytics			No. of Hrs: 8
Spark: Introduction, Features, Software Stack, Introduction to Data Analysis with Spark. Text Mining, Web Mining, Web Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph. Text book 2: 5.1 to 5.3, 9.1 to 9.4			

LAB COMPONENT		No of hours: 24
SL. No.	EXPERIMENTS	
1	Installing Apache Hadoop, Using Hadoop and Linux Commands	
2	Develop a MapReduce program to calculate the frequency of a given word in a given file.	
3	Develop a MapReduce program to find the maximum electrical consumption in each year given electrical consumption for each month in each year.	
4	Develop a MapReduce program to analyze a weather dataset and print whether the day is sunny or cool.	
5	Develop a MapReduce program to find the number of products sold in each country from sales data.	
6	Develop a MapReduce program to find the frequency of books published each year and identify the year with the maximum publications.	
7	Develop a MapReduce program to analyze Titanic dataset to find average age of people who died and survivors in each class.	
8	Develop a MapReduce program to analyze Uber dataset to find the days on which each base station has more trips.	
9	Develop a program to calculate the maximum recorded temperature year-wise for the weather dataset using Pig Latin.	
10	Write queries to sort and aggregate the data in a table using HiveQL.	
11	Develop a Java/Python application to find the maximum temperature using Spark.	
12	Create and manage a database using MongoDB and perform basic CRUD and aggregation operations.	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Identify and list various Big Data concepts, tools and applications. 2. Develop programs using HADOOP framework. 3. Apply MapReduce programming model to process the big data along with Hadoop tools.. 4. Implement data processing and querying using NoSQL, MogoDB, and Cassandra tools. <p>Apply machine learning techniques to analyze large-scale datasets and web graphs using Spark, text mining, web mining, and PageRank</p>		
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Seema Acharya and Subhashini Chellappan, “Big data and Analytics”, Wiley India Publishers, 2nd Edition, 2019. 2. Rajkamal and Preeti Saxena, “Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning”, McGraw Hill Publication, 2019 		

Reference Books:

1. Adam Shook and Donald Mine, “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems” - O'Reilly 2012
2. Tom White, “Hadoop: The Definitive Guide” 4th Edition, O’reilly Media, 2015
3. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016
4. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition

Web links:

1. <https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset>
2. <https://www.youtube.com/watch?v=bAyrObI7TYE&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ>
3. <https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&index=4>
4. <https://www.youtube.com/watch?v=GG-VRm6XnNk>

Foundations of Deep Learning			
Semester	VII	CIE Marks	50
Course Code	23ISPE411	SEE Marks	50
Teaching Hrs/Week (L:T: P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
Course Learning Objectives: This course is designed to			
<ol style="list-style-type: none"> 1. Introduce the need & working of deep learning and provide knowledge of linear algebra & probability concepts for formulating deep learning models. 2. Introduce the core principles of neural networks, including neuron models, activation functions, and feed-forward architectures. 3. Familiarize learning mechanisms and training algorithms in deep neural networks focusing on gradient-based optimization and generalization. 4. Provide knowledge on advanced optimization challenges and techniques. 5. Impart knowledge of convolution operation, convolutional neural network architectures and their components for feature extraction and classification from images. 			
Module 1: Introduction & Foundational Math for Deep Learning			No. of Hrs: 9
Deep Learning, Why to Use Deep Learning, How Deep Learning Works, The Fundamental Spaces, Column Space, Null Space, Random Variables, Expectation and Variance, Entropy, Cross Entropy, and KL Divergence, Continuous Probability Distributions Text Book 2: Chapter 1: 1.3, 1.4 & 1.5 Text Book 1: Chapter 1 & 2			
Module 2: Fundamentals of Neural Networks			No. of Hrs: 8
Building Intelligent Machines, Limits of Traditional Computer Programs, Mechanics of Machine Learning, The Neuron Model, Linear Perceptrons as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Activation Functions, Sigmoid, Tanh, ReLU, Softmax Output Layers Text Book 1: Chapter 3			
Module 3: Training Deep Neural Networks			No. of Hrs: 8
The Fast-Food Problem, Gradient Descent, Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons, Backpropagation Algorithm, Stochastic and Mini-batch Gradient Descent, Test Sets, Validation Sets, and Overfitting, Techniques to Prevent Overfitting in Deep Networks Text Book 1: Chapter 4			
Module 4: Advanced Optimization Techniques			No. of Hrs: 8
Local Minima in Deep Network Error Surfaces, Model Identifiability, Flat Regions in Error Surfaces, When Gradient Points in the Wrong Direction, Momentum-Based Optimization, Second-Order Optimization Methods, Learning Rate Adaptation Techniques, AdaGrad, RMSProp, Adam Text Book 1: Chapter 6			

