RIT/CSE-10/2025-26.

Date: 21/07/2025

To,
The Dean Academics.
RIT, Rajaramnagar

Subject: Submission of M.Tech Computer Science and Engineering structure and Syllabus for Batch 2025-27 and 2026-28

Respected Sir,

We, the Department of Computer Science and Engineering, are hereby submitting the hard copy of the following document for your kind approval:

1. M.Tech Computer Science and Engineering structure for Batch 2025-27 and 2026-28
2. M.Tech Computer Science and Engineering Syllabus for Batch 2025-27 and 2026-28

We kindly request you to accept the enclosed documents and take the necessary action at your earliest convenience.

Thank you for your attention and support.

Rajarambapu Institute of Technology, Rajaramnagar
Computer Science Engg. Department 415414

Head & BOS Chairman

Department of CSE

Enclosure:

1. M.Tech Computer Science and Engineering structure for Batch 2025-27 and 2026-28
2. M.Tech Computer Science and Engineering Syllabus for Batch 2025-27 and 2026-28

Approved

F.Y. M.Tech						**Semester: I**					
Course Code	**Course**	**Teaching Scheme**				**Evaluation Scheme**					
							Theory Marks			**Practical Marks**	
		L	**T**	**P**	**Credits**	**Scheme**	Max	Min. % for passing		Max	Min. % for passing
CSE129	Foundations of Data Science	3	--	--	2	ISE	30	40	40	--	--
						ESE	70	40		--	--
CSE1016	Machine Learning	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
CSE1026	Advanced Algorithms	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective-I	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective-II	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
CSE134	Research Methodology and IPR	2			2	ISE	50	40	40		
						ESE	50	40			
CSE1106	Machine Learning Laboratory	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
CSE1116	Advanced Algorithms	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
CSE135	Seminar	--	--	2	1	ISE	--	--		50	50
						ESE				50	50
SHE5513	Technical Communication	2			1	ISE	--	--		100	50
TOTAL		**19**	**-**	**06**	**20**						

Total Contact Hours/week:25
Total Credits :20
ISE=In Semester Evaluation, ESE=End Semester Exam,P=Pass,NP=Not Pass

Program Elective-I

Sr. No.	Course Code	Course
1.	CSE130	Big Data Paradigm
2.	CSE1046	Cloud Computing
3.	CSE131	Decision Support System

Program Elective-II

Sr. No.	Course Code	Course
1.	CSE132	Block Chain Technology
2.	CSE1073	Computer Vision
3.	CSE133	Software Engineering and Project Management

F.Y. M.Tech						**Semester: II**					
Course Code	**Course**	**Teaching Scheme**				**Evaluation Scheme**					
							Theory Marks			**Practical Marks**	
		L	**T**	**P**	**Credits**	**Scheme**	Max	Min. % for passing		Max.	Min. % for passing
CSE1152	Deep Learning	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
CSE136	Information and Network Security	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
CSE137	Adhoc Networks	3	-	-	3	ISE	30	40	40		
						ESE	70	40			
	Programme Elective – III	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
	Programme Elective –IV	3	--	--	3	ISE	30	40	40	--	--
						ESE	70	40		--	--
CSE1232	Deep Learning Laboratory	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
CSE139	Information and Network Security Laboratory Lab	--	--	2	1	ISE	--	--		50	50
						ESE	--	--		50	50
	Program Elective -III Laboratory	--	--	2	1	ISE	--	--		50	50
						ESE	--	-		50	50
CSE143	Mini Project	-	-	4	2		-	-		100	50
	TOTAL	**15**	**0**	**10**	**20**						

Total Contact Hours/week: 25
Total Credits :20

ISE=In Semester Evaluation, ESE=End Semester Exam,P=Pass,NP=Not Pass

Program Elective-III

Sr. No.	Course Code	Course
1.	CSE138	Advanced Database Management System
2.	CSE1186	Parallel Computing
3.	CSE139	Industry 4.0 and Industrial Internet of Things

Program Elective-IV

Sr. No.	Course Code	Course
1.	CSE1206	Soft Computing
2.	CSE140	Natural Language Processing
3.	CSE1226	Software Architecture

Program Elective-III Lab

Sr.No.	Course Code	Course
1.	CSE142	Advanced Database Management System Laboratory
2.	CSE1266	Parallel Computing Lab
3.	CSE1276	Internet of Things Lab

S.Y.M.Tech						**Semester:III**				
Course Code	**Course**	**Teaching Scheme**				**Evaluation Scheme**				
							Theory Marks		**Practical Marks**	
		L	**T**	**P**	**Credits**	**Scheme**	Max	Min. % for passing	Max	Min % for passing
CSE 2016	Industry Internship	--	--	-	01	ISE	--	--	100	50
	Open Elective	3	--	--	3	ESE	100	40	--	--
CSE 2026	Dissertation Stage I	--	--	12	6	ISE	--	--	100	50
CSE 2036	Dissertation Stage II	--	--	20	10	ISE	--	--	100	50
						ESE	--	--	100	50
	TOTAL	**3**	**--**	**32**	**20**					

Total Contact Hours/week: 35
Total Credits :20

ISE=In Semester Evaluation, ESE=End Semester Exam,P=Pass,NP=Not Pass

***Note-**Student has to complete industry internship of 02 weeks after second semester however its evaluation will be carried out in third semester.

Open Elective

Sr.No.	Course Code	Course
1.	MOE2012	Artificial Intelligence-Machine Learning
2.	MOE2022	Creative Thinking: Techniques and Tools
3.	MOE2032	MOOC Course
4.	MOE2041	Energy Audit and Management
5.	MOE2062	Augmented Reality and Virtual Reality
6.	MOE2072	Industrial Instrumentation
7.	MOE2082	Advanced Mechatronics systems
8.	MOE2091	Disaster Management

Note for Open Elective

An Open Elective course is included in the curriculum of S.Y. M.Tech (Semester-III),under which students need to learn either MOOC course or courses offered by department.

Guidelines for MOOC course under Open Elective

1. If students opt for MOOC course as an Open Elective, he/she should select this course from NPTEL platform only.
2. As three credits are allotted to open elective,selected MOOC course must be of minimum12 weeks or 30 hours.
3. Students need to solve assignments given by platform and also,give the final certification exam at allotted NPTEL exam center.
4. Student must secure certification of NPTEL platform within program duration, otherwise he/she will not be eligible for final evaluation.
5. If student fails in NPTEL certification course, he or she should re-register for the course in the next semester.

Guidelines for other courses mentioned under Open Elective:

1. Student can opt for courses mentioned in the curriculum.
2. While selecting the course, students must take care that selected course from the list is not learned in UG or PG first year curriculum.
3. Lectures of these courses will be conducted by concerned department faculty by online mode.
4. Evaluation of these courses will be as mentioned in the curriculum.

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S.Y.M.Tech						**Semester: IV**				
Course Code	**Course**	**Teaching Scheme**				**Evaluation Scheme**				
		L	**T**	**P**	**Credits**	**Scheme**	**Theory Marks**		**Practical Marks**	
							Max	Min.% for passing	Max	Min. % f or passing
CSE 2046	Dissertation Stage III	--	--	16	08	ISE	--	--	100	50
CSE 2056	Dissertation Stage IV	--	--	24	12	ISE	--	--	100	50
						ESE	--	--	100	50
	TOTAL		--	**40**	**20**					

Total Contact Hours/week:40
Total Credits :20

ISE=In Semester Evaluation,ESE=End Semester Exam,P=Pass,NP=Not Pass

K.E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)

Syllabus

M. Tech. Computer Science and Engineering

To be implemented for 2025-27 & 2026-28 Batch

Class: - **First Year M Tech.**	Semester-**I**
Course Code: **CSE129**	Course Name: **Foundation of Data Science**

L	T	P	Credits
2	**-**	**-**	**2**

Course Description:

This course equips students with fundamental and advanced skills in data science, emphasizing data analysis, visualization, and analytics techniques. Students will learn to extract meaningful insights from data, apply statistical and machine learning methods, and present results using effective visualizations. The course combines theoretical foundations with hands-on tools.

Course Learning Outcomes:

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

1. Apply statistical and computational techniques to analyze datasets.
2. Analyze different data visualizations techniques.
3. Evaluate data characteristics using hypothesis testing.
4. Explore ethical implications of data science.

Prerequisite: Prerequisites to this course are linear algebra, calculus, and introductory python programming.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Data Science:** Overview of data science and its workflow; Types of data and data sources; Data collection, cleaning, preprocessing. Dimensionality reduction.	4
2	**Data Visualization Techniques:** Principles of effective data visualization; Bar chart, Line charts, Scatterplots, Visualization tools and libraries (e.g., Matplotlib, Seaborn, Plotly); Dashboards and storytelling with data.	4
3	**Statistics and probability:** Describing single set of data, central tendencies, Dispersion, Correlation, Dependence and interdependence, Conditional Probability, Bayes's Theorem, Random variables, Normal distribution, The Central Limit Theorem, Binomial V/s Normal Distribution,	4
4	**Hypothesis and Inference:** Statistical Hypothesis Testing, Using the t-Test, Confidence intervals, Bayesian Inference. Case study examples of testing.	4
5	**Data Processing Case study examples:** clustering, classification, NLP, Recommender systems.	4
6	Ethical implications of data science, Commercial interests versus personal privacy, Computational approaches to preserving privacy, Legal frameworks for regulating data use.	4

References -

Text Book:

- Joel Grus, Data Science From Scratch, O'Reilly Media
- Data Science John D. Kelleher And Brendan Tierney, The MIT Press
- Introduction To Data Science Release 0.1 Steffen Herbold

Reference Books:

- Seema Acharya, Subhasini Chellappan, Big Data Analytics, Wiley
- GitHub - academic/awesome-datascience: :memo: An awesome Data Science repository to learn and apply for real world problems.

Class: - **First Year M Tech.**	Semester-**I**
Course Code: **CSE1016**	Course Name: **Machine Learning**

L	T	P	Credits
3	**-**	**-**	**3**

Course Description:

This course offers an in-depth exploration of advanced machine learning algorithms and paradigms beyond traditional supervised and unsupervised learning. It builds upon foundational knowledge to introduce cutting-edge topics such as semi-supervised and self-supervised learning, unsupervised representation learning, reinforcement learning, meta-learning, and federated learning. Emphasis is placed on mathematical foundations, algorithmic intuition, and practical applicability to real-world and low-data scenarios. Students will gain the skills to critically analyze modern machine learning approaches, address data and model challenges, and develop scalable, privacy-aware, and adaptive solutions. The course prepares learners for research, industry innovation, and continued learning in rapidly evolving ML domains.

Course Learning Outcomes:

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

1. Explain the working principles of advanced machine learning paradigms including semi-supervised, self-supervised, and reinforcement learning.
2. Apply appropriate advanced algorithms such as meta-learning, few-shot learning, and federated learning to solve domain-specific problems.
3. Analyze the performance and limitations of various advanced machine learning models on complex datasets.
4. Design end-to-end machine learning solutions using cutting-edge techniques with privacy, scalability, and data efficiency in mind.

Prerequisite: Basic knowledge of Machine Learning, Fundamental understanding of Python programming.

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Course Content		
Unit No	**Description**	**Hrs**
1	**Mathematical Foundations for Machine Learning:** Review of Linear Algebra, Probability, Statistics, Optimization techniques: Gradient Descent, SGD, Convexity, Bias-Variance Trade-off, Regularization: L1/L2, Elastic Net.	**6**
2	**Semi-Supervised and Self-Supervised Learning:** **emi-Supervised Learning Techniques**: Consistency Regularization (e.g., Π-Model, Mean Teacher), Entropy Minimization, Pseudo-labeling and Self-training, Graph-based methods. **Self-Supervised Learning Concepts**: Pretext tasks and auxiliary learning objectives, Contrastive Learning: SimCLR, MoCo, InfoNCE, Predictive Learning: BYOL, SwAV, Barlow Twins	**6**
3	**Unsupervised and Representation Learning:** Advanced Clustering: DBSCAN, Spectral Clustering, Dimensionality Reduction: t-SNE, UMAP, Manifold Learning, Matrix Factorization, Autoencoders, PCA vs. ICA	**6**
4	**Reinforcement Learning:** Introduction to Reinforcement Learning (RL), Markov Decision Processes (MDPs), Dynamic Programming in RL, Model-Free Prediction and Control: Monte Carlo methods, Temporal Difference (TD) Learning, Q-Learning and SARSA. Deep Reinforcement Learning (Deep RL), Applications of RL.	**6**
5	**Meta-Learning and Few-shot Learning:** Introduction to Meta-Learning: Concepts, motivation, and taxonomy (model-based, metric-based, optimization-based), Metric-based Methods: Siamese Networks, Matching Networks, Prototypical Networks, Relation Networks Optimization-based Methods: MAML (Model-Agnostic Meta-Learning), First-order MAML, Reptile, Meta-SGD	**6**

6	**Federated Learning and Privacy-Preserving Machine Learning** Introduction and Motivation , Federated Learning (FL): Fundamentals, Types of Federated Learning, Privacy-Preserving Techniques, **Applications of FL and Privacy-Aware ML**: Healthcare (e.g., patient data across hospitals), Finance (e.g., fraud detection across banks), Mobile applications (e.g., next-word prediction, personalization)	6

References -

Text Books:

- Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press
- Richard S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press

Reference Books:

- Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, Packt Publishing.

E-Resources:

- https://cs229.stanford.edu/
- https://www.fast.ai/#category=machine%20learning
- https://onlinecourses.nptel.ac.in/noc25_cs46/preview

Class:- **FY M Tech**	Semester- **I**
Course Code : **CSE1026**	Course Name : **Advanced Algorithms**

L	**T**	**P**	**Credits**
3	**-**	**-**	**3**

Course Description:

Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications. In this course, design paradigms are explored in greater depth and more advanced techniques for solving computational problems are presented. This course contains different algorithm design techniques, NP- hard & complete problems, approximation algorithms and heuristic Algorithms. The focus of the course is to understand the basics and recent trends of algorithms.

