



# **First Year Curriculum**

**Admission Year 2026-27**

**Master of Technology  
Computer Engineering**

**Faculty of Engineering & Technology**

**Parul University**

**Vadodara, Gujarat, India**

## 03020201PC02 - Advanced Data Structure Laboratory

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic Programming knowledge	
<b>Rationale</b>	A systematic treatment of advanced data structures using Python programming language, intended for computer science majors as seeking advanced Python experience. Coding topics include large program software engineering design, multidimensional arrays, string processing, primitives, compound types, and allocation of instance and static data. Data structure concept topics include dynamic memory, inheritance, polymorphism, hierarchies, recursion, linked-lists, stacks, queues, trees, hash tables and graphs. Algorithm concept topics include searching, big-O time complexity, analysis of all major sorting techniques, top down splaying, AVL tree balancing, shortest path algorithms, minimum spanning trees and maximum flow graphs	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	-	2	1.00	-	-	30	20	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Laboratory work will be based on above syllabus with minimum required experiments/exercises to be incorporated.

### Course Outcome

**After Learning the Course the students shall be able to:**

After Learning the Course the students shall be able to:

1. Implement symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, b-trees and splay trees.
3. Develop algorithms for text processing applications.
4. Identify suitable data structures and develop algorithms for computational geometry problems.

## 03020201PC03 - Advanced Machine Learning

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of programming in Python, Fundamental concepts of Mathematics, including Linear Algebra, Probability, and Statistics, and an Understanding of Data Structures and Algorithms for efficient data handling and processing.	
<b>Rationale</b>	The course aims to provide a comprehensive understanding of Machine Learning (ML) concepts, including supervised, unsupervised, and reinforcement learning, develop proficiency in decision tree learning, neural networks, and Bayesian learning, apply genetic algorithms, fuzzy logic, and optimization techniques to real-world problems, enable students to analyze and compare ML models based on accuracy, efficiency, and application, and implement ML models using Python for text classification, face recognition, healthcare, and fraud detection.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Introduction</b> Learning Problems, designing a learning system, Issues with machine learning, Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias	5	10
2	<b>Supervised and Unsupervised learning</b> Decision Tree Representation, Appropriate problems for Decision tree learning, Algorithm, Hypothesis space search in Decision tree learning, inductive bias in Decision tree learning, Issues in Decision tree learning ,K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Bases, Functions, Case Based Reasoning	7	20
3	<b>Artificial Neural networks and genetic algorithms</b> Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer Networks and Back Propagation, Algorithms, Remarks on Back Propagation Algorithms, Case Study: face Recognition	5	10
4	<b>Bayesian Learning</b> Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and Least squared Error Hypothesis, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorithm Case Study: Learning to classify text	6	15
5	<b>Fuzzy Logic</b> Classical Logic and Fuzzy logic, Fuzzy Rule based systems, Fuzzy Decision making, Fuzzy Classification, Fuzzy Pattern Recognition, Applications	5	10
6	<b>Optimization Techniques</b> Derivative based Optimization, Descent Methods, Genetic Algorithms, Ant Colony Optimization, Particle Swarm Optimization, Case Study - fraud detection, health care using Soft computing techniques.	5	10
7	<b>Generative Models &amp; Adversarial Learning</b> Generative Adversarial Networks (GANs) – DCGAN, CycleGAN, StyleGAN, Variational Autoencoders (VAEs), Adversarial Attacks & Defenses in Machine Learning	6	15
8	<b>Applications</b>	6	20

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
	Fairness, Interpretability, and Explainable AI (XAI), Federated Learning & Privacy-Preserving Machine Learning, Meta-Learning and Few-Shot Learning, Machine Learning for Healthcare, Finance, and Autonomous Systems		
<b>Total</b>		<b>45</b>	<b>110</b>

Reference Books	
1.	<b>Real-World Machine Learning (TextBook)</b> Henrik Brink, Joseph Richards, Mark Fetherolf; DreamTech
2.	<b>Pattern Recognition and Machine Learning</b> Christopher M. Bishop; Springer, 2011
3.	<b>Elements of Statistical Learning</b> By Hastie, Tibshirani, and Friedman; Soft Computing for Problem Solving, AISC, Springer
4.	<b>Data Mining: Tools and Techniques</b> By Jiawei Han and Michelline Kamber
5.	<b>Data Mining: A practical Machine Learning Tools and techniques</b> I H Witten, Eibe Frank, Mark A Hall; Elsevier

Course Outcome
<p><b>After Learning the Course the students shall be able to:</b></p> <p>After Learning the Course the students shall be able to:</p> <ol style="list-style-type: none"> <li>1. Implement and compare supervised and unsupervised learning algorithms, including Decision Trees, K-Nearest Neighbors, and Locally Weighted Regression for classification and regression tasks.</li> <li>2. Design and train Artificial Neural Networks (ANNs) and apply genetic algorithms for solving real-world problems like face recognition.</li> <li>3. Apply Bayesian learning techniques, including Naïve Bayes Classifier, Bayesian Belief Networks, and the EM Algorithm, for tasks such as text classification.</li> <li>4. Explore fuzzy logic and optimization techniques like Genetic Algorithms, Ant Colony Optimization, and Particle Swarm Optimization, and apply them in domains like fraud detection and healthcare.</li> <li>5. Apply generative models, adversarial learning, and privacy-preserving techniques to ensure fairness, interpretability, and adaptability in real-world applications.</li> </ol>

## 03020201PC04 - Advanced Machine Learning Laboratory

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of programming in Python, Fundamental concepts of Mathematics, including Linear Algebra, Probability, and Statistics, and an Understanding of Data Structures and Algorithms for efficient data handling and processing.	
<b>Rationale</b>	The course aims to provide a comprehensive understanding of Machine Learning (ML) concepts, including supervised, unsupervised, and reinforcement learning, develop proficiency in decision tree learning, neural networks, and Bayesian learning, apply genetic algorithms, fuzzy logic, and optimization techniques to real-world problems, enable students to analyze and compare ML models based on accuracy, efficiency, and application, and implement ML models using Python for text classification, face recognition, healthcare, and fraud detection.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	-	2	1.00	-	-	30	20	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Laboratory work will be based on above syllabus with minimum required experiments/exercises to be incorporated.

### Course Outcome

**After Learning the Course the students shall be able to:**

After Learning the Course the students shall be able to:

1. Implement and compare supervised and unsupervised learning algorithms, including Decision Trees, K-Nearest Neighbors, and Locally Weighted Regression for classification and regression tasks.
2. Design and train Artificial Neural Networks (ANNs) and apply genetic algorithms for solving real-world problems like face recognition.
3. Apply Bayesian learning techniques, including Naïve Bayes Classifier, Bayesian Belief Networks, and the EM Algorithm, for tasks such as text classification.
4. Explore fuzzy logic and optimization techniques like Genetic Algorithms, Ant Colony Optimization, and Particle Swarm Optimization, and apply them in domains like fraud detection and healthcare.
5. Apply generative models, adversarial learning, and privacy-preserving techniques to ensure fairness, interpretability, and adaptability in real-world applications.