Module 5: Basics of Supervised Deep Learning	No. of Hrs: 9
<p>Convolutional Neural Network (ConvNet/CNN), Evolution of Convolutional Neural Network Models, Convolution Operation, Architecture of CNN, Convolution Layer, Activation Function (ReLU), Pooling Layer, Fully Connected Layer, Dropout Text Book 2: Chapter 2: 2.2, 2.3, 2.4, 2.5</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Articulate working & need of deep learning, training of deep neural networks, overfitting, prevention of overfitting and optimization techniques. 2. Apply concepts of linear algebra & probability for deep learning algorithms. 3. Apply artificial neuron models and feed-forward neural networks with appropriate activation functions to solve basic classification problems. 4. Apply gradient descent-based algorithms, including backpropagation, to train neural networks. 5. Apply advanced optimization algorithms such as Momentum, AdaGrad, RMSProp, and Adam to train deep neural networks. 6. Design basic convolutional neural network architectures by integrating convolution, activation, pooling, and fully connected layers for image-based classification tasks. 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Nithin Buduma, Nikhil Buduma, and Joe Papa, Fundamentals of Deep Learning- Designing Next-Generation Machine Intelligence Algorithms 2nd Edition, O'Reilly Media, Inc., 2022 2. M. Arif Wani, Farooq Ahmad Bhat, Saduf Afzal, Asif Iqbal Khan, Advances in Deep Learning, 1st Edition, Springer, 2020. 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016. 2. John Krohn, Grant Beyleveld, Aglae Bassens, Deep Learning Illustrated, A Visual, Interactive Guide to Artificial Intelligence, Pearson, 2022. 	
<p>Web links:</p> <ol style="list-style-type: none"> 1. Deep Learning NPTEL Online Course Videos https://nptel.ac.in/courses/106106184 2. Deep Learning Crash Course for Beginners https://www.youtube.com/watch?v=VyWAvY2CF9c 3. MIT Introduction to Deep Learning https://www.youtube.com/watch?v=7sB052Pz0sQ 4. Deep Learning Tutorial (Tensorflow Tutorial, Keras & Python) https://www.youtube.com/watch?v=Mubj_fqiAv8 5. Neural Networks and Deep Learning (Coursera) https://www.coursera.org/learn/neural-networks-deep-learning 	

Information Retrieval System			
Semester	VII	CIE Marks	50
Course Code	23ISPE412	SEE Marks	50
Teaching Hrs/Week (L: T: P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
<p>Course Learning Objectives: This course is designed to</p> <ol style="list-style-type: none"> 1. Introduce the fundamental concepts of Information Retrieval Systems. 2. Impart knowledge on cataloging, indexing techniques, and underlying data structures. 3. Impart the concepts of automatic indexing and term clustering techniques. 4. Familiarize modern search techniques and information visualization concepts 5. Impart knowledge on text search algorithms and multimedia information retrieval methods. 			
Module 1: Introduction to Information Retrieval Systems			No. of Hrs: 8
Definition, Objectives, Functional Overview, Relationship to Database Management Systems, Digital Libraries, Data Warehouses, Search Capabilities, Browse Capabilities and Miscellaneous Capabilities. Text Book1: Ch: 1.1 to 1.5 Ch: 2.1 to 2.3			
Module 2: Cataloging & Indexing,			No. of Hrs: 9
History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction. Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages Text Book1: Ch: 3.1 to 3.5 Ch: 5.1 to 5.5			
Module 3: Clustering			No. of Hrs: 8
Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters. Text Book1: Ch: 4.1 to 4.8 Ch: 6.1 to 6.4			
Module 4: Search Technique and Visualization			No. of Hrs: 9
Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET, and Hypertext Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies. Text Book1: Ch: 7.1 to 7.6 Ch: 8.1 to 8.3			

Module 5: Text Search Algorithms and Retrieval	No. of Hrs: 8
<p>Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems</p>	
<p>Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval</p>	
<p>Text Book1: Ch: 9.1 to 9.3 Ch: 10.1 to 10.5</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Explain the fundamentals, objectives, architecture, and capabilities of Information Retrieval Systems. 2. Apply cataloging and indexing techniques along with appropriate data structures for effective information retrieval. 3. Implement and apply automatic indexing and clustering techniques to organize documents for improved retrieval performance. 4. Apply user search techniques, similarity measures to perform and improve effective information retrieval. 5. Apply text search algorithms and multimedia information retrieval techniques to retrieve information from text, audio, image, and video data sources 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Gerald J. Kowalski, Mark T. Maybury Information Storage and Retrieval Systems– Theory and Implementation 2nd Edition, Kluwer Academic Publishers 2019 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008. 2. Ophir Frieder “Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series “, 2nd Edition, Springer, 2004 	
<p>Web links:</p> <ol style="list-style-type: none"> 1. https://www.nptel.ac.in/courses/106/101/106101007 	

Generative AI			
Semester	VII	CIE Marks	50
Course Code	23ISPE413	SEE Marks	50
Teaching Hrs/Week (L: T: P)	3:0:0	Exam Hrs	3
Total Hrs	42	Credits	3
<p>Course Learning Outcomes: This course is designed to</p> <ol style="list-style-type: none"> 1. Provide knowledge of generative modeling concepts and applications. 2. Provide knowledge of Variational Autoencoders and Generative Adversarial Networks (GANs) for stable, sequence-based data generation. 3. Impart knowledge in using Autoregressive and Normalizing Flow models for generating data from learned distributions. 4. Impart knowledge of diffusion and world models to create realistic data and simulate environments for learning agents. 5. Provide knowledge of transformers-GPT and other models for generating text and training large language models. 			
Module 1 Generative Modeling			No. of Hrs.: 8
<p>Introduction to Generative Modeling, Generative Vs. Discriminative Modeling, Generative Modeling Framework, and Representation Learning. Characteristics of Generative Models, Advantages, Disadvantages and Challenges in Generative Models, Applications of Generative Models.</p> <p>Text Book 1: Chapter 1. Text Book 2: Chapter 3.3, 4.3</p>			
Module 2 Variational Autoencoders and GANs			No. of Hrs.: 9
<p>Autoencoders: Autoencoder Architecture, Encoders, Decoders, Joining the Encoders to the Decoder, Reconstructing Images, Variational Autoencoders (VAEs): The Loss Function, and Generating New Images from Latent distributions. Generative Adversarial Networks (GANs): Introduction of GANs, Deep Convolutional GAN(DCGAN), Wasserstein GAN with Gradient Penalty (WGAN-GP) for stability, and Conditional GAN(CGAN).</p> <p>Text Book 1: Chapter 3, 4.</p>			
Module 3 Large Language Models			No. of Hrs.: 8
<p>Evolution of Language Models: Statistical Language Models (SLM), Neural Language Models (NLM), Pre-trained Language Models (PLM), Large Language Models (LLM), LLMs: Key Techniques for LLMs, Types of LLMs, Tasks of LLMs, LLM Frameworks, LLMs Applications, Challenges in LLMs.</p> <p>Text Book-2: 5.2, 5.4, 5.5.</p>			