Course Learning Outcomes:

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

1. Select appropriate algorithm design techniques such as greedy method, dynamic programming, backtracking and heuristic algorithms.
2. Explore different NP problems and approximation algorithmic solutions.
3. Apply backtracking algorithm to solve real world problems.
4. Apply and design parallel algorithms to solve fundamental problems.
5. Apply and compare performance of local search techniques algorithms for solving fundamental combinatorial problems.
6. Compare and design global search techniques for solving engineering/real-world combinatorial problems.

Prerequisite: Basics of computer algorithms

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to design and analysis techniques** Algorithm design techniques: Divide and Conquer, greedy method, dynamic programming, applications.	**5**
2	**NP Completeness** P, NP and NP-Complete complexity classes, non-deterministic algorithms, NP-completeness and reducibility, Important NP Complete Problems - Reduction of standard NP Complete Problems (SAT, 3SAT, Clique, Vertex Cover, TSP), approximation algorithms, randomized algorithms.	**7**
3	**Backtracking** General method, State-Space tree, types of backtracking, applications - N queens Problem, Subset Sum problem, Backtracking for optimization and constraint satisfaction problems, variations of backtracking method.	**6**
4	**PRAM ALGORITHMS** Need of parallel algorithm, Amdahl's law, Parallel algorithms for reduction, prefix sum, list ranking, searching, sorting, matrix multiplication.	**5**
5	**Combinatorial algorithms- Local search techniques** Simulated annealing, tabu search, iterative local search algorithm, variable neighborhood search, applications to knapsack problem, bin packing problem, container allocation problem, resource allocation problem etc.	**6**
6	**Combinatorial algorithms- Global search techniques** Genetic algorithms, Swarm intelligence, applications to resource allocation, timetabling, scheduling in healthcare, cloud computing, wireless sensor network etc.	**7**

References -

Text Books:

- Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, Fundamentals of Computer Algorithms, Universities Press.
- S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd.

Reference Books:

- Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., Introduction to Algorithms, Prentice Hall of India Pvt. Ltd.
- Aho, A.V., Hopcroft J.E. and Ullman, J.D., The Design and Analysis of Computer Algorithms, Pearson Education.

Class : **F.Y. M. Tech.**	Semester : **I**
Course Code: **CSE130**	Course Name: **Program Elective-I-Big Data Paradigm**

L	T	P	Credits
3	-	-	3

Course Description:

The explosion of social media and the computerization of every aspect of social and economic activity resulted in creation of large volumes of mostly unstructured data: web logs, videos, speech recordings, photographs, e-mails, Tweets, and similar. In a parallel development, computers keep getting ever more powerful and storage ever cheaper. Today, we have the ability to reliably and cheaply store huge volumes of data, efficiently analyze them, and extract business and socially relevant information. The key objective of this course is to familiarize the students with most important information aspects of Big Data attributes, its organization and analysis.

The course is intended to build up necessary background for understanding the dynamics of data formats, different types and processing technologies. Moreover, it will assist to formulate the organizational and architectural aspects of big data in NoSQL sense. This course has much importance to analyze the usage of big data in association with advance applications and its design including the wisdom of ethics.

Course Learning Outcomes:

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

1. Analyze big data for business intelligence
2. Explore business case studies for big data analytics
3. Implement map-reduce analytics using hadoop related advance frameworks
4. Apply NoSQL big data management
5. Manage big data with aspects of Security, Privacy and ethics

Prerequisites: RDBMS concepts, Distributed systems, Knowledge of java/python

Course Content		
Unit No.	**Description**	**Hrs**
1.	**Big Data and Its Importance** What is big data, Why big data, Convergence of key trends, Expanding universe of Unstructured data, Industry examples of big data – Digital marketing, Fraud and big data, Risk and big data, Credit risk management, Big data and algorithmic trading, Big data and healthcare, Advertising and big data	**6**
2.	**Big Data Technology** World of parallel processing – Hadoop, Open Source technologies and big data, Cloud and big data, Mobile business Intelligence, Crowdsourcing analytics, Inter and Trans-firewall analytics, Adopting new technology mix	**6**
3.	**Hadoop and Map-Reduce** Hadoop ecosystem, Design of Hadoop distributed file system (HDFS), Anatomy of MapReduce job run, Classic Map-reduce, YARN, Failures in classic Map reduce and YARN, Data format, Analyzing data with Hadoop, Scaling out, Hadoop streaming, Unit tests with MapReduce	**6**
4.	**NoSQL Data Management** Introduction to NoSQL, Impedance mismatch, Emergence of NoSQL, Aggregate data models, Key-value and document data models, Columnfamily stores, Graph databases, Schemaless databases, Distribution models- sharding, Master-slave replication, Peer-peer replication, Sharding and replication, Relaxing consistency – CAP Theorem	**6**
5.	**Analytics Framework** Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services – HiveQL, Querying Data in Hive, Fundamentals of HBase and ZooKeeper	**6**

6.	**Hadoop Ecosystem Security, Data Privacy and Ethics** Steps to secure big data, Protecting–Big Data, Configuring Kerberos for Hadoop, Securing ecosystem components, Privacy landscape, Rights and responsibility, Focus of privacy and Anonymization	**6**

References -

Text Books:

- Michael Mineli, Michele Chambers, AmbigaDhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publication
- P. J. Sadalage, M. Flower , NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence
- Tom White , Hadoop: The Definitive Guide, Oreily Media
- Seema Acharya, SubhasiniChellappan, Big Data Analytics, Wiley
- Sudeesh Narayanan, Securing Hadoop, O Reilly **Reference Books:**
- Douglas Eadline, Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem, Pearson Education
- Chris Eaton, Dirk derooset al. , Understanding Big data, McGraw Hill
- E. Capriolo, D. Wampler, J. Rutherglen, Programming Hive, O Reilley
- Lars George, HBase: The Defenitive Guide, O reilly
- Alan Gates, Programming Pig, O Reilly

Class : **F. Y. M. Tech.**	Semester : **I**
Course Code : **CSE1046**	Course Name: **Program Elective-I (Cloud Computing)**

L	T	P	Credits
3	**-**	**--**	**3**

Course Description:

Cloud computing has evolved as a very important computing model, which enables information, software, and other shared resources to be provisioned over the network as services in an on-demand manner. Students will be exposed to the current practices in cloud computing. Topics include distributed computing models and technologies, service model, virtualization, security and privacy issues, performance and systems issues. It also covers challenges in clouds, data centers, cloud hosted applications and advanced topics in cloud computing.

Course Learning Outcomes:

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

1. Compare cloud computing with other computing technologies.
2. Illustrate the virtualization technologies and its role in enabling the cloud computing system model.
3. Identify and compare different cloud service and deployment models for scientific, business and consumer applications.
4. Describe Aneka platform as a service to design different applications.
5. Compare different cloud services with pros and cons from multiple cloud providers.
6. Describe recent advances in cloud framework/services for solving scientific and business applications.

Prerequisite: Basics of operating system and computer networking.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Introduction** Eras of Computing, defining a cloud, cloud computing reference model, historical developments: Distributed Systems, Virtualization, Web 2.0, Service Oriented Computing, Utility Oriented Computing.	**6**
2.	**Virtualization** Introduction, Characteristics of virtualized Environments, Taxonomy of Virtualization techniques, Virtualization and Cloud computing, Pros and Cons of virtualization, Technology Examples: Xen: Paravirtualization, VMWare: Full Virtualization, Microsoft Hyper-V, Dockers Containerand its configuration.	**6**
3.	**Cloud Computing Architecture** Introduction, Cloud reference Model: Architecture, IaaS, PaaS, SaaS. Types of Clouds: Public, Private, Hybrid and Community Clouds, Economics of the Cloud, Open Challenges.	**6**
4.	**Programming Enterprise Clouds using Aneka** Introduction, Aneka Architecture, Aneka Deployment, Parallel Programming Models, Thread Programming using Aneka, Task Programming using Aneka, and MapReduce Programming using Aneka, Parallel Algorithms, Parallel Data mining, Parallel Mandelbrot, and Image Processing.	**6**
5.	**Cloud Infrastructure and Platforms in Industry** Open Stack: Introduction to open stack, components of open stack, Dev stack. Amazon Web Services: Compute Services; Storage Services; Communication Services and Additional services. Google AppEngine: Architecture and Core concepts, Application Life Cycle, Cost Model. Microsoft Azure: Azure core concepts and SQL Azure, Windows azure platform appliance.	**6**

6	**Advanced Topics and Cloud Applications** Healthcare/agriculture/government data analysis using Cloud/Fog computing, social networking applications, loud automation tools and Dev ops concepts.	6

References :

Text Books:

- Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi, Mastering Cloud Computing, Tata McGraw Hill.

Reference Books:

- Judith Hurwitz, R. Bloor, M. Kanfman and F. Halper, Cloud Computing for Dummies, Wiley India.
- J. Vette, Toby J. Vette and Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw Hill.

Class:- **F.Y. M. Tech.**	Semester- **I**
Course Code : **CSE1046**	Course Name : **Program Elective-I- Decision Support Systems**

L	**T**	**P**	**Credits**
3	**-**	**-**	**3**

Course Description:

This course provides a comprehensive understanding of Decision Support Systems (DSS) and their role in enhancing managerial decision-making. It explores the architecture, components, and development of DSS, including data management, modeling, and user interfaces. Students will learn to apply analytical and modeling techniques such as what-if analysis, optimization, and simulation. The course also examines data-driven and knowledge-based systems, integrating business intelligence, expert systems, and artificial intelligence into decision processes. Emphasis is placed on real-world applications in various domains, as well as ethical, legal, and organizational considerations in deploying modern decision support technologies.

Course Learning Outcomes:

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

1. **Explain** the role of data, models, and user interfaces in supporting decision-making processes.
2. **Apply** decision models, what-if analysis, and optimization techniques in solving structured and semi-structured problems.
3. **Analyze** the integration of data-driven, knowledge-driven, and web-based DSS within enterprise environments.
4. **Evaluate** advanced DSS technologies and ethical considerations in the design and deployment of intelligent decision systems.

Prerequisite: Fundamental understanding of Information Systems and Database Management Systems.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Decision Support Systems** Definition and characteristics of DSS, evolution of DSS, types of decisions and decision-makers, decision-making process, components of DSS (data, model, user interface, knowledge).	**6**
2	**DSS Architecture and Development** DSS components and architecture, data management subsystem, model management subsystem, user interface subsystem, DSS hardware/software platforms, DSS development methodologies and tools, custom vs. off-the-shelf solutions.	**6**
3	**Modeling and Analysis in DSS** Types of models: strategic, tactical, operational; what-if analysis, sensitivity analysis, goal-seeking, optimization, simulation; role of spreadsheets and analytical tools.	**6**
4	**Data-Driven and Knowledge-Driven DSS** Data warehouses, OLAP, data mining in DSS, web-based DSS; knowledge-based DSS, expert systems, inference engines, rule-based reasoning, integration with AI/ML techniques.	**6**
5	**Decision Support in the Enterprise** Group Decision Support Systems (GDSS), Collaborative Systems, Executive Information Systems (EIS), enterprise DSS, business intelligence, dashboards, case studies in finance, marketing, healthcare, and supply chain.	**6**
6	**Recent Trends and Ethical Considerations:** Intelligent DSS, cognitive systems, recommendation systems, decision automation, explainability in AI-based DSS, ethical and legal issues in decision support, privacy, transparency, and accountability.	**6**

References -

Text Books:

- Efraim Turban, Ramesh Sharda, Dursun Delen, Decision Support and Business Intelligence Systems, Pearson Education

Reference Books:

- George M. Marakas, Decision Support Systems in the 21st Century, Pearson.
- Vicki L. Sauter, Decision Support Systems for Business Intelligence, Wiley.

E-Resources:

- MIT OpenCourseWare – Decision Support Systems
- IBM Cloud Decision Optimization Tutorials
- Tableau and Power BI official documentation
- DSSResources.com – Articles, case studies, and frameworks

Class : **F. Y. M.Tech**	Semester : **I**
Course Code : **CSE132**	Course Name : **Program Elective-II - Block Chain Technology**

L	T	P	Credits
3		-	3

Course Description:

Blockchain is an emerging technology platform for constructing decentralised apps and data storage. This platform's central concept is that it enables the creation of a distributed and replicated ledger of events, transactions, and data generated by various IT processes, with strong cryptographic assurances of tamper resistance, immutability, and verifiability. Even when untrusted people are participants of distributed apps with the ability to transact on the network, public blockchain systems allow us to ensure these qualities with overwhelming probabilities. Many academics are working on decentralised public key infrastructure, self-sovereign identity management, registry maintenance, health record management, decentralised authentication, decentralised DNS, and other similar use cases. In addition, companies like IBM and Microsoft are creating their own apps in domains like the Internet of Things (IoT), and are even allowing blockchain systems on the cloud.

Course Learning Outcomes:

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

1. Identify basic cryptographic primitives utilised in Blockchain- Secure, collision-resistant hash functions, digital signatures, public key cryptosystems, and zero-knowledge proof systems
2. Explain basic Distributed System concepts – distributed consensus and atomic broadcast, Byzantine fault-tolerant consensus methods
3. Compare Basic Blockchain (Blockchain 1.0), Blockchain 2.0 and Blockchain 3.0
4. Design various Blockchain applications

Prerequisite: Expertise In Programming, Basic Knowledge of Computer Security, Cryptography, Networking, Concurrent or Parallel Programming

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction** History of Blockchain – Types of Blockchain, Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers,consensus, byzantine fault-tolerant distributed computing, digital cash etc.	6
2	**Basic Distributed Computing** Atomic Broadcast, Consensus, Byzantine Models of fault toleranceBasic Crypto primitives:Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems	6
3	**Blockchain Technology versions** **Blockchain 1.0 :** Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use **Blockchain 2.0 :** Ethereum and Smart Contracts: Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts **Blockchain 3.0 :** Hyperledger fabric, the plug and play platform and mechanisms in permissioned Blockchain.	6
4	**Blochchain Technology Applications** Introduction to Decentralized Applications, Blockchain Mining, Whisper, Swarm, Forks.Medical Record Management System, Domain Name, Service and future of Blockchain	6

5	**Case Studies of Blockchain in Cognitive Applications** IBM Block Chain, Blockchain in Health care Innovation, AI Marketplaces, Investment Management Platforms, Future of AI and Block Chain	**6**
6	**Privacy, Security issues in Blockchain** Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - -advent of algorand, and Sharding based consensus algorithms to prevent these	**6**

References -

Text Books:

Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Cryptocurrency", CreateSpace Independent Publishing Platform

Scott Marks, "Blockchain for Beginners: Guide to Understanding the Foundation and Basics of the Revolutionary Blockchain Technology", CreateSpace Independent Publishing Platform

Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press.