## 03020201PC05 - Mathematical Foundations of Computer Science

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic Concepts of Statistics and Probability	
<b>Rationale</b>	To develop a strong theoretical foundation in logic, set theory, combinatorics, and graph theory, essential for problem-solving and algorithm design in computer science.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Curve Fitting &amp; Attributes</b> Principle of least squares and fitting of polynomials and exponential curves. Theory of attributes: Independence and association of attributes, consistency of data, measures of association and contingency, Yule's coefficient of colligation.	<b>15</b>	<b>15</b>
<b>2</b>	<b>Sampling Theory</b> Principle steps in a sample survey, Censuses versus sample survey, sampling and Non-sampling errors. Types of sampling: subjective, probability and mixed sampling methods. Simple Random Sampling, Stratified random sampling, Systematic sampling, Advantages and Disadvantages of the above methods of sampling.	<b>15</b>	<b>25</b>
<b>3</b>	<b>Time series</b> Time series and its components with illustrations, additive, multiplicative and mixed models. Determination of trend by the least squares, moving average methods. Growth curves and their fitting concerning modified exponential, Gompertz and Logistic curves. Determination of seasonal indices by Ratio to moving average, ratio to trend and link relative methods.	<b>15</b>	<b>25</b>
<b>4</b>	<b>Testing of Hypothesis, Large Sample Tests and Small Sample Tests</b> Formulation and procedure testing of hypothesis, critical region, two types of errors, level of significance and power of the test. Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one-sample and two-sample problems. Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi^2$ -test for goodness of fit, $\chi^2$ -test for independence of attributes. Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi^2$ -test for goodness of fit, $\chi^2$ -test for independence of attributes.	<b>15</b>	<b>35</b>
<b>Total</b>		<b>60</b>	<b>100</b>

<b>Reference Books</b>	
1.	<b>Fundamentals of Mathematical Statistics (TextBook)</b> S. C. Gupta and Kapoor
2.	<b>Ken Black, Business Statistics, Wiley Publication</b>
3.	<b>Daroga Singh and Chowdhary: Theory and Analysis of Sample Survey Designs, Wiley Eastern</b>
4.	<b>Richard A. Johnson, Iswin Miller and John Freund, Miller &amp; Freund's probability &amp; statistics for engineers, 7/3, Pearson, 2008.</b>
5.	<b>3. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol.I&amp; II, 8th Edition. The World Press, Kolkata</b>

<b>Course Outcome</b>
<b>After Learning the Course the students shall be able to:</b>
<p>After completing the course, students can be able to:</p> <ol style="list-style-type: none"> <li>1. Apply the principle of least squares for curve fitting and analyse the association and independence of attributes using Yule's coefficient and contingency tables.</li> <li>2. Understand various sampling methods and distinguish between sampling and non-sampling errors for effective data collection.</li> <li>3. Decompose time series data into components and apply suitable models and methods to estimate trends and seasonal variations.</li> <li>4. Formulate statistical hypotheses and apply appropriate large and small sample tests, including t, F, and <math>\chi^2</math> tests, for decision making under uncertainty.</li> </ol>

## 03020201PE03 - High Performance Computing

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	-	
<b>Rationale</b>	HPC is more than just for achieving high performance - it is a compelling vision for how computation can seamlessly scale from a single processor to virtually limitless computing power. The market demands general-purpose processors that deliver high single threaded performance as well as multi-core throughput for a wide variety of workloads on client, server, and high performance computing (HPC) systems.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction to Parallel Processing</b>  Parallel computing, scope of parallel computing, Levels of Parallelism (instruction, transaction, task, thread, memory, and function), Models (SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation etc.). Loosely Coupled and Tightly coupled, Multi-Core Architecture, accelerators, gpgpus	<b>7</b>	<b>15</b>
<b>2</b>	<b>Parallel algorithms</b>  Introduction to parallel algorithms, parallel algorithm models, decomposition techniques, characteristics of tasks & interactions, mapping techniques for load balancing, methods for containing interaction overheads.	<b>8</b>	<b>20</b>
<b>3</b>	<b>Programming Using message Passing Paradigm</b>  Principles, building blocks, MPI, Overlapping Communication and computation, collective Communication operations, Composite synchronization Constructs, openmp Threading Building blocks; An Overview of Memory Allocators, Parallel programming Model, combining MPI and openmp, Shared memory Programming	<b>8</b>	<b>20</b>
<b>4</b>	<b>Parallel Programming Using GPGPU</b>  An Overview of GPGPU, DGX architecture, An Overview of GPGPU Programming, An Overview of GPGPU Memory Hierarchy Features, CUDA Programming,	<b>8</b>	<b>20</b>
<b>5</b>	<b>Performance measures</b>  Speedup, efficiency and scalability. Abstract performance metrics (work, critical paths), Amdahl's Law, abstract vs. Real performance (granularity, scalability)	<b>4</b>	<b>10</b>
<b>6</b>	<b>HPC on AI/ML/DL Platform</b>  Dask, Pytorch, Keras, Tensorflow Case Study : Super Computers	<b>7</b>	<b>15</b>
<b>Total</b>		<b>42</b>	<b>100</b>

**Reference Books**

1.	<b>Introduction to Parallel Computing By Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar   Pearson Publication (TextBook)</b>
2.	<b>Advanced Computer Architecture: Parallelism, Scalability, Programmability</b> Kai Hwang, Naresh Jotwani, McGraw Hill, Second Edition, 2010
3.	<b>CUDA by Example – An Introduction to General Purpose GPU Programming</b> Edward Kandrot and Jason Sanders, Addison-Wesley Professional, 2010.

**Course Outcome**

**After Learning the Course the students shall be able to:**

After Learning the Course the students shall be able to:

1. To knowledge the overview and analyze the performance metrics of high-performance computing.
2. To comprehend the various High Performance Computing Paradigms and Job Management Systems.
3. To analyze the benchmarks of high-performance computing.
4. To demonstrate the various emerging trends of high-performance computing.
5. To apply high performance computing concepts in problem solving.

## 03020201PE04 - High Performance Computing Laboratory

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	-	
<b>Rationale</b>	HPC is more than just for achieving high performance - it is a compelling vision for how computation can seamlessly scale from a single processor to virtually limitless computing power. The market demands general-purpose processors that deliver high single threaded performance as well as multi-core throughput for a wide variety of workloads on client, server, and high-performance computing (HPC) systems	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	-	2	1.00	-	-	30	20	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Laboratory work will be based on above syllabus with minimum required experiments/exercises to be incorporated.

### Course Outcome

**After Learning the Course the students shall be able to:**

After Learning the Course the students shall be able to:

1. To knowledge the overview and analyze the performance metrics of high-performance computing.
2. To comprehend the various High Performance Computing Paradigms and Job Management Systems.
3. To analyze the benchmarks of high-performance computing.
4. To demonstrate the various emerging trends of high-performance computing.
5. To apply high performance computing concepts in problem solving.

## 03020201PE06 - Principles of Information Security and Privacy Laboratory

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	-	
<b>Rationale</b>	-	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	-	2	1.00	-	-	30	20	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Laboratory work will be based on above syllabus with minimum required experiments/exercises to be incorporated.
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## 03021601MC01 - Disaster Management

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 1</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of Environmental Science or Geography	
<b>Rationale</b>	This course enables students to understand, assess, and manage various types of disasters, their impacts, and mitigation strategies, thereby fostering resilience and sustainable development.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	-	-	0.00	-	-	-	-	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction to Disaster:</b> Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity Disaster and Development and disaster management Types ( Geological Disasters, Hydro-Meteorological Disasters, Biological Disasters, Technological Disasters and Man-made Disasters) , Global Disaster Trends, Causes, Consequences and Control of Disasters.	<b>12</b>	<b>20</b>
<b>2</b>	<b>Disaster Management Cycle and Framework:</b> Disaster Management Cycle -Paradigm Shift in Disaster Management, Pre-Disaster -Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster -Evacuation -Disaster Communication -Search and Rescue -Emergency Operation Centre -Incident Command System -Relief and Rehabilitation -Postdisaster -Damage and Needs Assessment, Restoration of Critical Infrastructure -Early Recovery -Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.	<b>14</b>	<b>30</b>
<b>3</b>	<b>Disaster Management in India:</b> Disaster Profile, Lessons Learnt from Major Disasters, Disaster Management Act 2005 -Institutional and Financial Mechanism National Policy on Disaster Management, Roles and responsibilities of Government (States, Centre) and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA).	<b>12</b>	<b>30</b>
<b>4</b>	<b>Technology for Disaster Management &amp; Mitigation:</b> Geo-informatics in Disaster Management (GIS, GPS), Disaster Communication System (Early Warning system), Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India.	<b>10</b>	<b>20</b>
<b>Total</b>		<b>48</b>	<b>100</b>

Reference Books	
1.	<b>'Introduction to Disaster Management'</b> Modh Satish; Macmilan Publishers India
2.	<b>An overview on natural &amp; man-made disasters and their reduction</b> R K Bhandani
3.	<b>Disaster Administration And Management Text And Case Studies</b> Goel S. L.,; Deep &Deep Publication Pvt. Ltd., New Delhi.