Module 4	Diffusion Models	No. of Hrs: 9
<p>Diffusion Models: Introduction, Denoising Diffusion Models (DDM): The Flowers Dataset, The Forward Diffusion Process, The Reparameterization Trick, Diffusion Schedules, The Reverse Diffusion Process, The U-Net Denoising Model, Training the Diffusion Model, Training the Diffusion Model, Sampling from the Denoising Diffusion Model, Analysis of the Diffusion Model.</p> <p>Text Book-1: Chapter 8.</p>		
Module 5	Applications	No. of Hrs: 8
<p>Transformers: GPT (Generative Pre-trained Transformer): Attention mechanisms, Queries, Keys and Values, Multihead Attention, Causal Masking, The Transformer Block, Positional Encoding, Training and Analysis of GPT.</p> <p>Advanced GANs – ProGAN, StyleGAN, Other Important GANs: Self-Attention GAN, BigGAN, VQ-GAN, ViT VQ-GAN.</p> <p>Text Book-1: Chapter 9, 10</p>		
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Explore how generative models create new data, their benefits and drawbacks, and how to use them responsibly. 2. Explain the operational mechanics of deep generative models and apply - VAEs, and GAN frameworks. 3. Explore the Large Language Models (LLMs) and techniques. 4. Apply GANs and diffusion models for creating new and realistic data. 5. Apply Transformer models, advanced GANs, and world models to solve structured problems in intelligent systems. 		
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Generative Deep Learning Teaching Machines to Paint, Write, Compose, and Play – David Foster – 2nd Edition. 2. Rajan Gupta, Sanju Tiwari, Poonam Chaudhary by Generative AI: Techniques, Models and Applications (Springer, 2025) 		
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville. 2. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow by Aurelien Geron 3. Hands-On Large Language Models: Language Understanding and Genera 		
<p>Web links:</p> <ol style="list-style-type: none"> 1. https://www.youtube.com/watch?v=Pq8lW5y8JpA 2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-courses/ 3. https://cloudxlab.com/course/188/pg-certificate-program-in-data-science-ai-by-cec-iit-roorkee. 		

IoT for Automation			
Semester	VII	CIE Marks	50
Course Code	23ICOE411	SEE Marks	50
Teaching Hrs/Week (L:T: P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
Course Learning Objectives:			
<ol style="list-style-type: none"> 1. Provide knowledge on the evolution of industrial automation, from traditional control systems to modern IoT-enabled Systems. 2. Impart knowledge on Local Automation Clouds, including their properties, establishment and applications. 3. Impart knowledge on IoT application automation systems to address industrial and societal challenges. 			
Module 1: Local Automation Clouds			No. of Hrs: 9
<p>The Local Cloud Concept, Local Cloud Properties, Local Cloud Establishment, Automation Support, Automation Application Engineering in Local Clouds, Latency in Local Clouds, Security in Local Clouds, SoS Scalability.</p> <p>The Arrow Head Framework architecture: Important definitions, Documentation structure, The mandatory core systems, Automation support core systems.</p> <p>Text Book: Chapter 2, Chapter 3.2, 3.3, 3.4.1 (3.4.1.1 to 3.4.1.3), 3.4.2 (3.4.2.1 to 3.4.2.9)</p>			
Module 2: Arrowhead Framework core systems and services			No. of Hrs: 9
<p>Service Registry system, Authorization system, Orchestration system, Plant Description system, Configuration system, System Discovery and Device Discovery services.</p> <p>Text Book :Chapter 4.2.1, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 4.3.3</p>			
Module 3: Engineering of IoT Automation Systems			No. of Hrs: 8
<p>Introduction, Component-based Engineering Methodology, Safety and Security Engineering of IoT Automation Systems, Swift Deployment and Configuration, PLC device monitoring, Replacement of device.</p> <p>Text Book :Chapter 6.1, 6.3, 6.4, 6.5.2, 6.5.3, 6.5.4</p>			
Module 4: Application System Design Energy Optimization			No. of Hrs: 8
<p>Introduction, Market as an Energy Optimizing Method, Optimizations Based on a Virtual Market of Energy, Energy Optimization on Lifts, Context Aware Streets, Optimization of Municipal Service Systems.</p> <p>Text Book :Chapter 7</p>			
Module 5: Complex Systems Management, Automation and Security			No. of Hrs: 8
<p>Electric Vehicles and Recharge Infrastructure, Arrowhead SOA EM Solution, Systems and Services, Arrowhead EM Services and Related Automation Aspects, Co-simulation Platform. Smart Maintenance Use Case, Authentication and Certification Service, Safety and Security Analysis for Identifying System Vulnerabilities.</p> <p>Text Book :Chapter 9.4, 9.5, 9.6, 9.7, 9.8; Chapter 10.2, 10.3, 10.5</p>			