Reference Books:

- Mark Watney, "Blockchain for Beginners".
- Alwyn Bishop, "Blockchain Technology Explained".
- J.H. Huiwitz, M.Kaufman, A.Bowles, "Cognitive Computing & Big Data Analystics",Wiley Publication.

MOOC / NPTEL Courses:

- NPTEL Course "Introduction to Block Chain Technology & Applications" https://nptel.ac.in/courses/106/104/106104220/
- NPTEL Course on "Blockchain Architecture & Use Cases" https://nptel.ac.in/courses/106/105/106105184/

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Class:- **F Y M Tech CSE**	Semester- **I**
Course Code : **CSE1073**	Course Name : **Program Elective-II- Computer Vision**

L	T	P	Credits
3	**0**	**0**	**3**

Course Description:

This course covers the introductory components of Computer Vision. Topics include introduction to computer vision, fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking.

Course Learning Outcomes:

After learning the course, the students should be able to:

1. Describe Image formation processs (BL2).
2. Apply fundamental image processing techniques required for computer vision (BL3).
3. Analyze 3-D vision. (BL4)
4. Generate and evaluate appropriate 3D model from images. (BL5)

Prerequisite: Matrix operations, Preliminary Statistics and Probability theory would be useful.

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Course Content		
Unit No	**Description**	**Hrs**
1	**The image, its representation and properties:** Image digitization, Histograms, Image Quality, Color spaces, Palette Images, Color camera.	6
2	**The image, its mathematical and physical background:** Eigen-analysis, Singular value decomposition, Principal component analysis, Image capture and geometric optics, Image capture from a radiometric point of view, Surface reflectance.	6
3	**Image pre-processing:** Matrices, Convolution, Linear filtering, Chains, Segmentation, Relational structures, Pyramids, Quadtrees, Gray-scale transformations, affine transformation, Averaging filters, Edge detectors, unsharp masking, Robert, Prewitt, Sobel operators, LoG, Canny edge detection, Parametric edge models, Edges in multi-spectral images, Image restoration, Relative motion of camera and object,	6
4	**3D Vision, geometry and radiometry:** Geometry of a linear perspective camera, Camera calibration from a known scene, Scene reconstruction from multiple views, Projective reconstruction, Matching constraints, Geometry of two cameras, Relative motion of the camera; essential matrix, Stereo correspondence algorithms, Correlation-based block matching, Reconstructing shape from shading,	6
5	**Use of 3D vision:** Shape from motion, Shape from optical flow, Shape from texture, Line labelling, Decimation of a triangulated surface, Structure from Motion pipeline,	6

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6	**Motion analysis:** Differential motion analysis methods, Optical flow computation, Optical flow in motion analysis, Distance (depth) determination, Lucas–Kanade point tracking, median filter approach to background maintenance in background modelling.	

References -

Text Books:

- Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle, Cengage Learning.
- Computer Vision Tutorial - GeeksforGeeks

Reference Books:

- Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
- Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
- R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc.
- Richard Szeliski, Computer Vision: Algorithms and Applications. Springer, 2010

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Syllabus

M. Tech. Computer Science and Engineering

To be implemented for 2025-27 & 2026-28 Batch

Class:- **FY M.Tech**	Semester-**I**
Course Code : **CSE133**	Course Name : **Program Elective-II-Software Engineering and Project Management**

L	T	P	Credits
3	-	-	3

Course Description:

This course provides a comprehensive introduction to software engineering and project management, equipping students with the knowledge and skills required to successfully plan, execute, and manage software projects. Covering essential topics such as software requirements analysis, project estimation, scheduling, risk management, and human resource management, the course emphasizes both technical and managerial aspects of software development. Through the study of industry-standard tools and methodologies various requirement elicitation techniques—students will learn to address real-world challenges in project planning, procurement, outsourcing, and team leadership. By the end of the course, students will be able to analyze, design, and manage software projects effectively, ensuring reliability, efficiency, and stakeholder satisfaction.

Course Learning Outcomes:

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

- Describe fundamental concepts of software engineering and project management, including project phases, stakeholder roles, and basic terminology.
- Explain various software requirement analysis and specification techniques, and describe the processes involved in software estimation and project planning.
- Apply appropriate tools and techniques to analyze, plan, and schedule software projects, including estimation and resource allocation.
- Evaluate and recommend effective risk management, reliability strategies, and human resource practices to enhance software project success and address real-world project challenges.

Prerequisite: Understanding of Software Engineering Concepts.

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Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to software engineering and project management** Introduction to Software Engineering: Software, Evolving role of software, Three "R"-Reuse, Reengineering and Retooling, An Overview of IT Project Management: Define project, project management framework, The role of project Manager, Systems View of Project Management, Stakeholder management, Project phases and the project life cycle.	4
2	**Software Requirement Analysis and Specification** Types of Requirement: Functional, Non-functional, Interface, Domain, Quality Attribute Scenarios, Service-Level Agreements (SLAs). Feasibility Study: Technical, Economic, Legal, Operational, Schedule, Risk-based Feasibility, Environmental and Social Impact Assessment. Requirement Analysis and Design: Domain-Driven Design (DDD), Story Mapping.Requirement Elicitation: Joint Application Development (JAD), Behavior-Driven Development (BDD).Cost Estimation: Analogy-Based Estimation, Parametric Tools (SEER-SEM, SLIM), ML-based Prediction Models. Earned Value Management	8
3	**Software Project Planning** Business Case, Project selection and Approval, Project charter, Project Scope management: Scope definition and Project Scope management, Creating the Work Breakdown Structures, Scope Verification, Scope Control.	6
4	**Project Scheduling and Procurement management** Relationship between people and Effort: Staffing Level Estimation, Effect of schedule Change on Cost, Degree of Rigor & Task set selector, Project Schedule, Schedule Control, CPM (Numericals), Basic Planning Purchases and Acquisitions, Planning Contracting, Requesting Seller Responses, Selecting Sellers, Out Sourcing: The Beginning of the outsourcing phenomenon, Types of outsourcing relationship, The realities of outsourcing, Managing the outsourcing relationship	8

5	**Software Risk Management and Reliability issues** Risk Management: Identify IT Project Risks including Cybersecurity, Privacy, Compliance, and Business Continuity Risks, Risk Analysis and Assessment Qualitative, Quantitative, and Monte Carlo Simulation-based, Risk Prioritization Techniques(Risk Exposure, Risk Burn-Down, Failure Mode and Effects Analysis - FMEA, Risk Strategies, Risk Monitoring and Control, Risk Response and Evaluation Reliability Growth Modeling Jelinski-Moranda, Musa-Okumoto, Bayesian Models, and Machine-Learning-based Predictive Reliability Models, Reliability Testing Techniques Stress, Load, Chaos Engineering.	4
6	**Human Resource Management** Human Resource Planning, Acquiring the Project Team: Resource Assignment, Loading, Leveling, Developing the Project Team: Team Structures, Managing the Project Team, Change management: Dealing with Conflict & Resistance Leadership & Ethics.	6

References -

Text Books:

- Walker Rayce, "Software Project Management", PEA.
- Henrey, "Software Project Management", Pearson.

Reference Books

- Richard H.Thayer." Software Engineering Project Management", IEEE Computer Society.

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Syllabus

M. Tech. Computer Science and Engineering

To be implemented for 2025-27 & 2026-28 Batch

Class:- **F. Y. M. Tech**	Semester- **I**
Course Code : **CSE134**	Course Name : **Research Methodology and IPR**

L	T	P	Credits
2	-	-	2

Course Description:

The research methodology course aims to give students a broad understanding of research methodology and Intellectual property rights. The course content aims to develop research problem by critically analyzing literature and present it effectively technically. This course also introduces ethics in publication, databases and research metrics. The types and new developments in intellectual property at national as well as international level introduced to learners.

Course Learning Outcomes:

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

1. Formulate a research problem.
2. Analyze research related information.
3. Prepare and present research proposal / paper by following research ethics.
4. Make effective use of computers and computing tools to search information, analyze information and prepare report.
5. Describe nature and processes involved in development of intellectual property rights.

Prerequisite: Nil

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Research Problem** Meaning of Research Problem, Sources of Research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and Objective of research problem	6
2	**Literature Studies** Effective literature studies approaches, Plagiarism, Research ethics, Approaches of investigation of solutions for research problem, Data collection, Data analysis with software, Interpretation.	6
3	**Effective Technical Writing** Effective technical writing, How to write technical report and paper, Developing a research proposal, A presentation and assessment by a review committee.	6
4	**Publication Ethics, Databases and Research Metrics** Publication Ethics: Introduction, Best practices and Guidelines, COPE, WAME, Publication misconduct, Violation of publication ethics, Authorship and Contribution, Identification of publication misconduct, Predatory publisher and Journals, Open Access Publications, Journal Finder. Databases: Indexing and Citation databases. Research metrics: Impact factor – JCR, SNIP, SJR, IPP, Cite score, h-index, g-index.	6
5	**Nature of Intellectual Property** Patents, Patentability, Designs, Trade and Copyright, Geographical indications, Process of patenting and development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual property, Procedure for grants of patents, Patenting under PCT.	6

6	**Patent Rights and New Development in IPR** Scope of patent rights, Licensing and transfer of technology, Patent information and databases, Administration of Patent system, New developments in IPR, IPR of biological systems, Computer software, etc., Traditional knowledge case studies.	6

References -

Text Books:

- Stuart Melville and Wayne Goddard, "Research Methodology: An Introduction for Science and Engineering Students", Juta & Co Ltd.
- Ranjit Kumar, Research Methodology: A step by Step Guide for Beginners", SAGE Publishers.
- Halbert, "Resisting Intellectual Property", Tayler & Francis Ltd.

Reference Books:

- Ryhan Ebad, "Research Methodology in Computer Science", Centrum Press.
- C.R. Kothari and Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International (P) Ltd.
- Official website of Intellectual Property India: http://www.ipindia.nic.in/

Class:- **F Y M Tech**	Semester- **I**
Course Code : **CSE1106**	Course Name : **Machine Learning Lab**

L	T	P	Credits
-	-	**2**	**1**

Course Description:

This Machine Learning Laboratory course is designed to provide practical experience with advanced machine learning techniques and frameworks. The course complements the theory syllabus by enabling students to implement, experiment with, and evaluate algorithms across various modern ML paradigms including semi-supervised learning, self-supervised learning, representation learning, reinforcement learning, meta-learning, and federated learning. Students will work with real-world datasets and open-source tools to build robust machine learning pipelines. The lab cultivates hands-on problem-solving abilities, promotes innovation through a focused mini-project, and reinforces a strong foundation in ethical, responsible, and real-world applications of machine learning.

Course Learning Outcomes:

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

1. Demonstrate data preparation, transformation, and visualization techniques.
2. Implement advanced ML algorithms using Python and open-source libraries.
3. Evaluate and compare models based on relevant performance metrics.
4. Design end-to-end ML pipelines and research-oriented solutions using real-world or benchmark datasets.

Prerequisite: Basic knowledge of Machine Learning, Fundamental understanding of Python programming.

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It should consist of 12 to 15 experiments based on the syllabus and experiment list mentioned below.

Course Content		
Experiment No	**Description**	**Hrs**
1.	Implement gradient descent and stochastic gradient descent (SGD) for convex optimization problems.	**2**
2.	Apply L1 and L2 regularization on a linear regression model and analyze bias-variance trade-off.	**2**
3.	Implement pseudo-labeling and consistency regularization for semi-supervised classification.	**2**
4.	Train a contrastive learning model (e.g., SimCLR or MoCo) using self-supervised learning on an image dataset.	**2**
5.	Perform clustering using DBSCAN and Spectral Clustering on high-dimensional data.	**2**
6.	Visualize and compare t-SNE and UMAP on real-world data for dimensionality reduction	**2**
7.	Build and train an autoencoder for unsupervised representation learning	**2**
8.	Implement Q-learning and SARSA for a simple reinforcement learning task (e.g., grid world)	**2**
9.	Train a Deep Q-Network (DQN) using OpenAI Gym for a game-like environment (e.g., CartPole)	**2**
10.	Implement prototypical networks or Siamese networks for few-shot image classification	**2**
11.	Apply MAML (Model-Agnostic Meta-Learning) using a few-shot learning library (e.g., learn2learn)	**2**

12.	Implement federated learning on a simulated environment using TensorFlow Federated or Flower, and explore differential privacy	**2**
13.	Design and develop a mini-project using advanced machine learning techniques to solve a real-world or research-oriented problem, demonstrating creativity, model evaluation, and ethical considerations.	**2**

References -

Text Books:

- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media.
- Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, Packt Publishing.

Reference Books:

- Richard S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press
- Ian Goodfellow. Yoshua Bengio. Aaron Courville. Deep Learning. MIT Press

E-Resources:

- TensorFlow Federated: https://www.tensorflow.org/federated
- Learn2Learn (Meta-Learning Library): https://github.com/learnables/learn2learn
- OpenAI Gym (Reinforcement Learning Environments): https://www.gymlibrary.dev/
- PyTorch Tutorials: https://pytorch.org/tutorials/
- Scikit-learn Documentation: https://scikit-learn.org/stable/

Class:- **FY M Tech**	Semester- **I**
Course Code : **CSE1116**	Course Name : **Advanced Algorithms Laboratory**

L	T	P	Credits
-	-	2	1

Course Description:

Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications.In this course, design paradigms are explored in greater depth and more advanced techniques for solving computational problems are presented. This course contains different algorithm design techniques, NP- hard & complete problems, approximation algorithms and heuristic Algorithms. The focus of the course is to understand the basics and recent trends of algorithms.