4.	<b>Disaster Management</b> B.Narayan; Rawat Publication
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<b>Course Outcome</b>
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<b>After Learning the Course the students shall be able to:</b>
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| <ol style="list-style-type: none"><li>1. Differentiate types of disasters, identify their causes, and evaluate their impact on the environment and society.</li><li>2. Analyse disaster damage and apply effective management strategies.</li><li>3. Assess vulnerability and recommend appropriate risk mitigation measures.</li><li>4. Develop a hazard and vulnerability profile using relevant tools and techniques.</li><li>5. Classify structural and non-structural disaster mitigation strategies.</li></ol> |
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## 03020002MC01 - Pedagogy Studies

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	A basic familiarity with education systems, classroom teaching–learning processes, and introductory research concepts is required.	
<b>Rationale</b>	This course aims to develop a critical and research-informed understanding of pedagogical practices, curriculum, teacher education, and professional development, with a special focus on evidence-based approaches and contextual challenges.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	-	-	0.00	-	-	-	-	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction and Methodology</b> Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching	<b>6</b>	<b>25</b>
<b>2</b>	<b>Thematic overview</b> Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.	<b>6</b>	<b>13</b>
<b>3</b>	<b>Evidence on the effectiveness of pedagogical practices Methodology for the in-depth stage</b> Quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches, Teacher's attitudes and beliefs and Pedagogic strategies	<b>6</b>	<b>25</b>
<b>4</b>	<b>Professional development</b> Alignment with classroom practices and follow-up support, Peer support Support from the head teacher and the community Curriculum and assessment Barriers to learning: limited resources and large class sizes	<b>6</b>	<b>25</b>
<b>5</b>	<b>Research Gaps</b> Research gaps and future directions, Research design, Contexts Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.	<b>6</b>	<b>12</b>
<b>Total</b>		<b>30</b>	<b>100</b>

Reference Books	
1.	<b>Education for All, the Quality Imperative and the Problem of Pedagogy</b> Alexander, R; CREATE, University of Cambridge, 2008
2.	<b>Teaching for Quality Learning at University</b> Biggs, J. & Tang, C; Open University Press, 2011
3.	<b>Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education</b> Cochran-Smith, M., & Zeichner, K.; Lawrence Erlbaum Associates, 2005
4.	<b>Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement</b> Hattie, J.; Routledge, 2009
5.	<b>Education 2030: Incheon Declaration and Framework for Action</b> UNESCO; UNESCO, 2015
6.	<b>National Curriculum Framework</b> NCERT; NCERT, 2005

Course Outcome
<p><b>After Learning the Course the students shall be able to:</b></p> <p>Remember key concepts, theories of learning, and pedagogical terminology relevant to curriculum and teacher education. Understand diverse pedagogical practices used in formal and informal classroom contexts.</p> <p>Apply appropriate research methodologies to evaluate the effectiveness of pedagogical practices.</p> <p>Analyze evidence from educational studies to assess strengths, limitations, and research gaps in pedagogy.</p> <p>Evaluate professional development models and curriculum frameworks to recommend context-sensitive improvements.</p>

## 03020002MC02 - Personality Development through Life Enlightenment Skills

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Learners should possess basic communication skills, self-awareness, and a foundational understanding of professional and academic environments.	
<b>Rationale</b>	This course develops communication, leadership, and self-awareness skills to support holistic personality growth and professional readiness among students. It fosters reflective thinking, responsible decision-making, and adaptability for success in academic and professional environments.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	-	-	0.00	-	-	-	-	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Goal Setting and Tracking</b> <ul style="list-style-type: none"> <li>• Meaning and importance of goal setting</li> <li>• Types of goals</li> <li>• SMART goal framework</li> <li>• Goal prioritization and alignment with career objectives</li> <li>• Action planning and milestone setting</li> </ul>	<b>2</b>	<b>10</b>
<b>2</b>	<b>SWOT &amp; SOAR Analysis</b> <ul style="list-style-type: none"> <li>• Identifying personal strengths and development areas</li> <li>• Opportunity mapping and goal alignment</li> <li>• Applying analysis for career planning</li> <li>• Reflection and action planning</li> </ul>	<b>2</b>	<b>10</b>
<b>3</b>	<b>Time Management</b> <p>Time audit and productivity analysis Tools for time management (planners, digital tools) Overcoming procrastination</p>	<b>2</b>	<b>10</b>
<b>4</b>	<b>Emotional Intelligence</b> <p>Self-awareness and regulation Stress Management and EI at the workplace Motivation and Emotional Resilience Empathy and Social Skills Managing stress and emotions at work</p>	<b>2</b>	<b>10</b>
<b>5</b>	<b>Decision Making</b> <p>Problem identification and goal Setting Evaluating alternatives and choosing solutions Decision making under risk and uncertainty</p>	<b>2</b>	<b>10</b>
<b>6</b>	<b>Conflict Management</b> <p>Conflict resolution styles and strategies Effective communication during conflict Negotiation and mediation skills Managing conflicts in teams and workplaces</p>	<b>2</b>	<b>10</b>
<b>7</b>	<b>Leadership Skills</b> <p>Leadership styles and decision-making Team building and ethical leadership Decision-making and problem-solving skills Team motivation and delegation Ethical leadership and accountability</p>	<b>2</b>	<b>10</b>
<b>8</b>	<b>Personal Branding and Professional Presence</b>	<b>4</b>	<b>10</b>

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
	Resume structuring for technical professionals Writing impactful profiles and summaries LinkedIn optimization and professional networking Digital etiquette and online presence		
9	<b>Group Discussion</b> Types and objectives of group discussions Initiation, participation, and conclusion strategies Critical thinking and developing the argument Handling disagreement and turn-taking Evaluation criteria and common mistakes	6	10
10	<b>Personal Interview</b> Interview preparation and strategies Answering situational and competency-based questions Non-verbal communication and professional etiquette Mock interviews and feedback	6	10
<b>Total</b>		<b>30</b>	<b>100</b>

Reference Books	
1.	<b>The 7 Habits of Highly Effective People</b> Stephen R. Covey; Simon & Schuster, 2020
2.	<b>How to Win Friends and Influence People</b> Dale Carnegie; Pocket Books
3.	<b>Speak with Impact</b> Allison Shapira; HarperCollins Leadership, 2018
4.	<b>Effective Communication Skills</b> Rizvi, M.A.; New Delhi: McGraw Hill Education, 2019
5.	<b>Mindset: The New Psychology of Success</b> Carol S. Dweck

Course Outcome
<b>After Learning the Course the students shall be able to:</b>
Remember key concepts of communication, leadership, and emotional intelligence. Understand principles of group discussion, interviews, and professional conduct. Apply leadership, time management, and emotional intelligence skills in real-life situations. Analyze personal strengths, weaknesses, opportunities, and goals for career development.