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

1. Describe the concept, architecture, and properties of Local Automation Clouds, including latency, security, scalability, and the Arrowhead Framework for industrial automation.
2. Apply Arrowhead core systems to enable service discovery, orchestration, authorization, and inter-cloud communication in IoT automation systems.
3. Describe the component-based engineering methodologies used to design, deploy, and configure safe and secure IoT automation systems for large-scale and dynamic environments.
4. Describe energy-optimized application systems, including virtual energy markets and context-aware automation solutions.
5. Apply systems management and security automation techniques to real-world use cases such as EV infrastructure and smart maintenance systems.

Textbooks:

1. Jerker Delsing, “IoT Automation: Arrowhead Framework”, CRC Press, Taylor & Francis Group..

Reference Books:

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication).
2. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication).

Web links:

1. <https://www.youtube.com/watch?v=HmbUJEShA-8>
2. <https://www.youtube.com/watch?v=eidD14dXW8s>
3. https://www.udemy.com/course/iot-internet-of-things-automation-withesp8266/?srsltid=AfmBOoqqKDLk_fKye1CPIO9QjctFfgHOflF_Zkmtze8uNRUvmq_9s1-3
4. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Data Visualization & Analytics			
Semester	VII	CIE Marks	50
Course Code	23CIOE412	SEE Marks	50
Teaching Hrs/Week (L:T: P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
Course Learning Objectives:			
<ol style="list-style-type: none"> 1. Impart knowledge on exploratory versus explanatory analysis, focusing on the need of effective storytelling for targeted audience. 2. Familiarize various approaches of Aesthetics in data visualization for enhancing the interpretability of data 3. Provide knowledge on various plots & graph approaches for visualizing the data proportion, distribution & trends in data for better interpretation. 4. Provide insights on data visualization approaches for effective interpretation of geospatial & probabilistic data. 			
Module 1: Introduction			No. of Hrs: 09
<p>Importance of context : Exploratory vs. explanatory analysis, Defining : Who - Identifying Audience, What- Audience Expectation, How - Presenting mechanism, The 3-Mintue Story, Big Idea, StoryBoarding</p> <p>Handling Clutter : Cognitive Load, Clutter, Gestalt Principles :Proximity, Similarity, Enclosure, Closure, Contineuty, Connection, Lack of Visual Order : Alignment, White Spaces, Decluttring Example</p> <p>Text Book 1: Chapter 1, 3</p>			
Module 2: Aesthetics in Data Visualization			No. of Hrs: 08
<p>Introduction, Visualizing Data: Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes: Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales: Color as a Tool to Distinguish, Color to Represent Data Values, Color as a Tool to Highlight, plots and charts : Bar Graph, Grouped & Stacked Bar Graph, Heatmap</p> <p>Text Book 2: Chapter 1,2,3,4,6</p>			
Module 3: Visualizing Distributions			No. of Hrs: 09
<p>Visualizing Distributions: Single Distribution, Multiple Distrubution, Cumulative Distribution Functions: Empirical Cumulative Distribution Functions, Highly Skewed Distribution, Quantile-Quantile Plots, Visualizing Many Distributions: boxplots, violin plots, Strip Charts, sina plots, ridgeline plot, Visualizing Proportions: Pie Chart, side-by-side bars, Stacked Bars, Stacked Densities, Relative Proportions</p> <p>Text Book 2: Chapter 7,8,9,10</p>			

Module 4: Visualizing Proportions & Trends	No. of Hrs: 08
<p>Visualizing Nested Proportions: Nested Proportions Issues, Mosaic Plots, Treemaps, Nested Pies, Parallel Sets, Visualizing Associations: Scatterplots, Correlograms, Dimension Reduction, Paired Data, Visualizing Time Series: Individual Time Series, Multiple Time Series and Dose–Response Curves, Visualizing Trends: Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition.</p> <p>Text Book 2: Chapter 11,12,13,14</p>	
Module 5: Visualizing Geospatial & Uncertainty data	No. of Hrs: 08
<p>Visualizing Geospatial Data: Projections, Layers, Choropleth Mapping, Cartograms Visualizing Uncertainty: Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots</p> <p>Text Book 2: Chapter 15,16</p>	
<p>Course Outcomes: At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Explain the concepts of exploratory and explanatory analysis & discuss the need of storytelling for targeted guidance 2. Identify various clutters in data visualization and discuss various approaches for incorporating Aesthetics in Data Visualization. 3. Illustrate the significance of various plots & graph approaches used in visualizing distribution, proportion, trends in data. 4. Explain the approaches used for visualizing geospatial data & uncertainty probabilistic data for effective interpretation. 5. Compare & discuss the pros & cons of various approaches used for data visualization 	
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Cole Nussbaumer Knaflic, “Storytelling with Data: A Data Visualization Guide for Business Professionals” Wiley Publisher, 2015 2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’Reilly Media, 2019 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Effective Data Storytelling: How to Drive Change with Data, Narrative and Visuals, WILEY Publisher, 2020. 2. Data Visualization: Exploring and Explaining with Data with MindTap, Cengage Learning India Pvt. Ltd, 2022. 	
<p>Web links:</p> <ol style="list-style-type: none"> 1. Youtube Chanllel on Storytelling based on Data https://www.youtube.com/channel/UCjhGILWNloXJdR2NTCBMIA 2. Data to visualization various graphs : https://www.data-to-viz.com/ 	