Course Learning Outcomes:

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

1. Select appropriate algorithm design techniques such as greedy method, dynamic programming, backtracking and heuristic algorithms.
2. Apply backtracking algorithm to solve real world problems.
3. Explore different NP problems and approximation algorithmic solutions.
4. Apply and design parallel algorithms to solve fundamental problems.
5. Apply and compare performance of local search techniques algorithms for solving fundamental combinatorial problems.
6. Compare and design global search techniques for solving engineering/real-world combinatorial problems.

Prerequisite: Basics of computer algorithms

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Course Content		
Experiment No	**Description**	**Hrs**
1.	Implementation of algorithms for problems that can be solved by one or more of the following strategies : Divide and Conquer, Brute force, Greedy.	**2**
2.	Implementation of dynamic programming technique. (Problems- Travelling salesperson problem, 01knapsack problem, reliability problem etc.)	**4**
3.	Implementation of backtracking algorithm. (Problems- Queen problem, 01 knapsack problem, timetabling problem etc.)	**4**
4.	Implementation of parallel algorithms for fundamental problems such as sorting, searching, merging.	**4**
5.	Implementation of probabilistic algorithm for sorting/searching problem.	**2**
6.	Implementation of hill climbing algorithm.	**2**
7.	Implementation of variable neighborhood search algorithm.	**4**
8.	Implementation of Genetic algorithms.	**4**

References -

Text Books:

- Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, Fundamentals of Computer Algorithms, Universities Press.
- S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd.

Reference Books:

- Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., Introduction to Algorithms, Prentice Hall of India Pvt. Ltd.
- Aho, A.V., Hopcroft J.E. and Ullman, J.D., The Design and Analysis of Computer Algorithms, Pearson Education.

Class : **F. Y. M. Tech.**	Semester : **I**
Course Code : **CSE135**	Course Name: **Seminar**

L	T	P	Credits
-	-	2	1

Course Description

This course is designed to initiate M.Tech (CSE) students into the process of structured research exploration and scholarly communication. Each student is required to identify and study a recent research paper from reputed journals or conferences such as IEEE, Springer, Elsevier, or other peer-reviewed sources in the field of Computer Science and Engineering.

Under the guidance of a faculty supervisor, students must conduct a comprehensive literature survey, critically analyze recent research advancements, and present their findings through a technical seminar. The topic selected must form the basis of the Mini-Project to be undertaken in Semester II. Emphasis is placed on research motivation, applicability, innovativeness, and future scope.

Course Learning Outcomes

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

- Conduct a focused and systematic literature review
- Identify state-of-the-art trends and open research problems
- Critically evaluate methodologies and research gaps
- Present technical content with academic rigor and clarity
- Formulate a feasible problem statement for the upcoming Mini-Project and Disseration

Prerequisite

- Fundamental understanding of core CSE subjects
- Familiarity with technical literature reading and basic research methodology
- Basic skills in academic writing and presentation

Guidelines

- Identification of a relevant and recent research problem
- Consultation with assigned faculty supervisor for topic refinement
- Literature survey peer-reviewed papers (national/international)
- Comparative analysis of existing methods, research gaps, and open challenges
- Preparation of a technical seminar report in the prescribed departmental format
- Seminar presentation before the Department Postgraduate Committee (DPGC)
- Framing of a problem statement and mini-project direction for Semester II and Dissertation work for Semester III and IV.

Course Deliverables

- Finalized seminar topic with approval from the supervisor
- Annotated bibliography of reviewed research papers
- Technical seminar presentation slides
- Seminar report (2 hard copies + soft copy in departmental format)
- Problem outline draft for the Mini-Project
- Viva-voce and Q&A before DPGC

Evaluation Scheme

Component	Weightage
Relevance and quality of paper selection	10%
Depth of literature analysis	25%
Seminar report quality	20%
Presentation skills and clarity	25%
Viva-voce and Mini-Project readiness	20%

Class: **F. Y. M. Tech**	Semester: **I**
Course Code: **SHP5513**	Course Name: **Technical Communication**

L	T	P	Credits
02	**--**	**--**	**01**

Course Description:
This course is designed to enhance students' ability to create well-structured technical documents and deliver impactful oral presentations. It emphasizes the principles of effective technical writing and explores various document types commonly used in technical fields and research. While the primary focus is on writing skills, the course also integrates oral communication skills, preparing students for professional presentations in diverse workplace settings.

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

1. Construct grammatically correct sentences in different types of technical writing, such as reports and proposals.
2. Apply technical writing skills to improve the readability of documents.
3. Demonstrate professional skills required in job interviews and at workplaces.

Prerequisite: Students enrolling in this course should have adequate LSRW abilities in English language.

Course Contents		
Unit No.	**Description**	**Hrs.**
1.	**Planning and Preparation** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	**4**
2.	**Paraphrasing and Plagiarism** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism	**3**
3.	**Structural Framework of Research Article** Abstract, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, and The Final Check.	**3**
4.	**Sections of Research Article: Part- I** Key skills needed when writing a Title, key skills needed when writing an Abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature,	**4**
5.	**Sections of Research Article: Part- II** Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, useful phrases, how to ensure good quality of the paper at the time of submission	**4**
6.	**Professional skills** Resume Writing, e-mails, Interview skills, Dos and Don'ts while Answering, FAQs, GROUP DISCUSSION: Structured and Unstructured GD, Opening and Closure, Showing Agreement and Disagreement	**6**

Reference Books:

- Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London.
- Day R, How to Write and Publish a Scientific Paper, Cambridge University Press.
- Goldbort R, Writing for Science, Yale University Press (available on Google Books).
- Jeff Butterfield, Soft Skills for Everyone, Cengage Learning India Private Limited.
- John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press.
- Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition.

Class:- **F.Y. M. Tech.**	Semester- **II**
Course Code : **CSE1152**	Course Name : **Deep Learning**

L	**T**	**P**	**Credits**
3	**0**	**0**	**3**

Course Description:

This course covers description and applications of single layer and multilayer neural networks, convolutional neural networks, generative adversarial neural networks, transformer networks. The course contents enable students to develop and evaluate deep learning networks for solving real world problems.

Course Learning Outcomes:

At the end of the course the student should be able to:

CO1: Apply various approaches for training of the neural network and Deep Learning networks.

CO2: Analyse working of the neural networks and Deep Learning networks with reference to certain case study examples.

CO3: Analyse performance of Generative Adversarial Network.

CO4: Develop typical applications of deep learning networks for solving real world problems.

Prerequisite: Understanding of Machine Learning, Linear Algebra, and Probability theory would be desired.

Course Content		
Unit No	**Description**	**Hrs**
1	**Foundations of Neural Networks:** Biological neuron, Perceptron, XOR Problem, Multilayer Feed forward networks, Activation function, Back Propagation Algorithm, SGD, Loss function, Learning rate, Regularization, Momentum term, Sparsity.	6
2	**Deep Learning Networks and training:** Hyperparameters, Nesterov, AdaGrad, RMSProp, ADAM, Noise Robustness, Early stopping, Dropout, Minibatching. Autoencoders,	6
3	**Recurrent neural Networks:** Vanishing Gradient Problem, LSTM networks, GRU, Back Propagation Through Time (BPTT), Recursive Neural Networks, Applications of recursive neural network.	6
4	**Convolutional Neural Network (CNN):** CNN, Convolution, Stride, padding, Pooling, LeNet, AlexNet, ZFNet, VGGNet, GoogLeNet. Case study examples of CNN.	6
5	**Generative Adversarial Networks (GANs):** Architecture of GANs, Generator and Discriminator, Training and challenges of GANs, Deep reinforcement learning, Attention Mechanisms and Transformer models.	6
6	**DL Applications:** Overview of applications in computer vision, Natural Language Processing, AI in healthcare, autonomous systems, Transfer learning and fine-tuning models for specific tasks, Ethical considerations in AI and deep learning, Future directions in deep learning.	6

References-

Text Books:

- "Deep learning" Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
- Evolution of CNN Architectures: LeNet, AlexNet, ZFNet, GoogleNet, VGG and ResNet
- "Neural networks and deep learning" Aggarwal, Charu C springer.
- "Deep Learning" A Practioner's Approach, O'REILLY, Josh Patterson & Adam Gibson.

Reference Books:

- https://github.com/topics/deep-learning
- "Dive into Deep Learning" Aston Zhang, Zachary C Lipton, Mu Li and Alexander J. Smola. (Dive into Deep Learning — Dive into Deep Learning 1.0.3 documentation)

Class: **F.T. M.Tech**	Semester: **II**
Course Code: **CSE136**	Course Name: **Information and Network Security**

L	T	P	Credits
3	-	-	3

Course Description:

This course introduces the fundamental principles of information and network security. It covers core topics such as confidentiality, integrity, and authentication; classical and modern encryption techniques (DES, AES, RSA); hash functions and message authentication codes (MAC); secure communication protocols (SSL/TLS, HTTPS, SSH); and system-level defenses like firewalls and malware detection. Students will gain hands-on experience in implementing basic cryptographic algorithms and analyzing security protocols using open-source tools.

Course Learning Outcomes:

1. After successful completion of the course, students will be able to,
2. Define basic concepts of computer security, attacks, and classical encryption. (L1)
3. Explain DES, AES, RSA and their cryptographic operations. (L2)
4. Apply hash and MAC algorithms for data integrity and authentication.(L3)
5. Analyze secure communication protocols like SSL, HTTPS, and S/MIME. (L4)
6. Evaluate threats from malware and configure firewalls for system protection. (L5)

Prerequisite: Basic knowledge of computer networks, Familiarity with operating systems and data structures

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Information and Network Security** Computer Security Concepts, OSI Security Architecture, Security Attacks, Services, Mechanisms, Symmetric Cipher Model, Substitution Techniques: Caesar, Monoalphabetic, Playfair	**6**
2	**Modern Symmetric Encryption: DES and AES** DES: Structure, Rounds, Key Scheduling, Security of DES, Design Principles, AES: Structure, Byte Substitution, Shift Rows, Key Expansion in AES	**6**
3	**Public Key Cryptography and RSA** Principles of Public-Key Cryptosystems, RSA Algorithm – Key Generation, Encryption/Decryption, Security of RSA and Key Management, Applications of Public-Key Cryptography	**6**
4	**Authentication, MACs, and Hash Functions** Authentication Requirements and Functions, Message Authentication Codes (MAC) and HMAC, Secure Hash Algorithms (SHA-1, SHA-2), Digital Signatures – Concept and Applications	**6**
5	**Transport Layer and Email Security** Web Security Considerations, Secure Sockets Layer (SSL) and TLS, HTTPS and SSH, Email Security: PGP and S/MIME Overview	**6**
6	**System Security and Firewalls** Malicious Software: Viruses, Worms, Trojans, Overview of Intruders and Detection Concepts, Firewalls: Types, Characteristics, Configurations, Security Trends and Challenges	**6**

References -

Text Books:

- Cryptography and Network Security: Principles and Practice by William Stallings, 6th Edition, Pearson.

Reference Books:

- Cryptography and Information Security,V K Pachghare, PHI, 2nd Edition

Class : **F.Y. M. Tech.**	Semester : **II**
Course Code : **CSE137**	Course Name: **Adhoc Network**

L	T	P	Credits
3	-	-	3

Course Description:

The course consists some advanced networking concepts with Wireless network, Ad-Hoc Network, Sensor Network. Wireless local area networks (WLAN) emphasis on the IEEE P802.11 family of WLAN standards, commonly known as Wi-Fi. Students will learn versions of the standard, current generation of WLAN systems (802.11a/g/n), Ad-Hoc network focus on MAC protocol and Routing in Ad Hoc Networks. The Course also contain Sensor Network with unique Constraints and Challenges with MAC, Routing and Transport Protocols in WNS.

Course Learning Outcomes:

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

1. Discuss the design and research issues in wireless networks
2. Demonstrate the working of 802.11 a/g/n wireless standards
3. Apply the different types of routing protocols in ad-hoc networks.
4. Analyze different protocols in MAC, Routing and Transport Control for Sensor Networks

Prerequisite: Acquaintance with the Computers and Internet, Knowledge of Computer networks

Course Content		
Unit No	**Description**	**Hrs**
1.	**Overview of Wireless Networks** Introduction to Wireless Transmission: Evolution of wireless network, challenges, Electromagnetic Spectrum, wireless propagation characteristics and Modelling, Analog and digital data, modulation Techniques for wireless Network, Multiple Access for wireless system, Wireless services: Circuit and Data Mode.	**6**
2.	**Wireless LAN** Introduction: Benefits of wireless LAN, Application, Wireless LAN Topologies, Wireless LAN requirement, Physical Layer: Infrared Physical Layer, Microwave based, MAC Layer: HIPERLAN 1 MAC Sublayer, IEEE 802.22 MAC Sublayer, WLAN standards: 802.11a,802.11b, 802.11.g.	**6**
3.	**Ad Hoc Networks** An Introduction, Issues in Ad-hoc Network: Medium Access Scheme, Routing, Multicasting, Transport Layer Protocol, Pricing Scheme, QOS,Self-Organization, Security, Ad hoc wireless Internet.	**6**
4.	**MAC protocol and Routing in Ad Hoc Networks** Introduction, Issues in designing MAC protocol, Design goals of MAC protocol, Classification of MAC protocols, Contention based protocols. Routing: Introduction, Issues in designing a routing protocol for ad hoc wireless networks, Classification of routing protocols, Table driven, on-demand routing protocols.	**6**
5.	**Sensor Network: Introduction & MAC Protocol** Application, Sensor Node Technology, Fundamental of MAC Protocol, MAC Protocol for WSN: Schedule-based Protocol, Random Access-Based Protocol.	**6**

6	**Sensor Network: Routing & Transport Control Protocol** Routing Challenges &design issues in wireless sensor network, Traditional Transport control Protocol, Transport Protocol Design Issue, Examples, and Performance, Operating Systems for WNS.	**8**

References:

Text Books :

- C. S. R. Murthy & B. S. Manoj, "Ad Hoc wireless Networks – Architecture and Protocols", Pearson Education.
- P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou & A. S. Pompportsis , "Wireless Networks", Wiley Publication.
- K. Sohraby, D. Minoli, T. Znati. "Wireless Sensor Networks" by Wiley publication.