## 03020202PC01 - Advance Algorithm

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of programming and algorithms	
<b>Rationale</b>	To provide advanced knowledge and skills in computer science	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Advanced Graph Algorithms</b> Single-source and all-pairs shortest path algorithms, network flow algorithms (Max-flow, Min-cut), bipartite and general matching algorithms, graph partitioning techniques, Eulerian and Hamiltonian paths and cycles.	<b>8</b>	<b>20</b>
<b>2</b>	<b>Approximation and Randomized Algorithms</b> Greedy approximation techniques, polynomial-time approximation schemes (PTAS) and fully polynomial-time approximation schemes (FPTAS), randomized algorithms, Asymptotic Notations, Master's Theorem, Substitution method for finding complexity.	<b>6</b>	<b>15</b>
<b>3</b>	<b>Computational Complexity and NP-Completeness</b> Complexity classes P, NP, NP-Complete and NP-Hard, Approximation problems - Clique problem, Vertex Cover Problem, The subset-sum problem, Binary Search Algorithm, Quick Sort Algorithm, Merge Sort Algorithm.	<b>6</b>	<b>15</b>
<b>4</b>	<b>Advanced Data Structures</b> Fibonacci heaps and their applications, splay trees and amortized analysis, Binary Search Trees, AVL Trees, Red Black Tree, K- Dimensional Trees.	<b>6</b>	<b>15</b>
<b>5</b>	<b>Exploring Graphs</b> An introduction of graphs, Undirected Graph, Directed Graph, Traversing Graphs, Depth First Search, Breath First Search, Topological sort, Prims algorithm, Kruskal algorithm.	<b>6</b>	<b>15</b>
<b>6</b>	<b>Dynamic Programming</b> Matrix chain multiplication, Huffman coding Algorithm, Longest common subsequence, 0/1 Knapsack problem, Travelling Salesman Problem.	<b>5</b>	<b>20</b>
<b>Total</b>		<b>37</b>	<b>100</b>

Reference Books	
1.	<b>Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms", MIT Press.</b>

<b>Course Outcome</b>	
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<b>After Learning the Course the students shall be able to:</b>
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CO1: Analyze advanced graph algorithms such as shortest path, network flow, and matching algorithms to solve complex problems.
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CO2: Evaluate approximation and randomized algorithms for solving NP-hard problems.
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CO3: Analyze computational complexity classes and NP-complete problems.
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CO4: Apply advanced data structures such as heaps, AVL trees, and Red-Black trees in problem-solving.
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CO5: Implement graph traversal and spanning tree algorithms.
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CO6: Design dynamic programming solutions for optimization
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## 03020202PC03 - Computer Vision and Image Processing

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of C	
<b>Rationale</b>	To learn different feature extraction and algorithm evaluation techniques for image analysis.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>LOW LEVEL IMAGE PROCESSING</b> Overview of Image and Vision Applications, Illumination, Sampling and Quantization, Image representation and Modeling, Image sources, Image processing application, Image Enhancement, Contrast, Resolution, Histogram Equalization, Spatial Filters, Frequency Representation and Filters, Edge detection, Canny edge detector, Corner detection, Morphological Operation, Color Image Processing, Human eye and cognitive aspects of color, Color transformation.	<b>8</b>	<b>15</b>
<b>2</b>	<b>HIGH LEVEL IMAGE PROCESSING</b> Order statistic filters, Image Segmentation, Object Boundary Detection and Representation, Texture representation, Gabor filters, Noise Removal, Blurring, Image restoration, Image compression.	<b>9</b>	<b>10</b>
<b>3</b>	<b>IMAGE FORMATION AND RADIOMETRY</b> Basics of Image Formation and Radiometry, Bidirectional Reflection Distribution Function, Reflectance Map, Image Formation and Coordinate Transformations, Camera Pin-hole model, Camera calibration, Camera Parameters: Internal and External, Camera Parameters estimation, 3D coordinates and transformation.	<b>5</b>	<b>15</b>
<b>4</b>	<b>SHAPE AND MOTION ANALYSIS</b> Calculus of variation theory, Light at Surfaces, Phong Model, Albedo estimation, Horn-Schunk Optical Flow Formulation, Motion estimation, Epipolar geometry, Photometric Stereo, Structure from motion, Depth from stereo, Shape from Shading, Surface smoothness, Relaxation methods for depth estimation, Shape from texture, 3-D models, Volumetric representation and modeling, Surface modeling.	<b>5</b>	<b>25</b>
<b>5</b>	<b>IMAGE ANALYSIS AND UNDERSTANDING</b> <b>b9</b> Multi resolution approach, Super resolution, MRF based modeling, Labelling, MRF based applications: Segmentation, Object recognition, Facial detection, Biometric: Iris and Finger print, Feature extraction, Feature vector dimension Reduction, Template based modeling for recognition, Knowledge representation, Feature matching algorithm.	<b>9</b>	<b>20</b>
<b>6</b>	<b>APPLICATIONS</b> Video summarization, In-painting, Biometric recognition, Target detection and tracking, Face recognition, Human gesture and action recognition, Animated Character, Rendering.	<b>6</b>	<b>15</b>
<b>7</b>	<b>Practical and mini-projects will be based on the coverage of the above topics.</b>		
<b>Total</b>		<b>42</b>	<b>100</b>

Reference Books	
1.	1. Rafael C. Gonzales and Richard E. Woods, "Digital Image Processing", 4th edition Education, Reprint 2018.
2.	2. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI, EEE, 4th reprint 2002.
3.	3. David A. Forsyth and Jean Ponce, "Computer Vision: A Modern Approach", Prentice -Hall, 2004.
4.	4. J. R. Parker, " Algorithms for Image Processing and Computer Vision", 2ndedition ,Wiley, 2010.
5.	5. Robert M. Haralick and Linda G. Shapiro, "Computer and Robot Vision ", Addison Wesley, 1992.

Course Outcome
<b>After Learning the Course the students shall be able to:</b>
CO1 be able to understand fundamentals of image processing and computer vision and image analyzing techniques.
CO2 be able to apply various image processing operations for analyzing images and vision related techniques for segmentation, visualization of depth and camera calibration.
CO3 be able to analyze the problem and effectively use appropriate technique for image processing and vision related problem solving.
CO4 be able to evaluate critically the solutions developed for image processing and vision problems.
CO5 be able to build new applications using advanced image processing and computer vision techniques.

## 03020202PE01 - Deep Learning

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Linear Algebra and Probability, Fundaments of Machine learning	
<b>Rationale</b>	The objective of this course is to provide a comprehensive understanding of artificial neural networks (ANN) and deep learning models, including their architectures, training methodologies, and optimization techniques. It focuses on advanced neural network paradigms such as CNNs, RNNs, LSTMs, and generative models for handling complex tasks in vision, speech, and natural language processing.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction to Neural Networks</b> Basics of Artificial Neural Networks (ANN): Artificial Neurons, Computational Models of Neurons, Structure of Neural Networks, and Functional Units of ANN for Pattern Recognition Tasks.	<b>5</b>	<b>10</b>
<b>2</b>	<b>Feed forward Neural Networks</b> Pattern Classification using Perceptron, Multilayer Feed forward Neural Networks (MLFFNNs), Back propagation Learning, Empirical Risk Minimization, Regularization, and Autoencoders.	<b>5</b>	<b>10</b>
<b>3</b>	<b>Feedforward Neural Networks</b> Pattern Classification using Perceptron, Multilayer Feedforward Neural Networks (MLFFNNs), Backpropagation Learning, Empirical Risk Minimization, Regularization, and Autoencoders.	<b>7</b>	<b>15</b>
<b>4</b>	<b>Convolution Neural Networks (CNNs)</b> Introduction to CNNs – Convolution, Pooling, Deep CNNs, Different Deep CNN Architectures – LeNet, AlexNet, VGG, PlacesNet. <b>Training a CNN:</b> Weights Initialization, Batch Normalization, Hyperparameter Optimization, and Understanding and Visualizing CNNs.	<b>8</b>	<b>20</b>
<b>5</b>	<b>Recurrent Neural Networks (RNNs)</b> Sequence Modeling using RNNs, Back propagation Through Time, Long Short-Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, and Gated RNN Architecture.	<b>8</b>	<b>20</b>
<b>6</b>	<b>Generative Models</b> Restricted Boltzmann Machines (RBMs), Stacking RBMs, Belief Nets, Learning Sigmoid Belief Nets, Deep Belief Nets, Stochastic Autoencoders (AE), Variational Autoencoders (VAE), and Generative Adversarial Networks (GAN).	<b>7</b>	<b>15</b>
<b>7</b>	<b>Applications</b> Applications in vision, speech, and natural language processing.	<b>5</b>	<b>10</b>
<b>Total</b>		<b>45</b>	<b>100</b>