Software Testing			
Semester	VII	CIE Marks	50
Course Code	23ISOE413	SEE Marks	50
Teaching Hrs/Week (L:T: P)	3:0:0	Exam Hrs	03
Total Hrs	42	Credits	03
Course Learning Objectives:			
<ol style="list-style-type: none"> 1. Impart knowledge on basics of software testing. 2. Impart knowledge on different types of software testing. 3. Provide knowledge on building test cases for a given application. 4. Provide knowledge on effective test planning. 5. Impart knowledge on automated testing process and Selenium tool. 			
Module 1: Basics of Software Testing			No. of Hrs: 8
Introduction to software testing, Approaches to testing, Principles of Testing, Salient Features of good testing, Test Policy & Planning, Challenges in testing, Cost Aspect of testing, Testing Process.			
Textbook 1: Ch3 (3.3, 3.4, 3.12, 3.13, 3.14, 3.16, 3.20, 3.23, 3.31)			
Module 2: Functional and Non-Functional Testing			No. of Hrs: 9
Boundary value analysis, Test cases for the Triangle problem, Equivalence class testing, Equivalence class test cases for the Triangle problem, Security testing, Performance testing, Recovery testing, Installation testing.			
Textbook 2: Ch5 (5.1, 5.2) Ch6 (6.1, 6.2) Textbook 1: Ch11 (11.5, 11.6, 11.7, 11.8)			
Module 3: Structural Testing			No. of Hrs: 9
Program Graphs, DD paths, Basis path testing, Guidelines and observations, Definition-Use testing, Slice based testing, Program slicing tools.			
Textbook 2: Ch8 (8.1, 8.2, 8.4, 8.5) Ch9 (9.1, 9.2, 9.3)			
Module 4: Test planning and Test cases			No. of Hrs: 8
Content of test policy, Content of test strategy, Test plan, Test plan template, Building test data and test cases, Test scenario, test cases, Template for test cases, Test management software.			
Textbook 1: Ch14 (14.3, 14.5, 14.6, 14.7, 14.10, 14.15, 14.16, 14.17, 14.19, 14.21)			
Module 5: Selenium - Testing tool			No. of Hrs: 8
Test Automation, Test Automation environment, Getting Started with Selenium IDE, Installing Selenium-IDE, Recording a script with IDE, Save the test case, Create Selenium Test Suite, Format of Selenium Test, Selenium Test Case writing in HTML, Applying CSS to Selenium Test Cases.			
Textbook 3: Ch1, Ch2, Ch6, Ch9			

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

1. Describe the basic concepts of software testing.
2. Articulate various types of software testing techniques, their advantages, disadvantages and significance of testing in software development process.
3. Write effective test cases for the given software systems.
4. Develop elaborate testing plans for the hypothetical project.
5. Test software systems using Selenium and create testing reports.

Textbooks:

1. M G Limaye, “Software Testing Principles, Techniques and Tools”, Tata McGraw Hill, 2012.
2. Paul C. Jorgensen, “Software Testing, A Craftsman’s Approach”, 4th Edition, Auerbach Publications, 2014.
3. Ashish Mishra and Aditya Garg, “A Practitioner’s Guide to Test Automation using Selenium”, Tata McGraw Hill, 2012.

Reference Books:

1. Elfriede Dustin, “Effective Software Testing” Pearson Education, 2007.
2. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.
3. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" – Second Edition 2018.

Activities/Assignments:

1. Develop a Mini Project with documentation of suitable test-cases and their results to perform automation testing of any E-commerce or social media web page using Selenium.

Web links:

1. Software Testing Course, IIT, Kharagpur
<https://nptel.ac.in/courses/106/105/106105150/>
2. Software Testing Course, NPTEL https://onlinecourses.nptel.ac.in/noc19_cs71/preview
3. Software Testing Course, IIT, Madras
<https://www.youtube.com/watch?v=OGImfxO2TEU&t=10s>
4. Lecture series on Software Testing <https://www.youtube.com/watch?v=Q50ZyydS7pI>

PROJECT PHASE – II			
Semester	VII	CIE Marks	100
Course Code	23ISSE409	SEE Marks	100
Hrs/Week (L: T: P)	0:0:12	Exam Hrs	03
		Credits	06

Objectives:

1. To enable students to execute, validate, and communicate the engineering solution to the identified problem conceptualized in Project Phase – I
2. To motivate students to extend their project work toward research publications, patent filing, funding proposals, or technology transfer, where applicable.

General Guidelines for CIE procedure:

1. The Department project coordinator will take the responsibility of monitoring all the activities related to the project execution.
2. The HOD shall constitute project evaluation/review committee(s) & the composition shall be as follows:
 - a. HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee
 - b. Project Coordinator shall be member - Convener
 - c. Project guide shall be the member
 - d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)
3. Project teams must implement the problem identified using the proposed methodology through systematic experimentation and/or simulation leading to a functional solution or validated outcome in consultation with their project guide.
4. Each project team shall maintain a project diary and record their project progress at regular interval of time. This shall carry signature of the students and the project guide.
5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the guide and committee.
6. A student shall obtain minimum of 40% of the total CIE marks to gain eligibility for SEE

General Guidelines for SEE procedure:

1. The Department project coordinator will take the responsibility of all the requirements for successful conduction of the SEE.
2. SEE for project work will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations.
3. Project teams must present their projects that have been executed and completed with a functional solution or validated outcome during the SEE.