Reference Books :

- O. K. Tonguz and G. Ferrari, "Ad hoc Wireless Networks – A communication Theoretic perspective", Wiley India.
- Charles E. Perkins, "Ad Hoc Networking", Pearson Education.

Class:- **F.Y. M. Tech..**	Semester- **II**
Course Code : **CSE138**	Course Name : **Program Elective-III- Advanced Database Management System**

L	T	P	Credits
3	-	-	3

Course Description:

This course provides an in-depth study of advanced topics in database management systems, building upon foundational DBMS knowledge. It explores query processing and optimization techniques, advanced transaction management, and concurrency control mechanisms. The course introduces distributed and parallel database architectures, along with modern non-relational database systems such as NoSQL and graph databases. It also covers data warehousing concepts and big data frameworks like Hadoop and Spark. Emphasis is placed on understanding system internals, practical implementation strategies, and emerging technologies to manage complex and large-scale data systems.

Course Learning Outcomes:

1. After successful completion of the course, students will be able to,
2. Describe query processing steps, join strategies, indexing techniques, and cost-based optimization used in relational databases.
3. Apply transaction and concurrency control mechanisms such as 2PL and timestamp ordering to maintain data consistency.
4. Analyze distributed and parallel database systems to determine suitable fragmentation, replication, and query strategies.
5. Compare and evaluate object-oriented, temporal, and NoSQL databases based on structure, use cases, and consistency models.
6. Design a data warehousing solution and big data processing framework using OLAP, ETL, Hadoop, and Spark for large-scale analytical workloads.

Prerequisite: Basic knowledge of relational databases, SQL, and introductory DBMS concepts

Course Content		
Unit No	**Description**	**Hrs**
1	**Query Processing and Optimization:** Query evaluation plans, cost estimation, Selection operations and join strategies, External sorting and indexing in query execution, Heuristics-based and cost-based optimization	**6**
2	**Transaction Management and Concurrency Control:** ACID properties and transaction states, Serializability and recoverability, Concurrency control: 2PL, timestamp ordering, Deadlocks: prevention, detection, and recovery	**6**
3	**Distributed and Parallel Databases:** Architecture of distributed databases, Data fragmentation and replication, Distributed query processing and optimization, Parallel database architecture and parallel query evaluation	**6**
4	**Object-Oriented and Temporal Databases:** Object-relational features and OODBMS concepts, Storage and indexing in object databases, Temporal database concepts and time-stamping techniques, Querying temporal data	**6**
5	**NoSQL and New Data Models:** Limitations of RDBMS and need for NoSQL, Types of NoSQL databases: Key-value, Document, Column-family, Graph, CAP Theorem and BASE properties, Case studies: MongoDB, Cassandra, Neo4j	**6**
6	**Data Warehousing and Big Data:** Data warehouse architecture and OLAP operations, ETL processes and data cube computation, Introduction to Hadoop ecosystem and HDFS, MapReduce and Spark basics for database operations	**6**

References -

Text Books:

- Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education
- Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, McGraw Hill

Reference Books:

- M. Tamer Özsu and Patrick Valduriez, Principles of Distributed Database Systems, Springer
- Pramod J. Sadalage and Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison-Wesley
- Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom, Database Systems: The Complete Book, Pearson

Class:- **F.Y. M. Tech.**	Semester- **II**
Course Code : **CSE1186**	Course Name : **Program Elective-III- Parallel Computing**

L	**T**	**P**	**Credits**
3	**-**	**-**	**3**

Course Description:

This course introduces the fundamentals of parallel computing with the GPU and the CUDA programming environment. This course experience the parallel programming, which consists of CUDA programming model features, performance and numerical considerations, parallel patterns, and application case studies. The heterogeneous programming is also introduced to learners.

Course Learning Outcomes:

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

1. Explain how massive parallelisms are implemented in accelerator architectures.
2. Design and implement parallel algorithms for GPGPU.
3. Demonstrate parallel patterns for performance improvement.
4. Analyze the parallel programming and computational thinking strategies.
5. Compare different Parallel algorithms from various application domains for performance analysis.

Prerequisite: C++Programming and Mathematics

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to GPU Computing and CUDA Parallelism Model** CUDA Data Parallelism Model, CUDA Program Structure, Device Memories and Data Transfer, Kernel Functions and Threading. CUDA Threads: CUDA Thread Organization, Using blockIdx and threadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance.	6
2	**CUDA Memories** Importance of Memory Access Efficiency, Memory Types, Reducing Global Memory Traffic, Memory as limiting factor to parallelism. Performance Considerations: More on Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Pre-fetching, Instruction Mix, Thread Granularity, Measured Performance and Summary.	6
3	**Parallel Patterns – Convolution and Prefix Sum** 1D Parallel Convolution - A Basic Algorithm, Constant Memory and Caching, Tiled 1D Convolution with Halo Elements, A Simpler Tiled 1D Convolution - General Caching, A Simple Parallel Scan, Work Efficiency Considerations, A Work-Efficient Parallel Scan, Parallel Scan for Arbitrary-Length Inputs. Atomic operations and privatization - Use of Atomic Operations, Block versus Interleaved Partitioning, Latency versus Throughput of Atomic Operations, Atomic Operation in Cache Memory, Privatization and Aggregation.	7
4	**Parallel programming and Computational Thinking** Goals of Parallel Computing, Problem Decomposition, Algorithm Selection, Computational Thinking, Single Program, Multiple Data, Shared Memory and Locality, Strategies for Computational Thinking, A Hypothetical Example.	6

5	**Heterogeneous Programming** Message Passing Interface Basics, Point-to-Point Communication, Overlapping Computation and Communication, Message Passing Interface Collective Communication, CUDA-Aware Message Passing Interface, OpenMP-CUDA C programming, Parallel Computing with MATLAB, Perform large-scale computations and simulations using multicore desktops, GPUs, clusters, and clouds.	6
6	**Application Case Study - Machine Learning** Introduction, Convolutional Neural Networks, Convolutional Layer: A Basic CUDA Implementation of Forward Propagation, Reduction of Convolutional Layer to Matrix Multiplication, cuDNN and other libraries.	6

References -

Text Books:

- David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors, Morgan Kaufmann.

Reference Books:

- http://developer.nvidia.com/cuda
- Jason Sanders, Edward Kandrot, CUDA by Example: An introduction to general-purpose GPU programming, Addison-Wesley.
- Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Introduction to Parallel Computing, Addison-Wesley.
- Michel Queen, Parallel Computing - Theory and Practice, Tata McGraw Hill.

Class:- **F.Y. M. Tech.**	Semester- **II**
Course Code : **CSE139**	Course Name : **Program Elective-III- Introduction to Industry 4.0 and Industrial Internet of Things**

L	T	P	Credits
3	-	-	3

Course Description:

This course describes core idea of the Industrial Internet of Things (IIOT), and the role of the Industrial Internet Consortium. Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems.

Course Learning Outcomes:

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

1. Describe the fundamental of theory and practice related to Industrial IoT Systems.
2. Identify, formulate and solve engineering problems by using Industrial IoT.
3. Explain Data Monitoring & Control in IIoT.
4. Discuss the Advanced Technologies and platform in IIoT.
5. Investigate the use of IoT capability in Industrial applications.

Prerequisite: Basic knowledge Internet of Things (IoT)

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Course Content		
Unit No	**Description**	**Hrs**
1	**Industry 4.0** The Fourth Revolution, Sustainability Assessment of Manufacturing Industry, Lean Production System, Smart and Connected Business Perspective, Smart Factories	**6**
2	**Introduction to IIoT** Basics of Industrial IoT, Industrial Internet Systems, Basics of IIoT: Industrial Sensing & Actuation, Industrial IoT: Industrial Processes	**6**
3	**Business Models, Reference Architecture and Key Enablers** Business Models for IIoT, Reference Architecture for IIoT, Sensing, Connectivity for IIoT, Processing for IIoT, Process Control	**6**
4	**IIoT Analytics and Data Management** Introduction, Machine Learning and Data Science, Fog Computing in IIoT Cloud Computing in IIoT, Data Management with Hadoop, Data Center Networks	**6**
5	**Advanced Technologies** Software-Defined Networking (SDN) in IIoT, Security in IIoT.	**6**
6	**Industrial IoT Applications** Factories and Assembly Line, Food Industry, Inventory Management & Quality Control, Plant Security and Safety, Facility Management, Oil, Chemical and Pharmaceutical Industry, UAVs in Industries	**6**

References -

NPTEL Course Link: https://onlinecourses.nptel.ac.in/noc24_cs34/preview

Text Books:

- S. Misra, A. Mukherjee, and A. Roy, "*Introduction to IoT*" , Cambridge University Press.
- Alasdair Gilchrist , "Industry 4.0: The Industrial Internet of Things", Apress 2
- Bartodziej, Christoph Jan, "The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics", Springer

Reference Books:

- S. Misra, C. Roy, and A. Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0.", CRC Press.1
- Rajkamal, "Embedded System: Architecture, Programming and Design", TMH 3 edition.
- Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

Class:- **F. Y. M. Tech**	Semester- **II**
Course Code : **CSE1206**	Course Name : **Program Elective-IV - Soft Computing**

L	T	P	Credits
3	-	-	3

Course Description:

Soft Computing is a discipline that deals with the design of intelligent systems which are in contrast to classical hard computing techniques. The principal objective of this course is to introduce students to soft computing techniques application perspective. It covers fuzzy logic, ANN and evolutionary algorithms. These techniques help to achieve tractable, robust, and low cost solutions to real-world problems.

Course Learning Outcomes:

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

1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Design artificial neural network for solving real world problems.
4. Evaluate solutions by various evolutionary approaches for a given problem.
5. Design hybrid algorithms for solving complex problems.

Prerequisite: Algorithms.

Course Content		
Unit No	**Description**	**Hrs**
1.	**Introduction to Soft Computing** Introduction, Components of Soft Computing, Importance of Soft Computing, Soft computing constituents and Conventional AI, Soft computing characteristics.	**6**
2.	**Fuzzy Logic** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, applications of Fuzzy logic to agriculture, smart city etc.	**6**
3.	**Artificial neural networks** Biological neurons and its working, simulation of biological neurons to problem solving, different ANNs architectures, training techniques for ANNs, applications of ANNs to solve some real life problems, introduction to deep learning.	**6**
4.	**Genetic Algorithms** Introduction to evolutionary algorithms, Basic GA framework and different GA architectures, GA operators: encoding, Crossover, selection, mutation, solving single-objective optimization problems using GAs, concept of multi-objective optimization problems (MOOPs) and issues of solving them, application to constraint satisfaction problems such as bin packing, resource allocation problems.	**6**
5.	**Evolutionary algorithms** Particle Swarm Optimization (PSO), Frog Inspired Algorithms, Teaching Learning Based Optimization Algorithm (TLBO), Jaya algorithm, Harmony search algorithm, flower pollination algorithm, application to constraint satisfaction problems such as bin packing, resource allocation problems.	**6**

6.	**Parallel and Hybrid methods of optimization** Need of parallelism, models of parallelism, need of hybrid algorithms, hybrid GA-Tabu algorithm, hybrid GA and ANN, Fuzzy-GA.	**6**

References -

Text Books:

- J. S. R. Jang, C.T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education.
- S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd.

Reference Books:

- George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall.
- David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India.

Class:- **F Y M Tech CSE**	Semester- **II**
Course Code : **CSE140**	Course Name : **Program Elective-IV -Natural Language Processing**

L	T	P	Credits
3	0	0	3

Course Description:

Natural language processing (NLP) is one of the most important technologies of the information age. It gives deep understanding of the fundamental concepts of NLP and its role in current and emerging technologies. Understanding complex language utterances is also included. In addition, course discusses syntactic parsing, semantic parsing and machine translation issues.

Course Learning Outcomes:

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

1. Acquire knowledge of the fundamental mathematical models and algorithms in the field of NLP. (BL2)
2. Apply NLP models and algorithms in applications. (BL3)
3. Analyze deep learning models for NLP applications. (BL4)
4. Evaluate NLP applications such as information extraction and Machine translation (BL5).

Prerequisite: Preliminary knowledge of FSA, Probability and Statistics would be advantageous.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction:** NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.	6
2	**Language Models** : The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Architectural Overview of Large Language Model (LLM): Understand the evolution from encoder-decoder Transformers to decoder-only architectures like GPT, which form the basis of modern LLMs. Focus on how these models process and generate text at a high level.	6
3	**Part Of Speech Tagging and Sequence Labeling**. : Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. Tokenization: Learn the principles of tokenization - how text is converted into numerical representations that LLMs can process. Core concepts of attention mechanisms, Mechanisms enabling LLMs to process long-range dependencies and maintain context throughout sequences.	6
4	**Parsing: Syntactic parsing** : Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing, **Semantic Analysis** Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.	6

5	**Information Extraction (IE):** Named entity recognition and relation extraction. IE using sequence labeling. Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.	**6**
6	**Case study**: Machine Translations, Sentiment analysis, Question Answering, Language Modeling and recent relevant newer applications.	**6**

References -

Text Books:

- Daniel Jurafsky and James H Martin. Speech and Language Processing.
- Link GitHub - mlabonne/llm-course: Course to get into Large Language Models (LLMs) with roadmaps and Colab notebooks.
- Applications of NLP - GeeksforGeeks

Reference Books:

- James A.. Natural language Understanding. Pearson Education.
- Bharati A., Sangal R., Chaitanya V..Natural language processing: a Paninian perspective, PHI.
- Applications of Deep Learning for Natural Language Processing https:// machinelearningmastery.com/applications-of-deep-learning-for-natural-language-processing

Class:- **F. Y. M. Tech**	Semester- **II**
Course Code : **CSE1226**	Course Name : **Program Elective-IV - Software Architecture**

L	T	P	Credits
3	-	-	3

Course Description:

Software architecture assists to learn principles and methods that aids the designer/developer/architect to gain increased confidence in the architectural design. It includes quantitative modeling and qualitative architecture evaluation methods. Furthermore, it augments to address the specific challenges related to scale, dynamics and heterogeneity as found in system of systems and ultra-large scale systems.