Reference Books	
1.	<b>Deep Learning (Textbook) by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.</b>
2.	<b>Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal.</b>
3.	<b>Deep Learning with Python by François Chollet.</b>

Course Outcome
<b>After Learning the Course the students shall be able to:</b> <ol style="list-style-type: none"><li>1. Include artificial neurons, computational models, and their role in pattern recognition.</li><li>2. Identify and address challenges in training deep neural networks (DNNs) using advanced optimization techniques.</li><li>3. Design and train convolutional neural networks (CNNs) for image classification and feature extraction.</li><li>4. Implement recurrent neural networks (RNNs) and advanced architectures for sequence modeling and time-series applications.</li><li>5. Apply neural networks to real-world problems in vision, speech, and natural language processing (NLP) using deep learning.</li></ol>

## 03020202PE03 - Malware Analysis and Mitigation

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of operating system and malwares	
<b>Rationale</b>	To understand design and implementations issues in distributed systems.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>INTRODUCTION :</b> Introduction To Malwares, Different Types of Malwares, Characteristics of Malwares.	<b>6</b>	<b>15</b>
<b>2</b>	<b>Static Analysis :</b> Identification and Initial Assessment of Malwares, Antivirus Scanning, Hashing, Finding Strings, Packed and Obfuscated Malware, File Formats, Linked Libraries and Functions, X86 Architecture and Disassembly, Recognizing C Code Constructs In Assembly, Analyzing Malicious C Programs, Shellcode Analysis	<b>6</b>	<b>20</b>
<b>3</b>	<b>Dynamic Analysis:</b> Sandboxes, Process Monitors, Process Explorer, Registry Snapshots, Faking A Network, Packet Sniffing, Source and Assembly Level Debugger, Kernel and User Level Debugging Exceptions.	<b>6</b>	<b>25</b>
<b>4</b>	<b>Malware Functionality:</b> Malware Behaviour, Covert Malware Launching, Data Encoding, Malware Focused Network Signatures	<b>6</b>	<b>25</b>
<b>5</b>	<b>Anti Reverse Engineering :</b> Anti-Disassembly, Anti-Debugging, Anti-Virtual Machine Techniques, Packers and Unpacking	<b>8</b>	<b>10</b>
<b>6</b>	<b>Practical assignments will be based on the coverage of above topics.</b> This practical module focuses on understanding, analyzing, and mitigating various types of malware. Students will gain hands-on experience in identifying malware behavior, performing basic static and dynamic analysis, and applying appropriate mitigation techniques. Practical assignments will be designed based on the covered topics to strengthen analytical skills, improve awareness of cybersecurity threats, and develop effective response strategies for securing systems and networks.	<b>2</b>	<b>5</b>
<b>Total</b>		<b>34</b>	<b>100</b>

Reference Books	
1.	Ligh, M., Adair, S., Hartstein, B., Richard, M., “Malware analyst's cookbook and DVD: tools and techniques for fighting malicious code”, Wiley Publishing, 2010.
2.	Michael Sikorski, andrewHonig, Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software publisher William Pollock, 2012.
3.	Michael Hale Ligh, andrew Case, Jamie Levy, Aaron Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory, 2014.
4.	Marak V., “Windows malware analysis essentials”, Packt Publishing Ltd, 2015.
5.	Dang, B., Gazet, A., Bachaalany, E., “Practical reverse engineering: x86, x64, ARM, Windows kernel, reversing tools, and obfuscation”, John Wiley & Sons, 2014..

Course Outcome
<b>After Learning the Course the students shall be able to:</b>
CO1 have the knowledge of different types of malware, its behaviour and analysis techniques.
CO2 be able to apply different tools and techniques for malware data acquisition and analysis.
CO3 be able to analyse and evaluate the effect of malware on system and network.
CO4 be able to create malware analysis report and suggest suitable preventive measures.

## 03020202PE05 - Secure Software Engineering

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of software engineering, programming, and computer networks	
<b>Rationale</b>	To provide advanced knowledge and practical skills for designing, developing, testing, and maintaining secure software systems by integrating security principles throughout the software development life cycle.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Introduction to Secure Software Engineering:</b> Security concepts, CIA triad, threat landscape, secure design principles.	4	10
2	<b>Secure Software Development Life Cycle (SSDLC)</b> Security requirements, threat modeling, risk assessment.	6	15
3	<b>Secure Coding Practices</b> OWASP Top 10, secure coding standards, authentication and authorization.	8	20
4	<b>Software Vulnerability Analysis</b> Static and dynamic analysis, secure code review.	6	15
5	<b>Security Testing and Verification</b> Testing, fuzz testing, DevSecOps fundamentals	8	20
6	<b>Software Security Architecture</b> Secure APIs, cryptography, secure data storage and transmission.	8	20
<b>Total</b>		<b>40</b>	<b>100</b>

Reference Books	
1.	<b>1. Gary McGraw, Software Security: Building Security In, Addison-Wesley.</b>
2.	<b>2. Michael Howard and David LeBlanc, Writing Secure Code, Microsoft Press</b>
3.	<b>3. Mark G. Graff and Kenneth R. van Wyk, Secure Coding: Principles and Practices, O'Reilly.</b>
4.	<b>4. OWASP Foundation – OWASP Top 10 Documentation.</b>
5.	<b>5. Ross Anderson, Security Engineering, Wiley.</b>

<b>Course Outcome</b>
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<b>After Learning the Course the students shall be able to:</b>
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- |  |
|--|
| CO1: Understand core principles of secure software engineering.<br>CO2: Apply security practices across the software development life cycle.<br>CO3: Identify and mitigate common software vulnerabilities.<br>CO4: Design and implement secure software architectures.<br>CO5: Perform security testing and vulnerability assessment. |
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## 03020202PE06 - Secure Software Engineering Laboratory

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of software engineering, programming, and computer networks	
<b>Rationale</b>	To provide advanced knowledge and practical skills for designing, developing, testing, and maintaining secure software systems by integrating security principles throughout the software development life cycle.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
-	-	2	1.00	-	-	30	20	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Laboratory work will be based on above syllabus with minimum required experiments/exercises to be incorporated.

### Course Outcome

**After Learning the Course the students shall be able to:**

- CO1: Understand core principles of secure software engineering.
- CO2: Apply security practices across the software development life cycle.
- CO3: Identify and mitigate common software vulnerabilities.
- CO4: Design and implement secure software architectures.
- CO5: Perform security testing and vulnerability assessment.