4. Each project team shall bring to the SEE a project report that shall carry signature of the students, project guide, HOD and the Principal. Plagiarism, data fabrication, or copying of work will result in stringent disciplinary action and /or penalties. (Note: Any disciplinary actions or penalties will be as per institutional policy.)
5. Marks may be equally or proportionally distributed among team members based on contribution assessed by the examiners.
6. A student shall obtain minimum of 40% of the total SEE marks to pass this course.

Deliverables:

1. Comprehensive Project Report comprising of:
 - Abstract
 - Introduction
 - Literature Survey
 - Problem Definition
 - Proposed Methodology
 - Design
 - Implementation
 - Results and discussion
 - References
 - Appendices

The project report shall be prepared in the prescribed format provided by the institute.

2. A plagiarism report shall be obtained from the Department of Library. Acceptable similarity threshold is generally below 20%, and hence, the plagiarized content shall not exceed 20%. Similarity above 20% will require resubmission after proper revisions.

Review and Evaluation for CIE:

1. There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review - 1	
Phase wise execution of proposed solution	20 Marks
Use of modern tools for proposed solution	10 Marks
Contribution as an individual and team member	10 Marks
Total	40 Marks

Review - 2	
Complete Implementation and Demonstration of Modules	15 Marks
Report Quality & Formatting	15 Marks
Total	30 Marks

Presentation	
Presentation	20 Marks
Team work	10 Marks
Total	30 Marks

Grand Total	100 Marks
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2. First review shall be conducted after one month from the start of the semester.
3. Every department shall develop rubrics to assess performance of the students based on the above given parameters.

Evaluation for SEE:

1. There shall be a presentation for SEE. Total of 100 SEE marks is distributed as follows:

SEE	
Execution of proposed solution	40 Marks
Evaluation of Project Report	30 Marks
Project presentation & Question and Answer	30 Marks
Total	100 Marks

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

1. Execute the problem identified using the methodology proposed through systematic design, development, experimentation, and/or simulation, leading to a functional solution or validated outcome.
2. Translate theoretical concepts into practical implementation while considering constraints such as feasibility, cost, sustainability, safety, ethics, and societal relevance.
3. Exhibit the resourcefulness to act independently as well as collaboratively within a team in overcoming technical challenges encountered during project execution.
4. Plan tasks effectively, manage time and resources, meet defined milestones, and adhere to deadlines, reflecting professional engineering practice.
5. Prepare a comprehensive project report that clearly documents design decisions, implementation details, experimental results, analysis, and conclusions using standard technical writing practices.
6. Confidently present the project work through reviews, demonstrations, seminars, and viva-voce examinations, addressing questions from peers, faculty, and examiners.

Constitution of India & Professional Ethics			
Semester	VII	CIE Marks	100
Course Code	23HMCC421	SEE Marks	-
Teaching Hrs/Week (L:T:P)	1:0:0	Exam Hrs	-
Total Hrs	13	Credits	01
Course Learning Objectives:			
This course is designed to			
<ol style="list-style-type: none"> 1. Introduce the foundational principles and features of the Indian Constitution 2. Familiarize the Fundamental Rights and Directive Principles. 3. Provide an understanding of Union and State government policies and Electoral Process. 4. Develop awareness on Sustainable development goals, energy conservation and climate change 5. Inculcate Ethical responsibilities and Code of Conduct. 			
Module 1: Introduction to the Indian Constitution			No. of Hrs:2
Definition and Significance of the Constitution, Making of the Constitution, Constituent Assembly, Preamble, Salient features of the India Constitution, Amendments, other Provisions and Citizenship.			
Module 2: Fundamental Rights and Duties			No. of Hrs:3
Fundamental Rights: Right to Equality, Right to Freedom, Right to Life & Personal Liberty, Right against Arbitrary arrest and Preventive Detention, Right against Exploitation, Right to Religion, Cultural & Educational Rights and Right to Constitutional Remedies, Restrictions and Limitations, Directive Principles of State Policy and its relevance in the society, Fundamental Duties of Citizens.			
Module 3: Union and State Government Structure			No. of Hrs:3
Union Govt: Union Legislature- Parliament-Lok Sabha and Rajya Sabha, Sessions of Parliament, Parliamentary System, Parliamentary Committees, Important Parliamentary Terminologies. Union Executive- President, Prime Minister, Union Cabinet, Union Council of Ministers. Union Judiciary- Supreme Court of India, Judicial Review and Judicial Activism. State Govt: State Legislature- State Legislative Assembly, State Legislative council, State Executive- Governor, Chief Minister, State Cabinet, State Council of Ministers, State Judiciary- High Court and Subordinate Courts. Elections: Election Commission of India, Process and Laws. Emergency Provisions			
Module 4: Ethics and Sustainable Development			No. of Hrs:3
Ethics: Values and types, Honesty, Trust, Integrity and Reliability in Engineering, Sustainable development goals, energy conservation, sustainable developments, Environmental Ethics: climate change and ethical responsibility.			
Module 5: Professional Ethics for Engineers			No. of Hrs:2
Scope & Aims, Code of Ethics, Professional responsibility, Accountability, Research Ethics, Clash of Ethics (example with respect to technology), Conflicts of Interest, Risks, Safety, Liability and Corporate Social Responsibility.			