The course is intended to build quality attributes in particular techniques for developing reliable and flexible systems: design patterns, frameworks. Also course is focused on applied architecture including cloud, decentralized, service oriented architecture and web services.

Course Learning Outcomes:

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

1. Recognize major software architectural styles, design patterns, and frameworks.
2. Describe a software architecture using various documentation approaches and architectural description languages.
3. Design and develop software architecture for large scale software systems.
4. Formulate architectural alternatives for a problem and select among them.
5. Apply well-understood paradigms for designing new systems.

Prerequisite: Software Engineering, Object-Oriented Programming.

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to Software Architecture** Software Architecture, Foundations of Software Architecture, Software architecture in the context of the overall software life cycle, Architectural Styles, CASE study of Architectures	6
2	**Modeling** Modeling concepts, Views and viewpoints, Early Architectural Description Language (ADL), Domain and style specific ADLs	6
3	**Analysis** Static, Dynamic and Scenario based Analysis, Architectural Trade-off, Analysis Method	6
4	**Introduction to Design Patterns** Structural Patterns, Patterns for Organization of Work, Access Control Patterns, Management Patterns, Communication Patterns	6
5	**Architecture Pattern** Structural Patterns (Layers, Pipe& Filter, Blackboard), Patterns for Distribution (Broker), Patterns for Interactive Systems (MVC, Presentation-Abstraction-Control), Adaptable Systems (Microkernel, Reflection), Frameworks and Patterns	6
6	**Applied Architecture and styles** Network architecture (Cloud), Decentralized architecture (Grid), Service oriented Architecture and Web Services, Architecture for specific Domains (Wireless network)	6

References -

Text Books:

- R. N. Taylor, N. Medvidovic, E. M. Dashofy, Software Architecture: Foundations, Theory, and Practice, John Wiley & Sons
- Frank Buschmann, Hans Rohnert, Kevin Henney, Douglas C. Schmidt, Pattern-Oriented Software Architecture, Wiley

Reference Books:

- Erich Gamma, John Vlissides, Richard Helm, Ralph Johnson, Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley Professional Computing Series
- Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, Pearson.
- Stephen T. Albin, The art of Software Architecture, Wiley

Class:- **First Year M Tech**	Semester- **II**
Course Code : **CSE1232**	Course Name: **Deep Learning Lab**

L	T	P	Credits
-	-	2	1

Course Description:

This laboratory course focuses on applications of large data pre-processing, visualization, and analysis of training of neural networks as well as deep learning networks. The course contents enable students to develop and evaluate deep learning networks for solving real world problems.

Course Learning Outcomes:

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

1. Apply various approaches for pre-processing and visualization of input data for Deep Learning networks.
2. Apply various approaches for training of neural networks and Deep Learning network with reference to certain case study examples.
3. Analyse performance of Deep Learning Networks.
4. Develop and present typical applications of deep learning networks for solving real world problems.

Prerequisite: Understanding of Machine Learning, Linear Algebra, Probability theory and programming in Python would be desired.

It should consist experiments based on the list mentioned below.

Course Content		
Expt. No.	**Description**	**Hrs**
1.	Preprocess and visualize data for training Deep Learning Network.	**2**
2.	Train a multi-layer perceptron (MLP) on a given dataset for solving XOR problem.	**2**
3.	Implement back propagation algorithm for training of a multilayer feedforward neural network.	**2**
4.	Implement adaptive learning algorithm for training of the neural network	**2**
5.	Build a CNN for image classification task and analyze its performance.	**2**
6.	Build autoencoder for a given task and analyze its performance.	**2**
7.	Build a Generative Adversarial Network and analyze its performance.	**2**
8.	Build application of DL for pattern recognition task and analyze its performance.	**2**
9.	Build application of DL for Natural Language Processing task and analyze its performance.	**2**
10.	In a batch of students, develop and present a DL application for solution of a typical real time problem.	**2**

References -

Text Books:

- "Deep Learning" A Practioner's Approach, O'REILLY, Josh Patterson & Adam Gibson.

Reference Books:

- https://github.com/topics/deep-learning

K.E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)

Syllabus

M. Tech. Computer Science and Engineering

To be implemented for 2025-27 & 2026-28 Batch

Class: **F.Y. M. Tech.**	Semester: **II**
Course Code: **CSE139**	Course Name: **Information and Network Security Lab**

L	T	P	Credits
-	-	2	1

Course Description

This lab-oriented course introduces students to fundamental concepts of cryptography and network security through practical experiments. Using tools like Python and CrypTool 2, students implement classical and modern encryption algorithms (e.g., Caesar, AES, RSA), cryptographic hashing (SHA, HMAC), digital signatures, and perform basic cryptanalysis. The course emphasizes hands-on understanding of confidentiality, integrity, authentication, and system-level protection mechanisms.

Course Learning Outcomes

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

1. Define basic cryptographic concepts and classical encryption techniques like Caesar, Vigenère, and Playfair.
2. Explain and simulate symmetric (DES, AES) and asymmetric (RSA) encryption algorithms
3. Apply hashing (SHA, MD5) and HMAC to ensure data integrity and authentication.
4. Analyze the use of digital signatures and secure key generation techniques in cryptographic applications. (L4)
5. Evaluate weaknesses in classical encryption using frequency analysis and demonstrate secure password practices. (L5)

Prerequisite: Basic understanding of computer networks, operating systems, and programming knowledge in Python

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Course Content		
Expt. No.	**Description**	**Hrs**
1.	Using Python Implement Caesar Cipher for Message Encryption	**2**
2.	Demonstrate Vigenère Cipher Encryption using CrypTool 2	**2**
3.	Implement Playfair Cipher Encryption Algorithm using Python	**2**
4.	Conduct Hashing using SHA and MD5 Algorithms using Python(hashlib)	**2**
5.	Demonstrate HMAC-based Message Authentication using Python(hmac)	**2**
6.	Demonstrate DES Encryption Process using CrypTool 2	**2**
7.	Demonstrate AES Rounds and Key Expansion using CrypTool 2	**2**
8.	Implement RSA Key Generation and Encryption using Python (cryptography)	**2**
9.	Conduct Digital Signature Signing and Verification using CrypTool 2	**2**
10.	Write a Secure Random Key Generator using Python (secrets)	**2**
11.	Implement Secure Password Hashing and Verification Python (hashlib, os)	**2**
12.	Conduct Cryptanalysis using Frequency Analysis using CrypTool 2	**2**

References -

Textbook:

- Cryptography and Network Security: Principles and Practice by William Stallings, 6th Edition, Pearson.

e-resources:

- https://www.cryptool.org/en/ct2/
- https://github.com/sobolevn/awesome-cryptography
- https://realpython.com/lessons/brief-intro-cryptography/
- http://williamstallings.com/Cryptography/Crypto6e-Student/

Class:- **F.Y. M. Tech..**	Semester- **II**
Course Code : **CSE142**	Course Name : **Program Elective-III-Lab Advanced Database Management System Lab**

L	T	P	Credits
-	-	2	1

Course Description:

This laboratory course aims to provide hands-on experience with advanced database concepts such as query optimization, transaction management, distributed databases, NoSQL, data warehousing, and big data technologies. Students will implement real-world scenarios and simulate advanced functionalities using various DBMS and big data tools. The course enables practical understanding and skill development to design and optimize modern data systems.

Course Learning Outcomes:

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

1. Implement advanced SQL queries including views, indexing, and performance tuning.
2. Simulate transaction management and concurrency control mechanisms using real-time cases.
3. Analyze distributed database models using fragmentation, replication, and optimization strategies.
4. Evaluate NoSQL and graph database technologies for unstructured data handling.
5. Design a data warehousing and big data solution using OLAP and Hadoop/Spark frameworks.

Prerequisite: Basics of SQL and relational database concepts

Course Content		
Expt. No.	**Description**	**Hrs**
1.	Write advanced SQL queries using subqueries, views, joins, and indexing.	**2**
2.	Perform query optimization using EXPLAIN plan and analyze index performance.	**2**
3.	Implement PL/SQL procedures, functions, cursors, and triggers.	**2**
4.	Simulate transaction concurrency using 2PL and deadlock detection algorithms.	**2**
5.	Implement a case study of data fragmentation and replication in a distributed database.	**2**
6.	Execute distributed query optimization with cost analysis.	**2**
7.	Set up a NoSQL (MongoDB) environment, and perform CRUD + aggregate operations.	**2**
8.	Model data and run queries in a graph database (Neo4j) using Cypher.	**2**
9.	Design a simple data warehouse: create fact and dimension tables and perform ETL operations.	**2**
10.	Perform OLAP operations and implement a basic MapReduce job using Hadoop or Spark.	**2**

References -

Text Books:

- Ramez Elmasri and Shamkant Navathe, Fundamentals of Database Systems, Pearson Education
- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, Database Systems: The Complete Book, Pearson
- Pramod J. Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley

Reference Books:

- M. Tamer Özsu and Patrick Valduriez, Principles of Distributed Database Systems, Springer
- Tom White, Hadoop: The Definitive Guide, O'Reilly
- Rick Cattell, Scalable SQL and NoSQL Data Stores, Communications of the ACM

Class:- **F. Y. M. Tech**	Semester- **II**
Course Code : **CSE1266**	Course Name : **Program Elective-III - Parallel Computing Lab**

L	**T**	**P**	**Credits**
-	-	**2**	**1**

Course Description:

This laboratory course is designed to prepare the student to understand and apply the skills and knowledge of parallel computing with the GPU to solve various compute intensive problems from different domains. It demonstrates the use of various CUDA libraries and tools. The heterogeneous programming is also introduced to learners. The performance metric will be used to measure the performance of developed applications.

Course Learning Outcomes:

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

1. Design different parallel algorithms suitable for multi-core and many-core systems.
2. Implement different parallel algorithms on multi-core and many-core systems.
3. Solve compute intensive applications using accelerators.
4. Perform the analysis with different performance metrics.

Prerequisite: C/C++ Programming, Mathematics.

It should consist experiments based on the list mentioned below.

Course Content		
Expt. No.	**Description**	**Hrs**
1.	Demonstration of CUDA data parallelism model.	**2**
2.	Demonstration of use of different types of CUDA memories.	**2**
3.	Demonstration of performance improvement with CUDA memories.	**2**
4.	Demonstration of different parallel patterns.	**2**
5.	Demonstration of Atomic operations.	**2**
6.	Heterogeneous programming with CUDA-MPI.	**2**
7.	Heterogeneous programming with CUDA-OpenMP.	**2**
8.	Use of different libraries in CUDA.	**2**
9.	Machine learning application development using CUDA libraries.	**2**
10.	Demonstration of parallel computing using Parallel Computing Toolbox from MATLAB.	**2**

References -

Text Books:

- David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors, Morgan Kaufmann.

Reference Books:

- http://developer.nvidia.com/cuda
- Jason Sanders, Edward Kandrot, CUDA by Example: An introduction to general-purpose GPU programming, Addison-Wesley.
- Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Introduction to Parallel Computing, Addison-Wesley.
- Michel Queen, Parallel Computing - Theory and Practice, Tata McGraw Hill.

K.E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)

Syllabus

M. Tech. Computer Science and Engineering

To be implemented for 2025-27 & 2026-28 Batch

Class:- **F.Y. M. Tech.**	Semester-**II**
Course Code : **CSE1276**	Course Name :**Program Elective-III- Internet of Things Lab**

L	T	P	Credits
-	-	2	1

Course Description:

This course on Cloud IoT will introduce you to implementation of IoT on Cloud platforms like AWS and Azure. IoT or the Internet of Things as we know has made data sensing easy and with all the devices connected over the internet using sensors, we actually have smart devices that make our life easy. In this course we will see how cloud computing platforms like Amazon Web Services and Microsoft Azure provide variety of IoT Cloud services to implement IoT on top of these Cloud platforms. This course designed to introduce individuals to Cloud IoT concepts and provide hands-on experience with basic IoT devices and cloud platforms.

Course Learning Outcomes:

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

1. Explore the relationship between IoT, cloud computing.
2. Adapt the emerging cloud and IoT technologies informed by an appropriate evaluation process to support business applications.
3. Design secure cloud and IoT applications to support scalable online services using best practice.
4. Demonstrate knowledge of cloud computing and IoT concepts, components, architecture, frameworks and issues.
5. Analyze applications of IoT in real time scenario.

Prerequisite: Basic knowledge of Internet of Things (IoT) , Cloud Technology, Python programming

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It should consist experiments based on the list mentioned below.