## 03020202PE07 - Digital Forensics

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of security	
<b>Rationale</b>	To understand the system activity logs to perform the scripting for investigating cyber-crime.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction</b> Introduction to Digital Forensics, Definition and Types of Cybercrimes, Rules for Digital Forensic, Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Introduction to Internet Crimes, Hacking and Cracking, Credit Card and ATM Frauds, Web Technology, Cryptography.	<b>6</b>	<b>15</b>
<b>2</b>	<b>Cyber Crime and Digital Evidences</b> Types of Digital Evidences and their Characteristics, Electronic Evidence and Handling, Challenges in Digital Evidence Handling, Searching and Storage of Electronic Media, Emerging Digital Crimes and Modules, Understanding Law Enforcement Agency Investigations, Following the Legal Process, Understanding Corporate Investigations, Establishing Company Policies.	<b>8</b>	<b>15</b>
<b>3</b>	<b>Computer Security Incident Response</b> Introduction to Computer Security Incident, Goals of Incident Response, Incident Response Methodology, Formulating Response Strategy, Incidence Response Process, Data Collection on Unix Based Systems.	<b>6</b>	<b>15</b>
<b>4</b>	<b>Disk and File System Analysis</b> Media Analysis Concepts, File System Abstraction Model, Partition Identification and Recovery, Virtual Machine Disk Images, Forensic Containers Hashing, Carving, Forensic Imaging, Data Analysis Methodology, Investigating Applications, Malware Handling	<b>8</b>	<b>25</b>
<b>5</b>	<b>Identification of data</b> Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events, Useable File Formats, Unusable File Formats, Converting Files, Investigating Network Intrusions and Cyber Crime, Network Forensics and Investigating Logs, Investigating Network Traffic, Investigating Web Attacks, Router Forensics. Cyber Forensics Tools and Case Studies.	<b>8</b>	<b>15</b>
<b>6</b>	<b>Network Forensics</b> Technical Exploits and Password Cracking, Analyzing Network Traffic, Collecting Network Based Evidence, Evidence Handling, Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers As Response Tools	<b>6</b>	<b>15</b>
<b>7</b>	<b>Based on Practical</b> Practical Assignments Will Be Based on the Coverage of Above topics. (Problem Statements Will Be Changed Every Year and Will Be Notified on Website.)	<b>4</b>	
<b>Total</b>		<b>46</b>	<b>100</b>

<b>Reference Books</b>	
1.	<b>1. Jason Luttgens, Matthew Pepe, Kevin Mandia, “Incident Response and computer forensics”, Tata McGraw Hill, 2014.</b>
2.	<b>2. Nilakshi Jain, DhananjayKalbande, “Digital Forensic: The fascinating world of Digital Evidences”, Wiley, 2016.</b>
3.	<b>3. C. Altheide&amp; H. Carvey, “Digital Forensics with Open Source Tools, Syngress”, 2011. ISBN: 9781597495868</b>
4.	<b>4. Angus M.Marshall, “Digital forensics: Digital evidence in criminal investigation”, John – Wiley andSons, 2008</b>
5.	<b>5. Amelia Phillips, Bill Nelson, Christopher Steuart, “Guide to Computer Forensics and Investigations”, Fourth Edition, Course Technology, 2009.</b>

<b>Course Outcome</b>
<b>After Learning the Course the students shall be able to:</b>
CO1 have the knowledge of various cybercrimes and the concepts of digital forensic, and handling evidences. CO2 be able to apply appropriate response Strategy and the overall incidence response process. CO3 be able to analyze the data and handling of malware. CO4 be able to evaluate difference evidences and methodologies for forensic analysis. CO5 be able to design the digital forensic system to carry out system level forensics for cybercrimes.

## 03020202PE09 - Data Science for Software Engineering

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of operating system	
<b>Rationale</b>	To understand design and implementations issues in distributed systems.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>FORMAL SOFTWARE ENGINEERING</b> Formal specifications, Techniques, Verification and Validation, Theorem Provers, Model checking, modeling concurrent systems, Temporal logics, CTL & LTL and model checking, SAT Solvers, Testing Techniques, TestCase Generation	<b>6</b>	<b>10</b>
<b>2</b>	<b>SOFTWARE REQUIREMENTS AND ESTIMATION</b> Software Requirements: What and Why, Software Requirements Engineering, Software Requirements Management, Software Requirements Modeling, Software Estimation, Size Estimation, Effort, Schedule and Cost Estimation, Tools for Requirements Management and Estimation.	<b>6</b>	<b>15</b>
<b>3</b>	<b>SOFTWARE DEVELOPMENT METHODOLOGIES</b> Introduction to Software Engineering, A Generic View of Process, Process Models, Software Requirements, Design Engineering, Creating an Architectural Design, Modeling Component.	<b>6</b>	<b>15</b>
<b>4</b>	<b>SOFTWARE PROCESS AND PROJECT MANAGEMENT:</b> Software Process Maturity, Process Reference Models, Software Project Management Renaissance, Life Cycle Phases and Process artifacts, Workflows and Checkpoints of Process, Process Planning, Project Organizations, Project Control and Process Instrumentation, CCPDS-R Case Study and Future Software Project Management Practices.	<b>8</b>	<b>20</b>
<b>5</b>	<b>FUNDAMENTALS OF OBJECT ORIENTED DESIGN IN UML</b> Static and Dynamic Models, Necessity of Modeling, UML Diagrams, Class Diagrams, Interaction Diagrams, Collaboration Diagram, Sequence Diagram, State Chart Diagram, Activity Diagram, Implementation Diagram.	<b>6</b>	<b>15</b>
<b>6</b>	<b>USER INTERFACE</b> Module Introduction, Objectives of Usability, How to Approach Usability, Designing with Usability in mind, Measuring Usability, Guidelines for User Interface Design, User Interface Elements.	<b>6</b>	<b>15</b>
<b>7</b>	<b>SOFTWARE QUALITY ASSURANCE AND TESTING</b> Software Quality Assurance and Standards, Quality Standards, Software Testing Strategy and Environment, Building Software Testing Process, Software Testing Techniques, Software Testing Tools, Testing Process Seven Step Testing Process, Specialized Testing Responsibilities	<b>4</b>	<b>10</b>
<b>Total</b>		<b>42</b>	<b>100</b>

Course Outcome	
<b>After Learning the Course the students shall be able to:</b>	
CO1 have knowledge about software engineering tools for integrated development environments, syntax checking, testing, debugging, and version control. CO2 be able to apply software engineering principles to solve Data Science applications. CO3 be able to critically analyze the Data Science problems to apply software engineering solutions. CO4 be able to evaluate various Data Science applications using software engineering principles. CO5 be able to design software engineering principles based applications using Data Science principles.	

## 03020202PE11 - Advance Compiler Design

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic Knowledge of Compilers and Automate Theory	
<b>Rationale</b>	This course focuses on the analysis and optimization techniques needed to obtain high performance on current computer architectures.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
3	-	-	3.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Introduction</b> Front-end concepts: lexical, syntactic, and semantic analysis; intermediate representations	4	15
2	<b>Optimization</b> Introduction to code optimization, efficient code generation and parallelizing compilers, Using Program Analysis for Optimization, peephole, local, global, and interprocedural optimizations	9	20
3	<b>Data-flow</b> Classical theory, bi-directional flows, unified algorithms, Introduction to Abstract Interpretation, Control-Flow Optimizations	5	15
4	<b>Efficient code generation and Parallelism detection:</b> Efficient code generation: Algorithms, register allocation heuristics and automated tools. Parallelism detection: Data dependence, control dependence, various restructuring transformations on loops Inter-procedural analysis: Constant propagation, data dependence etc. Selected case studies	12	25
5	<b>Virtual Machines and Automatic Memory Management</b> Virtual Machines and their Interpreters: Pros & Cons, Components, Implementations, Forms of Interpreter, Interpreter Implementations Automatic Memory Management: Memory Allocation, Memory Deallocation, Garbage Collection Algorithms, Copying Garbage Collection, Cheney's Garbage Collector, Incremental and Generational Garbage Collection,	12	25
<b>Total</b>		<b>42</b>	<b>100</b>

Reference Books	
1.	<b>Advanced Compiler Design and Implementation By S. Muchnick, Morgan Kaufmann Publication (TextBook)</b>
2.	<b>High Performance Compilers for Parallel Computing By M. J. Wolfe, Addison-Wesley Publication</b>
3.	<b>Compilers: Principles, Techniques, and Tools, 2nd Edition By Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Addison-Wesley Publication</b>

## Course Outcome

### After Learning the Course the students shall be able to:

1. Specify the lexical and syntactic structure of a programming language and implement a compiler to validate the structure of an input program.
2. Apply the principles of storage allocation and register allocation to the generation of assembly code for an input program.
3. Compare and contrast different intermediate representations.
4. Define and implement peephole and local optimizations.
5. Define and implement global data-flow analyses and optimizations.