Course Outcomes:

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

1. State the preamble and the basic features of the Indian Constitution.
2. Explain the Fundamental Rights, Directive Principles of State Policy and their relevance in contemporary Indian society.
3. Compare the functioning of the Union and State legislature, Executive and Judiciary
4. Classify Ethical, Virtues and explain sustainable development goals and climate change.
5. Outline the Aims, Code of Ethics, and principles of Corporate Social Responsibility.

TEXT BOOKS

1. Raja Ram, M., (2015), *Constitution of India & Professional Ethics*, (3rd Edition), New Age International Publishers.
2. Dr. Tharanath, Santhosh Prabhu & Suma Suresh Kogilgeri, (2018), *Constitution of India & Professional Ethics*, Pristine Publishing House.
3. Sharma Brij Kishore, (2011), *Introduction to the Constitution of India*, (8th Edition), PHI Learning Pvt. Ltd.
4. Charles E Harris, Michael S. Pritchard & Michael J. Rabins (2018), *Engineering Ethics: Concepts and Cases*, (1st Edition), IEEE / Cengage.
5. Iqbal, Jaquir, (2013), *SDG – Sustainable Urban Development: Challenges, Achievements & Opportunities*, (1st Edition), Global Vision Publishing House.

Weblinks:

1. Making of the Indian Constitution - <https://www.youtube.com/watch?v=Z5nQ4xea9ts>
2. Parts, Articles and Schedules of the Indian Constitution - <https://www.youtube.com/shorts/TJRdYarLPYI>
3. The Indian Constitution - <https://www.youtube.com/watch?v=vXvLSXlmkyM>
4. Professional Engineering Ethics - <https://www.youtube.com/watch?v=SVz6Q7EoBJM>
5. Sustainable Development Goals - <https://www.youtube.com/watch?v=qAlolKgDPrA>

Internship			
Semester	VIII	CIE Marks	100
Course Code	23ISSE431	SEE Marks	100
Hrs/Week (L: T: P)	-	Exam Hours	03
Total Hrs	-	Credit	12

Objectives: This course is designed to

3. Bridge the gap between academic learning and real-world engineering practice.
4. Provide hands-on experience in industry, research and incubation environments.
5. Develop technical, analytical, and professional skills.
6. Expose students to organizational structure, workflow, and workplace ethics.
7. Enhance employability, innovation, and lifelong learning capabilities.

Preamble:

Internship refers to the position of a student as trainee or a temporary (or unconfirmed) employee, who works in an organization, with or without pay/stipend, in order to gain work experience or satisfy requirements for a qualification. It is a structured, supervised professional experience in an industry, research organization, or incubation centers.

Internships play a vital role in bridging the gap between theoretical education and professional practice. In general, engineering internships serve as a crucial component of professional education by providing experiential learning, industry readiness, and holistic skill development, ultimately producing competent engineers or entrepreneurs. Apart from these, it develops professional ethics, work culture awareness and communication skills.

Types of Internships:

Following are the types of internships:

- i. **Industry Internship:** Carried out in the engineering industry, companies, manufacturing units, startups, business, IT industry. The topic involved may be technical, managerial, production-related tasks, live projects, or innovative activities.
- ii. **Research Internship:** Carried out at universities, research labs, or R&D departments or organizations. The internship involves literature review, data analysis, and experimental work leading to publications, prototypes, technical reports or innovations. The research internship may induce students to plan for higher studies or academic careers.
- iii. **Entrepreneurship Internship:** Undertaken in association with start-ups, or entrepreneurship cells or launching own idea in Preincubation/Incubation centers. The internship offers exposure to business planning, prototype, product development, and promotes innovation, risk-taking, and entrepreneurial mindset.

- iv. **Post-Placement Internship:** Refers to the internship offered to students after they receive a confirmed job offer (placement) from a company, but before formally joining as full-time employees. This internship (on-site, virtual, or hybrid) ensures that students are groomed to be professionally ready, technically competent, and culturally aligned with the organization even before official induction.

General Guidelines:

1. The official engagement period of 15-week for students selected/recruited by the company/ organization only at their premises under the supervision of the company, shall only be considered as an internship.
2. The period of training and working of students who have been recruited as employees by organizations at the beginning of the 4th year of the program, shall also be treated as an internship.
3. The assigned faculty mentor/coordinator/guide should monitor the student's progress, and document offer letters, training reports, attendance, and evaluations for awarding academic credits.
4. All students undergoing an internship, should adhere to all the guidelines, reporting protocols, and evaluation procedures prescribed by the Institution and the company.
5. Students must submit the certificate of completion of an internship with the period of internship clearly mentioned, from the respective company/organization.

Procedure for CIE:

1. The Department Internship coordinator identified by the HOD will take the responsibility of monitoring all the activities related to the Internship.
2. The HOD shall constitute Internal Internship evaluation/review committee & the composition shall be as follows:
 - a. HOD shall be the Chairman of the committee
 - b. Internship Coordinator shall be member – Convener
 - c. Internal Internship Guide shall be member
 - d. Two senior faculty members nominated by the HOD shall be the members
3. The External Internship evaluation/review committee shall be composed of industry supervisor/external guide. For evaluation, the industry supervisor/external guide may join the review in online mode.
4. The internal evaluation shall be conducted by the departmental review committee based on the student's internship progress, documentation, and presentation which will comprise the student's daily report, focusing on the regularity, completeness, and clarity of the internship logbook/diary; the deliverables and outcomes, considering the quality of work, relevance, and achievement of the stated objectives; and the presentation skills, assessing clarity, communication effectiveness, and the ability to

present the work in a structured and professional manner.