Course Content		
Expt. No.	**Description**	**Hrs**
1.	Temperature Monitoring with IoT: Set up a simple IoT device (e.g., Raspberry Pi) with a temperature sensor. Send temperature readings to a cloud platform (e.g., AWS IoT, Google Cloud IoT) and visualize the data on a web dashboard.	**2**
2.	Smart Light Control: Use an IoT device (e.g., ESP8266) to control an LED light remotely. Connect the device to the cloud and create a basic web or mobile app to toggle the light on/off.	**2**
3.	Weather Station: Build a weather station using IoT sensors for temperature, humidity, and barometric pressure. Send sensor data to the cloud for storage and analysis. Create a basic dashboard to display weather trends.	**2**
4.	Home Security System: Develop a simple IoT-based home security system using a motion sensor. Send alerts to a cloud service when motion is detected, and create a basic mobile app to receive notifications.	**2**
5.	Soil Moisture Monitoring for Plants: Build an IoT device with a soil moisture sensor to monitor plant hydration levels. Send data to the cloud and set up alerts for when soil moisture levels are too low/high.	**2**
6.	Smart Doorbell: Create a basic IoT-enabled doorbell with a button and camera. When the button is pressed, the camera captures an image or video, which is sent to the cloud for storage. Receive notifications on a mobile app.	**2**
7.	Pet Feeder: Build an IoT-controlled pet feeder using a servo motor. Control the feeding schedule remotely via a cloud platform and track feeding times in a simple database in the cloud.	**2**

8.	Vehicle Tracking: Use an IoT device (e.g., Arduino with GPS module) to track the location of a vehicle. Send GPS coordinates to the cloud at regular intervals and visualize the vehicle's route on a map.	**2**
9.	Water Level Monitoring: Construct an IoT device with a water level sensor to monitor water levels in a tank or reservoir. Send data to the cloud and set up alerts for when water levels are too low/high.	**2**
10.	Remote Controlled Robot: Build a basic IoT-controlled robot using a microcontroller (e.g., Arduino) and motors. Control the movement of the robot remotely via a cloud-based dashboard or mobile app.	**2**

References -

Text Books:

- Verma, Jitendra Kumar , "Cloud IoT: Concepts, Paradigms and Applications", Taylor and Francis Ltd, 1st Edition 2022
- Monika Mangla , Suneeta Satpathy , Bhagirathi Nayak , Sachi Nandan Mohanty , "Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications", Willy Publication, 2021

Reference Books:

- Muhammad Afzal , "Arduino IoT Cloud for Developers", Packt

Class : **F. Y. M. Tech.**	Semester : **II**
Course Code : **CSE143**	Course Name: **Mini-Project**

L	T	P	Credits
-	-	4	2

Course Description

This course is designed to initiate M.Tech (CSE) students into the process of structured research exploration and scholarly communication. Each student is required to identify and study a recent research paper from reputed journals or conferences such as IEEE, Springer, Elsevier, or other peer-reviewed sources in the field of Computer Science and Engineering.

Under the guidance of a faculty supervisor, students must conduct a comprehensive literature survey, critically analyze recent research advancements, and present their findings through a technical seminar. The topic selected must form the basis of the Mini-Project to be undertaken in Semester II. Emphasis is placed on research motivation, applicability, innovativeness, and future scope.

Course Learning Outcomes

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

1. Conduct a focused and systematic literature review
2. Identify state-of-the-art trends and open research problems
3. Critically evaluate methodologies and research gaps
4. Present technical content with academic rigor and clarity
5. Define a feasible problem statement for the upcoming Mini-Project

Prerequisite

- Fundamental understanding of core CSE subjects
- Familiarity with technical literature reading and basic research methodology
- Basic skills in academic writing and presentation

Syllabus

- Identification of a relevant and recent research problem
- Consultation with assigned faculty supervisor for topic refinement
- Literature survey of peer-reviewed papers (national/international)
- Comparative analysis of existing methods, research gaps, and open challenges
- Preparation of a technical seminar report in the prescribed departmental format
- Seminar presentation before the Department Postgraduate Committee (DPGC)
- Framing of a problem statement and mini-project direction for Semester II and Foundation for Disseration work in Semster III and IV

Course Deliverables

- Finalized seminar topic with approval from the supervisor
- Annotated bibliography of reviewed research papers
- Technical seminar presentation slides
- Seminar report (2 hard copies + soft copy in departmental format)
- Problem outline draft for the Mini-Project
- Viva-voce and Q&A before DPGC

Evaluation

Component	Weightage
Relevance and quality of paper selection	10%
Depth of literature analysis	25%
Seminar report quality	20%
Presentation skills and clarity	25%
Viva-voce and Mini-Project readiness	20%

Class: **S. Y. M. Tech.**	Semester: **III**
Course Code: **CSE2016**	Course Name: **Industry Internship**

L	T	P	Credits
--	--	--	**01**

Course Description:
In the field training work, the student is expected to get training in the industry, related to subject specialization for duration of 15 days (minimum) for at least 6 hrs. per day. Student should write a report on the field training and submit to department for ISE evaluation at the beginning of third semester. Student should include the certificate from the company regarding satisfactory completion of the field training.

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

1. Identify the real applications and practices of courses studied, at industry level
2. Recognize various modeling, analysis and validation techniques adopted at industries
3. Demonstrate the issues at design, manufacturing and assembly levels
4. Summarize and present technical data in report format.

Open Elective

Class: **S. Y. M. Tech**	Semester- **III**
Course Code: **MOE2012**	Course Name: **Artificial Intelligence - Machine Learning**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
Machine learning is a part of Artificial Intelligence. It uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security, from analyzing biochemical interactions to structural monitoring of aging bridges, and from emissions to astrophysics, etc. This class will familiarize students with a broad cross-section of models and algorithms for machine learning and prepare students for research or industry application of machine learning techniques.

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

1. Describe central machine learning methods and techniques and how they relate to artificial intelligence.
2. Differentiate between supervised and unsupervised learning techniques.
3. Apply the ML algorithms to a real-world problem.
4. Optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
5. Evaluate a given problem and apply appropriate machine learning technique.

Prerequisite: Statistics, Linear Algebra, Optimization Techniques, Programming Language

Course Content		
Unit No	**Description**	**Hrs.**
1.	**Introduction to Artificial Intelligence and Machine Learning** Introduction: What Is AI and ML? Examples of AI and ML, Applications, Supervised Learning, Un-Supervised Learning and Reinforcement Learning, Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory.	6
2.	**Feature Selection** Scikit- Learn Dataset, creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)- non-negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.	6
3.	**Regression** Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Polynomial regression, Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descendent algorithms.	6
4.	**Naïve Bayes and Support Vector Machine** Bayes Theorom, Naïve Bayes Classifiers, Naïve Bayes in Scikit- learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes. **Support Vector Machine(SVM)** Linear Support Vector Machines, Scikit- learn implementation, Linear Classification, Kernel based classification, Non- linear Examples. Controlled Support Vector Machines, Support Vector Regression.	6
5.	**Decision Trees and Ensemble Learning** Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier. Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index.	4
6.	**Clustering Techniques** Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering Dendrograms, Agglomerative clustering in Scikit- learn, Connectivity Constraints. Introduction to Recommendation Systems Naïve User based systems, Content based Systems, Model free collaborative filtering-singular value decomposition, alternating least squares.	8

References:

Text Books:

- Giuseppe Bonaccorso, Machine Learning Algorithms, Packt Publishing Limited.
- Josh Patterson, Adam Gibson, Deep Learning: A Practitioners Approach, O REILLY, SPD.

Reference Books:

- Ethem Alpaydin, Introduction to Machine Learning, PHI.
- Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press.

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2022**	Course Name: **Creative Thinking: Techniques & Tools**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
In today's ever-growing and changing world, being able to think creatively and innovatively are essential skills. It can sometimes be challenging to step back and reflect in an environment which is fast paced or when students required to assimilate large amounts of information. Making sense of or communicating new ideas in an innovative and engaging way, approaching problems from fresh angles, and producing novel solutions are all traits which are highly sought after by employers. This course will equip with a 'tool-box', introducing to a selection of behaviors and techniques that will augment innate creativity. Some of the tools are suited to use on own and others work well for a group, enabling you to leverage the power of several minds. People can pick and choose which of these tools or techniques suit needs and interests, focusing on some or all of the selected approaches and in the order that fits best.

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

1. Comprehend importance in tackling global challenges as well as in everyday problem-solving scenarios.
2. Apply different brainstorming techniques in group activities.
3. Be proficient in the application of the 6 thinking hats tool in different life scenarios.
4. Develop a systematic approach to idea generation through the use of morphological analysis.
5. Innovate on an existing product, service or situation applying the SCAMPER method.
6. Get confident with the theory of inventive problem solving, called TRIZ.

Prerequisite: There are no prerequisites to this course.

Course Content		
Unit No	**Description**	**Hrs.**
1.	**Introduction to the Principles of Creativity** Basic principles of creativity and highlight its importance in tackling global challenges. Creativity is explored and applied at two different levels, lower and higher-level creativity.	**6**
2.	**Creativity Tools** Augment our creativity using different methods of Brainstorming, a creativity approach that aids the generation of ideas in solving a stated problem. Particularly focus on the application of brainstorming tools in group activities, with the aim of enabling to understand, evaluate and apply different types of brainstorming techniques in own context.	**6**
3.	**Six Thinking Hats** Principles as well as application of the 6 Hats thinking tool both at an individual level and in a group, under various professional and personal situations, allowing students to develop competency and accelerate proficiency on the use of technique.	**6**
4.	**Clarifying the Problem** Organizing a process, turning problems into opportunities, facts, feelings & hunches, problem as question.	**6**
5.	**Generating Ideas** Brainstorming, scamper, forced connections, portable think tank, case studies on generating ideas.	**6**
6.	**Developing Ideas and Planning for Action** Organizing ideas, ideas to solutions, implementing solutions, case studies of development of ideas and plan of action.	**6**

References -

Text Books:

- Michael Michalko, Thinkertoys: A Handbook of Creative-Thinking Techniques, second edition, Ten Speed Press.
- Michael Michalko, Cracking Creativity: The Secrets of Creative Genius, revised edition, Ten Speed Press.
- Edward de Bono, Penguin, Lateral Thinking: A Textbook of Creativity.
- Edward de Bono, Penguin, Six Thinking Hats.

Reference Books:

- New World Library, Creative Thinkering: Putting Your Imagination to Work.
- Chris Griffiths, Kogan Page, The Creative Thinking Handbook: Your Step by Step Guide to Problem Solving in Business.

Open Elective

Class: **S. Y. M. Tech.**	Semester: **III**
Course Code: **MOE2032**	Course Name: **MOOC Course**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
Student can opt for online certification course and produce certificate.

- The students who are doing course on MOOC/NPTEL Course /Courses suggested by DPGC should select the course in consultation with supervisor and submit the details to Head of Program.
- The course should be minimum 25 hours duration and should have certification facility.
- Student should complete course and get certificate. The certificate copy should be submitted to head of program with supervisor signature.

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

1. Identify the real applications and practices of courses studied, at industry level
2. Recognize various modelling, analysis and validation techniques adopted at industries.
3. Demonstrate the issues at design, manufacturing and assembly levels.
4. Summarize and present technical data in report format.

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2041**	Course Name: **Energy Audit and Management**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
This course provides basic understanding of energy audit and management. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in commercial and industrial sector will be achieved through this course.

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

1. Identify the important of Energy Scenario.
2. Use energy audit knowledge to carry out energy audit of a given firm.
3. Examine different rolls in energy action planning
4. Apply project finance and management skills to carry out energy audit
5. Plan for energy monitoring and targeting.

Prerequisite: Electric Machines, Thermal Systems and Finance system

Course Content		
Unit No	**Description**	**Hrs.**
1.	**Energy Scenario** Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment, Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.	**6**
2.	**Energy Management and Audit** Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments	**6**
3.	**Energy Action Planning** Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing –location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivating-motivation of employees: Information system-designing barriers, Strategies; Marketing and communicating-training and planning.	**6**
4.	**Financial Management** Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs	**6**
5.	**Project Management** Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification	**6**
6.	**Energy Monitoring and Targeting** Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).	**6**

References:

Text Books:

- Amit Kumar Tyagi,Handbook on Energy Audits and Management, TERI Publication
- Wayne C. Turner, Energy Management Handbook, Wiley Inter Science Publication

Reference Books:

- P. O'Callaghan, Energy Management, McGraw - Hill Book Company
- Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I

Open Elective

Class: **S. Y. M. Tech.**	Semester: **III**
Course Code: **MOE2062**	Course Name: **Augmented Reality and Virtual Reality**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
This course presents an introduction to virtual and augmented reality technologies, with an emphasis on designing and developing interactive virtual and augmented reality experiences. The course will cover the history of the area, fundamental theory, and interaction techniques. Students are provided with hands-on experience developing applications for modern virtual and augmented reality systems. In the course, students will also explore libraries and tools for creating AR/VR experiences such as Vuforia and UNITY.

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

1. Define the basic concepts of Virtual and Augmented Reality
2. Identify the differences in AR/VR concepts and technologies
3. Describe the fundamental concepts relating to Virtual Reality such as presence,immersion, and engagement
4. Evaluate usability of AR/VR applications and critique their use of AR/VR capabilities
5. Design and prototype effective AR/VR applications using UNITY platform for various application.

Prerequisites: Programming and Data Structures

Course Content		
Unit No	**Description**	**Hrs.**
1.	**Introduction to Augmented Reality** Definition and Scope, Brief History of Augmented Reality, Displays (Multimodal Displays, Spatial Display Model, and Visual Displays), Strong vs Weak, AR Applications AR Challenges in AR.	**6**
2.	**Introduction to Virtual Reality** Definition and Scope, Types of VR Characteristics, Basic VR environments, Limitations of VR environments, Immersion Vs Presence.	**6**
3.	**Interaction Design for AR/VR Environments** Interaction design process Identifying user needs, AR/VR design considerations Typical AR/VR Interface Metaphors, User experience (UX) guidelines for AR/VR, UX challenges for AR/VR, Prototyping for AR/VR, Evaluation of the developed AR/VR prototype.	**6**
4.	**Introduction to UNITY** Unity Overview: Windows, Interface, Navigation, Terminology, Game Objects, Hierarchy, Parenting Objects, Asset Store, Importing Plug-ins, Creating a Terrain, Materials, Colors, Transparency, Introduction to Mono behaviours: Awake, Start, Update.	**6**
5.	**Introduction to Vuforia and Physics in UNITY** Vuforia Overview: Interface, Navigation, Terminology, Image Targeting, Custom Images, Overview of Physics in Unity, Introduction to Scripting: Terminology, Creating Objects, Accessing Components, Debugging, Lists, Loops.	**6**
6.	**Expanding on Scripting and Interaction** Creating Trigger Events, Manipulating Components in Scripts, Programming Interactions between Objects and Tracked Images in AR, designing a simple User Interface in AR, Introduction to colliders and their use: On Collision Enter, On Collision Exit. On Collision Stay, On Trigger vs On Collision, Rigid bodies and how Colliders report to them.	**6**

References:

Text Books:

- Vince, Virtual Reality Systems, Pearson Education.
- Grigore Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley.
- Schmalstieg, D., & Hollerer, T. Augmented reality: principles and practice.Addison-Wesley Professional.