## 03020202UE01 - Augmented Reality and Virtual Reality

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Students enrolling in this course should have fundamental knowledge of computer graphics, data structures, and object-oriented programming, along with a basic understanding of linear algebra, 3D geometry, and human-computer interaction concepts. Familiarity with game engines, computer vision, or artificial intelligence is desirable but not mandatory, as these concepts support effective understanding of immersive AR and VR systems and application development.	
<b>Rationale</b>	Augmented Reality and Virtual Reality are emerging immersive technologies that are transforming multiple sectors such as education, healthcare, manufacturing, entertainment, and industrial training. This course is designed to equip M.Tech (CSE) students with theoretical foundations and practical exposure to AR/VR technologies by integrating interdisciplinary concepts from computer graphics, HCI, computer vision, and artificial intelligence.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction to AR and VR</b>  Reality-Virtuality Continuum, Definitions: AR, VR, MR, XR, History and evolution of immersive technologies, Applications: Education, Healthcare, Manufacturing, Gaming, Defense, Challenges and future trends, Ethical, social, and accessibility considerations (NEP focus)	<b>8</b>	<b>20</b>
<b>2</b>	<b>Virtual Reality Systems and Components</b>  VR system architecture, Displays: HMDs, CAVE, stereoscopic displays, Sensors and tracking: position, orientation, motion, Input devices: controllers, haptics, gloves, Rendering pipeline for VR, Performance issues: latency, frame rate, motion sickness	<b>10</b>	<b>20</b>
<b>3</b>	<b>Augmented Reality Techniques</b>  AR system architecture, Marker-based and marker-less AR, Computer vision for AR, Tracking and registration techniques, AR SDKs: ARCore, ARKit, Vuforia, Spatial mapping and environment understanding	<b>10</b>	<b>20</b>
<b>4</b>	<b>Interaction, Modeling, and Visualization</b>  3D interaction techniques, User experience (UX) and human-computer interaction (HCI), 3D modeling basics, Scene graph and animation, Multimodal interaction (gesture, voice, eye-tracking), Accessibility and inclusive design (NEP emphasis)	<b>8</b>	<b>20</b>
<b>5</b>	<b>Development Platforms and Applications</b>  Game engines: Unity, Unreal Engine, AR/VR application development workflow, Integration with AI, IoT, and Digital Twins, Case studies: Virtual labs, Medical simulation, Industrial training, Research trends and open problems	<b>8</b>	<b>20</b>

<b>Reference Books</b>
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1.	<b>Sherman, W. R., &amp; Craig, A. B., Understanding Virtual Reality, Morgan Kaufmann</b>
2.	<b>Cawood, S., &amp; Fiala, M., Augmented Reality: A Practical Guide</b>
3.	<b>LaValle, S. M., Virtual Reality, Cambridge University Press</b>

<b>Course Outcome</b>
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**After Learning the Course the students shall be able to:**

- CO1: Explain core principles of AR, VR, and Mixed Reality systems.
- CO2: Analyze AR/VR hardware, tracking, rendering, and interaction techniques.
- CO3: Design and develop immersive applications using AR/VR SDKs.
- CO4: Apply 3D graphics, simulation, and visualization techniques effectively.
- CO5: Evaluate real-world AR/VR use cases in healthcare, education, gaming, and industry.
- CO6: Undertake mini-projects or research work aligned with emerging technologies.

## 03020202UE02 - Cyber Physical Systems

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Good working knowledge of C, Python and Fundamentals of computer network, Wireless Communication and Internet Technology	
<b>Rationale</b>	The course aims to develop a multidisciplinary perspective by integrating IoT with domain-specific applications in areas such as industrial automation, structural health monitoring, smart energy systems, predictive maintenance, and environmental sensing. Through hands-on experience with embedded hardware, sensor networks, and cloud platforms, students will gain the ability to conceptualize, design, and implement IoT-based solutions for real-world engineering problems. The course will also emphasize data-driven decision-making, secure communication protocols, and the role of IoT in enabling Industry 4.0 and smart infrastructure.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Advanced IoT Concepts</b> Evolution of IoT, CPS, Edge/Fog/Cloud Computing in engineering, IoT for Industry 4.0 & 5.0, IoT-OT Convergence	<b>4</b>	<b>10</b>
<b>2</b>	<b>IoT Reference Architecture, Sensor Nodes, Gateways, Device-to-Cloud, Data Acquisition Systems</b> Domain Focus: IIoT system design for Smart Plants, Aircraft Health Monitoring, Power Distribution Automation	<b>6</b>	<b>15</b>
<b>3</b>	<b>Communication Protocols for Engineering Applications</b> MQTT, CoAP, DDS, Zigbee, LoRa, NB-IoT, 6LoWPAN, OPC-UA, SCADA Integration <b>Use-cases:</b> Sensor buses in aircraft, building automation, grid communication	<b>6</b>	<b>15</b>
<b>4</b>	<b>Embedded Systems &amp; Platform Development</b> Raspberry Pi, ESP32, STM32 boards, RTOS, Linux programming <b>Hands-on:</b> Motor control, vibration monitoring, high-frequency data logging, integration with MATLAB/Python dashboards	<b>8</b>	<b>20</b>
<b>5</b>	<b>Introduction to real-world IoT case studies and platforms</b> Overview of domain-independent IoT applications: smart manufacturing, predictive maintenance, smart home automation, energy monitoring, healthcare, wearable IoT systems, environmental monitoring, waste management, smart transportation, fleet management, asset tracking, , system-level design, sensor integration, and cloud connectivity, Evaluation of the impact of IoT on efficiency, safety, and sustainability	<b>6</b>	<b>15</b>
<b>6</b>	<b>Advanced Data Analytics and Cloud Integration</b> Cloud Platforms (AWS IoT, Azure IoT, IBM Watson), Data Logging, Visualization, Streaming Analytics, Digital Twin Concepts	<b>4</b>	<b>10</b>
<b>7</b>	<b>Security, Standards &amp; Research Trends</b> Lightweight Cryptography, PKI, Interoperability Standards (OneM2M, ISO/IEC 30141), Research challenges, Survey methods	<b>6</b>	<b>15</b>
<b>Total</b>		<b>40</b>	<b>100</b>

<b>Reference Books</b>	
1.	<b>Internet of Things (A Hands-on-Approach) By Vijay Madiseti and Arshdeep Bahga,   VPT</b>
2.	<b>Industrial Internet of Things: Cybermanufacturing Systems By Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat</b>
3.	<b>Internet of Things and Data Analytics Handbook By Hwaiyu Geng (Editor)</b>
4.	<b>Interconnecting Smart Objects with IP: The Next Internet By Jean-Philippe Vasseur, Adam Dunkels   Morgan Kuffmann Publishers</b>
5.	<b>Getting Started with the Internet of Things By Cuno Pfister,   O'Reilly Media</b>

<b>Course Outcome</b>
<b>After Learning the Course the students shall be able to:</b>
<ol style="list-style-type: none"> <li>1. To impart a comprehensive understanding of IoT architecture and communication protocols</li> <li>2. To analyze integration of IoT in domain-specific scenarios like smart grids, industrial automation, structural monitoring, and avionics</li> <li>3. To develop prototypes for smart engineering systems using embedded platforms and cloud services</li> <li>4. To explore current research trends, standards, and challenges in IoT applications for engineering systems</li> </ol>