5. The external evaluation shall be carried out by the industry supervisor/external guide based on the student's performance at the workplace which will comprise the student's technical knowledge, assessment of the understanding and application of domain-specific concepts during the internship; work ethics, considering professionalism, punctuality, discipline, and adherence to organizational practices; deliverables and outcomes, evaluating the quality and completion of assigned tasks; and the ability to learn independently, adapt to new and emerging technologies, and exhibit critical thinking, reflecting the student's capacity for continuous learning, problem-solving, and adaptability in a professional environment.

Procedure for SEE:

7. SEE for Internship will be conducted by two examiners (one internal examiner and the other an external examiner) appointed by the Controller of Examinations.
8. Students must present their Internship work to the examiners.
9. Each student shall bring to the SEE, an Internship report which includes the Internship Completion Certificate from the organization. The report shall also carry signatures of the student, Internship guides (Internal & External), HOD and the Principal.

Deliverables:

1. Internship Daily Report
2. Final Internship Report
3. Internship Completion Certificate

Evaluation for CIE:

There shall be two reviews and a presentation. Total of 100 CIE marks is distributed as follows:

Review – 1 & 2 (Internal Internship Evaluation Committee)	
Internship Daily Report	10 Marks
Deliverables and Outcomes	10 Marks
Presentation Skills	05 Marks
Review – 1 Total	25 Marks
Review – 2 Total	25 Marks
Review – 1 & 2 (External Internship Evaluation Committee)	
Technical Knowledge	10 Marks
Work Ethic	05 Marks
Deliverables and Outcomes	05 Marks

Ability to Learn, Adapt & Critical Thinking	05 Marks
Review – 1 Total	25 Marks
Review – 2 Total	25 Marks
Grand Total	100 Marks

Evaluation for SEE:

Total of 100 SEE marks is distributed as follows:

SEE (Internal & External Examiners)	
Internship Report	70 Marks
Final Presentation	30 Marks
Grand Total	100 Marks

Course Outcomes:

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

- CO1:** Apply engineering knowledge to real-world industrial or societal problems.
- CO2:** Demonstrate technical competency in a professional environment.
- CO3:** Analyze and solve practical engineering problems using modern tools / techniques.
- CO4:** Communicate effectively through reports and presentations.
- CO5:** Exhibit professional ethics, teamwork, and adaptability.
- CO6:** Inculcate industry practices, workflows, and organizational behavior.

Publication / Patenting			
Semester	VIII	CIE Marks	100
Course Code	23ISSE432	SEE Marks	-
Hrs/Week (L: T: P)	-	Exam Hours	-
Total Hrs	-	Credit	02

Objectives: This course is designed to

1. Enable students to systematically document literature review and research gaps.
2. Train students in research paper writing and publication process.
3. Provide knowledge of patentability search and drafting patent applications.
4. Motivate students to publish research work or file patents.
5. Inculcate ethical research practices.

Procedure for CIE:

1. The project guide from Project Phase I / II shall continue as the research guide, ensuring continuity in converting the completed project work into a research publication or patent.
2. Students shall derive research contributions from their completed project work, focusing on:
 - a. Accurately representing experimental results
 - b. Providing evidence for validated outcomes / effective performance
 - c. Explicit mention of novelty / innovation
3. The evaluation shall be carried out based on the following three major components:

Component 1: Literature Review & Manuscript / Patent Drafting

 - a. Comprehensive literature survey and identification of research gap
 - b. Structuring of research paper / patent document
 - c. Technical depth, methodology, and clarity of presentation
 - d. Patentability analysis (in case of patent track)

Component 2: Submission / Filing

 - a. Submission of manuscript to a reputed Scopus / SCI / WoS indexed journal
OR
Filing of a patent application with appropriate authority
 - b. Submission proof (acknowledgement / application number) is mandatory

Component 3: Publication / Patent Outcome

Publication of article in Scopus / SCI / WoS indexed journal
OR
Publication of patent
4. Marks shall be awarded proportionately based on:
 - a. Paper publication status (accepted / published)
 - b. Patent filing / publication status

5. Students must ensure originality and adherence to ethical practices, including proper citation and avoidance of plagiarism.
6. A plagiarism report shall be submitted, with similarity generally not exceeding 10%, failing which revision and resubmission is required.
7. Progress shall be monitored through periodic reviews by the departmental committee, focusing on:
 - a. Conversion of project work into quality manuscript / patent
 - b. Quality of manuscript / patent drafting
 - c. Readiness for submission / publication
8. The HOD shall constitute publication/patenting evaluation/review committee(s) & the composition shall be as follows:
 - a. HOD or one of the HODs in case of an interdisciplinary project, shall be the Chairman of the committee
 - b. Coordinator shall be member - Convener
 - c. Guide shall be the member
 - d. One/Two senior faculty members nominated by the HOD (may be from different departments in case of an interdisciplinary project jointly nominated by the HODs)

Deliverables:

1. Literature Review Report / Patentability Report
 - a. Representation of problem identification
 - b. Representation of gap analysis
 - c. Survey of recent literature / prior art
2. Manuscript / Patent Draft
Structured manuscript (Abstract, Introduction, Methodology, Results, References)
OR
Patent Draft (Title, Abstract, Claims, Description, Drawings)
3. Submission Proof
Journal submission acknowledgement / Patent filing receipt
4. Paper Publication / Patent Filing / Patent Publication Evidence