Reference Books:

- Azuma, R.T. A survey of augmented reality. Presence: Teleoperators & Virtual Environments.

- Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. Recent advances in augmented reality. IEEE computer graphics and applications.
- Bhagat, K. K., Liou, W.-K., & Chang, C.-Y.A cost-effective interactive 3D virtual reality system applied to military live firing training. Virtual Reality.
- Carmigniani, J., Furht, B., Anisetti, M., Ceravolo, P., Damiani, E., & Ivkovic, M. Augmented reality technologies, systems and applications. Multimedia tools and applications.
- Raisamo, R., Rakkolainen, I., Majaranta, P., Salminen, K., Rantala, J., & Farooq, A. Human augmentation: Past, present and future. International journal of human- computer studies.
- Schuemie, M. J., Van Der Straaten, P., Krijn, M., & Van Der Mast, C. A. Research on presence in virtual reality: A survey. Cyber Psychology & Behavior.

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2072**	Course Name: **Industrial Instrumentation**

L	T	P	Credits
03	**--**	**--**	**03**

Course Description:
This course is an overview of the principles, concepts, and applications of process transmitters found in an industrial plant. Continuous measurement and control of all the parameters will be emphasized. Also practical installation and calibration procedures of various types of sensors and transducers will be covered. Open and closed loop control systems will also be discussed, including such concepts as on/off control, set point, overshoot, undershoot, gain, feedback, PID loops, and reverse/direct acting systems.

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

1. Elaborate working principal of different transducers.
2. Select suitable transducer/sensor for specific application.
3. Justify the use of specific measurement technique for specific task.
4. Evaluate the Calibration and Interfacing of the transducers.

Prerequisite: Sensor And Measurement

Course Content		
Unit No	**Description**	**Hrs**
1.	**Metrology** Measurement of length – Gauge blocks – Plainness – Area using Simpson's rule, Plain meter – Diameter – Roughness – Angle using Bevel protractor, sine bars and Clinometer – Mechanical, Electrical, Optical and Pneumatic Comparators. Optical Methods for length and distance measurements using Optical flats and Michelson Interferometer.	**6**
2.	**Velocity and Acceleration Measurement** Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers – Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers-different types, Gyroscopes-applications.	**6**
3.	**Force and Pressure Measurement** Force measurement – Different methods –Gyroscopic Force Measurement – Vibrating wire Force transducer. Basics of Pressure measurement –Manometer types – Force-Balance and Vibrating Cylinder Transducers – High and Low Pressure measurement – McLeod Gauge, Knudsen Gauge, Momentum Transfer Gauge, Thermal Conductivity Gauge, Ionization Gauge, Dual Gauge Techniques, Deadweight Gauges, Hydrostatic Pressure Measurement.	**6**
4.	**Flow Measurement and Level Measurement** Flow Meters- Head type, Area type (Rota meter), electromagnetic type, Positive displacement type, mass flow meter, ultrasonic type, vertex shedding type, Hotwire anemometer type, Laser Doppler Velocity-meter. Basic Level measurements – Direct, Indirect, Pressure, Buoyancy, Weight, Capacitive Probe methods.	**6**
5.	**Density, Viscosity and Other Measurements** Density measurements – Strain Gauge load cell method – Buoyancy method – Air pressure balance method – Gamma ray method – Vibrating probe method. Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity –Two float viscorator –Industrial consistency meter. Sound-Level Meters, Microphones, Humidity Measurement.	**6**
6.	**Calibration and Interfacing** Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow, Density and Viscosity Sensors, Variable Frequency Drive. Open and closed loop control system with on/off control, setpoint, overshoot, undershoot, gain, feedback, PID loops, and reverse/direct acting systems.	**6**

References:

Text Books:

- Doeblin E.O., Measurement Systems – Applications and Design, McGraw Hill International.
- Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill.

Reference Books:

- Considine D. M., Process Instruments and Control Handbook, McGraw Hill International.
- Jain R.K., Mechanical and Industrial Measurements, Khanna Publications.

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2082**	Course Name: **Advanced Mechatronics Systems**

L	T	P	Credits
03	--	--	**03**

Course Description:

The course will be helpful to provide overview of mechanical and electronic systems used in industrial atmosphere. This will be helpful for upcoming automation in industry. Mechatronics is a multidisciplinary field of science that includes a combination of Mechanical Engineering, Electronics, Computer Engineering, Telecommunications Engineering and Control Engineering. Mechatronics is a multi-disciplinary study dealing with the integration of mechanical devices, actuators, sensors, electronics, intelligent controllers and computers. Mechatronics generally involves

(i) implementing electronics control in a mechanical system
(ii) enhancing existing mechanical design with intelligent control and
(iii) replacing mechanical component with an electronic solution.

This course will cover all aspects related with mechatronics such as sensors and transducers, actuators and mechanisms, signal conditioning, microprocessors and microcontrollers, modeling & system response and design of mechatronics systems.

Course Outcomes:

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

1. Explain Mechatronics System.
2. Analyze the Mechatronics Based System.
3. Model, simulate, and verify the mechatronics systems.
4. Identify Electrical, Hydraulic and Pneumatic Components.

Prerequisite: Basic knowledge of research related activities.

Course Content		
Unit No.	**Description**	**Hrs.**
1.	**Introduction** What is Mechatronics, Integrated Design Issues in mechatronics, Mechatronics Design Process, Mechatronics Key elements, applications in mechatronics.	**6**
2.	**Modelling and Analysis of Mechatronics Systems** Block Diagram Modelling, Analogy approach, Impedance Diagrams, Electrical Systems, Mechanical systems and electromechanical systems. Mass-Spring-Oscillation and Damping system, Dynamic response of systems, Transfer function and frequency response. Labview, MATLAB, Scilab.	**6**
3.	**Sensors and Actuators** Performance terminology of sensors, Displacement, Position & Proximity Sensors, Displacement, Position sensors, Force, Fluid pressure, Liquid flow sensors, temperature, light sensor, Acceleration and Vibration measurement, Electrical and Mechanical Actuation Systems.	**6**
4.	**Signal Conditioning** Introduction to signal processing, Op-Amp as signal conditioner, Analogue to Digital Converter, Digital to Analogue Converter, Signal processing devices, relays, contactors and timers. Microcontrollers, PID controllers and PLCs.	**6**
5.	**Hydraulic System and Pneumatic System** Flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps, Pneumatic system components and graphic representations, Advantages and limitations of pneumatic systems.	**6**
6.	**Case Study** List of various mechatronics systems, Case study of pick and place mechanism of robotic arm using pneumatic power, Hydraulic circuit for CNC Lathe machine, 3D Printer, Auto-control system for Green House Temperature and Auto-focusing in Digital Cameras.	**6**

References:

Text Books:

- Bradley, D. Dawson, N. C. Burd and A.J. Loader, Mechatronics: Electronics in product and process, Chapman and Hall, London.
- Devadas Shetty, Richard A. Kolkm, Mechatronics system design, PWS publishing company.
- David G. Alciatore, Michael B. Histand, Introduction to mechatronics and measurement systems Mc Graw Hill Education.

References Books:

- Intelligent Mechatronic Systems: Modeling, Control and Diagnosis, R. Merzouki, A. K. Samantaray, P. M. Pathak, B. Ould Bouamama, Springer, London.
- Technical website: https://onlinecourses.nptel.ac.in/noc21_me27/course

Open Elective

Class: **S. Y. M. Tech**	Semester: **III**
Course Code: **MOE2091**	Course Name: **Disaster Management**

L	T	P	Credits
03	--	--	03

Course Description:
This course provides a holistic understanding of disaster management, covering both natural and manmade disasters. Students will delve into the meaning, nature, and various types of disasters, exploring their effects on individuals, communities, and the environment. The course encompasses a global perspective while focusing on the disaster profile of India, considering regional and seasonal variations

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

1. Outline disaster and disaster management cycle.
2. Summarize disaster preparedness and response activities for various types of disaster.
3. Apply various advanced techniques for disaster management.
4. Examine role of various agencies in disaster management.
5. Dissect the disaster management scenario in India.

Prerequisite: Environmental Science

Course Content		
Unit No.	**Description**	**Hrs.**
1.	**Natural Disaster** Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic, eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.	**6**
2.	**Manmade Disasters** Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents. Disasters -A Global View, Disaster Profile of India- Regional, and Seasonal.	**6**
3.	**Disaster Management Cycle** Introduction to Disaster Management Cycle: Mitigation, Preparedness, Response and Recovery. Disaster Mitigation, Hazard identification and vulnerability analysis, Mitigation strategies or measures	**6**
4.	**Disaster Preparedness, Response and Recovery** Introduction to Disaster Preparedness, Disaster Risk Reduction (DRR), The Emergency Operation Plan (EOP). Introduction to Disaster Response, Aims of disaster response, Disaster Response Activities, Modern and traditional responses to disasters, Modern methods of disaster response, Disaster Recovery, The Recovery Plan, Disasters as opportunities for development initiatives.	**6**
5.	**Role of Technology in Disaster Management** Geographic Information System (GIS) and Disaster Management. GIS applications. Global Positioning System (GPS) and Disaster Management, Applications of GPS to Disaster management. Remote Sensing and its significance in Disaster Management.	**6**
6.	**Role of Multiple Stakeholders In Disaster Management** Role of NGO's, Community based organizations, media, Central, State, District and Local Administration, armed forces, Police and other organizations.	**6**

References:

Codes of Practice:

- National Disaster Management Authority (NDMA). National Disaster Management Plan 2019.
- National Disaster Management Authority (NDMA). National Disaster Management Act 2005.

Text Books:

- Coppola, D. P., Introduction to International Disaster Management, Elsevier USA.
- Singh R. B., Disaster Management, Rawat Publication.

Reference Books:

- Reiter L., Earthquake Hazard Analysis: Issues and Insight, Colombia University Press.
- Mileti D. S. Disaster by Design: A Reassessment of National Hazards in United States, The National Academic Press.

Class: **S. Y. M. Tech.**	Semester: **III**
Course Code: **CSE2026**	Course Name: **Dissertation Phase – I**

L	T	P	Credits
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Course Description:

Dissertation Phase I and Synopsis Approval Presentation:

Under the guidance of faculty called as Supervisor, PG student from second year is required to do innovative and research oriented work related to various theory and laboratory courses he/she studied during previous semesters. Dissertation work should not be limited to analytical formulation, experimentation or survey based project. Student can undertake an interdisciplinary type project with the prior permission of DPGC from both departments.

Synopsis:

Student need to carry out exhaustive literature survey with consultation of his/her Supervisor for not less than 25 reputed national international journal and conference papers. Student should make the Synopsis Submission Presentation (SSP) with literature survey report to DPGC and justify about the innovativeness, applicability relevance and significance of the work. At the time of presentation, student shall also prepare Synopsis of the work and submit to department for approval. Student shall submit synopsis of dissertation as per the prescribed format in 02 copies to department.

Course Outcomes:

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

1. Explain the contributions of various researchers in the field of design engg. after carrying out literature survey from reputed journals.
2. Recognize the gap in the research and define a problem statement.
3. Explain significance and applicability of problem statement.
4. Summarize and present technical data in report format.

Class: **S. Y. M. Tech.**	Semester: **III**
Course Code: **CSE2036**	Course Name: **Dissertation Phase – II**

L	T	P	Credits
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Course Description:

Phase II evaluation is based on End Semester Examination (ESE) which is based on the work during the semester. It is expected that student shall present preliminary results from his/her work during the semester with report as per prescribed format. DPGC including external examiner as expert will approve the report and progress of student. ISE will be evaluated by DPGC and ESE will be evaluated by DPGC and one external expert. Student will submit a report (soft bound before 1 week of date of presentation) as per prescribed format and present to DPGC for ISE and ESE. If student is not showing satisfactory performance, then he /she will be given grace period of 2 week. After 2 weeks, student will again evaluated with grade penalty.

Course Outcomes:

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

1. Outline the work plan for problem statement.
2. Identify the proper modelling and analysis tool.
3. Reproduce the preliminary results of problem statement.
4. Summarize and present technical data in report format.

Class: **S. Y. M. Tech.**	Semester: **IV**
Course Code: **CSE2046**	Course Name: **Dissertation Phase – III**

L	T	P	Credits
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Course Description:
Student is required to make a presentation on the progress of his/her dissertation work in front of supervisor and DPGC. It is expected that up to this stage almost 90% of the dissertation work is completed. Student will make the presentation and seek the suggestions from the supervisor and DPGC. Supervisor and DPGC will ensure that work carried out by the students till this stage is satisfactory and in compliance with synopsis of the dissertation submitted by the student. This is In Semester Evaluation (ISE).

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

1. Explain the issues related to method adopted in solving the problem
2. Select proper technique in solving the problem
3. Compare the results with available literature

Class: **S. Y. M. Tech.**	Semester: **IV**
Course Code: **CSE2056**	Course Name: **Dissertation Phase – IV**

L	T	P	Credits
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Course Description:
This is the final presentation i.e., viva voce of the dissertation. Student will be allowed to make this presentation only if he has submitted duly completed and certified dissertation report. Students will make the presentation in front of supervisor, DPGC and external supervisor. Examiners will check whether the dissertation work is in full compliance with synopsis of dissertation or not. Dissertation will assess on the bases quality of dissertation work, efforts taken by the student, quality of the paper(s) published on the dissertation work etc.

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

1. Design new methodology to address the problem.
2. Justify the results obtained from new methodology.
3. Write technical report and de end work.