## 03020202UE03 - Social Networking

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Students should have prior knowledge of data structures, algorithms, database management systems, and basic concepts of computer networks and web technologies. Familiarity with probability, graph theory, and programming languages such as Python or Java is desirable for understanding social network analysis and application development.	
<b>Rationale</b>	Social networking platforms generate massive volumes of data and play a critical role in communication, information dissemination, and decision-making in modern society. This course aims to provide M.Tech (CSE) students with theoretical foundations and practical insights into social network structures, analysis, and applications	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction to Social Networking</b>  Evolution of social networks, Types of social networks: online, offline, professional, Components and architecture of social networking platforms, Applications and societal impact, Challenges and future trends	<b>8</b>	<b>20</b>
<b>2</b>	<b>Graph Theory and Network Models</b>  Graph representation of social networks, Network metrics: degree, centrality, clustering coefficient, Random graph models, Small-world and scale-free networks, Network visualization techniques	<b>10</b>	<b>20</b>
<b>3</b>	<b>Social Network Analysis</b>  Community detection algorithm, Link prediction technique, Influence and information diffusion models, Opinion dynamics, Recommendation systems in social networks	<b>10</b>	<b>20</b>
<b>4</b>	<b>Data Mining and Machine Learning in Social Networks</b>  Social media data collection and preprocessing, Sentiment analysis, User behavior modeling, Fake news and misinformation detection, Integration with AI and NLP	<b>8</b>	<b>20</b>
<b>5</b>	<b>Privacy, Security, and Ethics</b>  Privacy models and access control, Security threats in social networks, Trust and reputation systems, Legal and ethical issues, NEP-2020 perspective on responsible and inclusive technology	<b>8</b>	<b>20</b>
<b>Total</b>		<b>44</b>	<b>100</b>

<b>Reference Books</b>	
1.	<b>Easley, D. &amp; Kleinberg, J., Networks, Crowds, and Markets, Cambridge University Press</b>
2.	<b>Newman, M., Networks: An Introduction, Oxford University Press</b>
3.	<b>Aggarwal, C., Social Network Data Analytics, Springer</b>

<b>Course Outcome</b>
<b>After Learning the Course the students shall be able to:</b>
CO1: Explain core concepts and evolution of social networking systems. CO2: Model social networks using graph theory and mathematical tools. CO3: Apply algorithms for community detection, link analysis, and influence maximization. CO4: Analyze social network data for real-world applications CO5: Evaluate privacy, security, and ethical issues in social networking platforms. CO6: Conduct research-oriented or industry-based mini projects in social networking.

## 03020502UE01 - Business Analytics

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Inclination to learn machine Learning, basic knowledge of differential classification clustering and regression algorithms , Data Mining.	
<b>Rationale</b>	The course will provide a strong foundation on business analytics and the basic concepts.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Business analytics</b> Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	<b>10</b>	<b>15</b>
<b>2</b>	<b>Trendiness and Regression Analysis</b> Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	<b>10</b>	<b>15</b>
<b>3</b>	<b>Organization Structures of Business analytics</b> Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.	<b>12</b>	<b>20</b>
<b>4</b>	<b>Forecasting Techniques</b> Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	<b>12</b>	<b>20</b>
<b>5</b>	<b>Decision Analysis</b> Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	<b>12</b>	<b>20</b>
<b>6</b>	<b>Recent Trends in</b> Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	<b>4</b>	<b>10</b>
<b>Total</b>		<b>60</b>	<b>100</b>

<b>Reference Books</b>	
1.	<b>"Fundamentals of Business Analytics" by R.N.Prasad and Seema Acharya (TextBook)</b>
2.	<b>"Business Analytics – The Science of DataDriven Decision Making" by U. Dinesh Kumar (TextBook)</b>
3.	<b>"Data Analytics "</b> by Anil Maheshwari; McGraw Hill
4.	<b>"Business Analytics for Managers: Taking Business Intelligence Beyond" by Jesper Thorlund &amp; Gert H.N. Laursen</b>
5.	<b>"Business Analytics ", by Sahil Raj</b>

<b>Course Outcome</b>
<b>After Learning the Course the students shall be able to:</b>
<ol style="list-style-type: none"> <li>1. Explain business analytics and its role within an organization.</li> <li>2. Acquire domain knowledge of business analytics and its critical concepts.</li> <li>3. Understand business intelligence systems and applications of business analytics.</li> <li>4. Implement business problems and to support managerial decision making.</li> </ol>

## 03020602UE01 - Industrial Safety

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of safety in the field of electrical engineering, chemical engineering, civil engineering and fire safety.	
<b>Rationale</b>	The main objective of this subject is to introduce practical knowledge of industrial safety and its maintenance considering different acts and standards related to safety. It also helps in understanding different types of hazards and safety precautions to avoid these hazards. The subject will also help in gaining field knowledge related to safety audit and policies.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Introduction:</b>  Introduction to Industrial Safety, History and Development of Safety Movements, Safety Programs, Need for Safety, Different Safety Acts, Rules, Standards, Safety Organizations and Responsibilities, Safety Policy, Requirement and Responsibility of Safety Officer and Safety Committee, Safety Audit.	<b>8</b>	<b>12</b>
<b>2</b>	<b>Health &amp; Safety Management and Audit - Standards and Acts:</b>  Occupational Health and Safety Audit - Code of Practice (IS 14489), Occupational Health and Safety System Elements, Occupational Health and Safety Policy, Organizational Setup, Safety Manual, Safety Culture, Hazard Identification and Job Safety Analysis, Product Safety and Safety Training, The Factory Act 1948, The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, The Central Electricity Authority Regulations, 2011, The Static and Mobile Pressure Vessels Rules, 2016, The Gas Cylinder Rules, 2016, The Explosive Rules, 2008, The Building and other Construction Workers Act, 1996.	<b>14</b>	<b>24</b>
	<b>Physical and Chemical Hazard:</b>  Machine and General Area Guarding, Material Handling, Safety in Storage, New Equipment Inspection, Electrical Hazard: Hazards related to Electrical Energy, Safe limits of Ampere & Voltage, Safe Distance from Power Lines, Means of Cutting off Power, Overload and Short Circuit Protection, Protection against Voltage Fluctuation, Protection for Electrical Equipments in Hazardous Atmosphere, Hazardous Area Classification, Criteria for Selection, Installation, Maintenance and Use of Equipment in Hazardous Areas, Electrical Safeguarding, Earthing, Importance of Earthing, Parameters related to Earthing, Earthing Design for Safety considering IEEE Standard, Chemical Hazard: Transportation of Hazardous Materials, Safety and Handling of Storage of Hazardous Chemicals, Gas Cylinders, Labelling and Colour Coding	<b>14</b>	<b>24</b>
<b>4</b>	<b>Fire Hazard:</b>  Fire Phenomena, Chemistry of Fire, Stages of Fire, Factors contributing to Fire, Classification of Fires, Common causes of Industrial Fires, Building, Plant and Exits Design considering Prevention of Fire and Fire Safety, Safety considering Electrical Equipments and Circuits, Fire Safety in Handling Flammable and Explosive Materials, Fire Detection and Alarm System, Fixed Water Sprinkler System, Fire Hydrant, Portable Fire Extinguishers and Types of Portable Fire Extinguishers, Fire Drill and Fire Fighting Training.	<b>10</b>	<b>18</b>

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
5	<b>Industrial Safety, Hygiene and Occupational Health:</b>  Industrial Hygiene & Health Definitions, Difference between Industrial Hygiene & Occupational Health, Work coordination between Industrial Hygienist, Role of Safety Officer and Factory Medical Officer, Occupational Health Hazards, Work Place Monitoring for Hazardous Chemicals, First Aid Facilities and Health Center, Personal Protection Equipment (PPE) and Emergency Equipment.	8	12
6	<b>Accident Analysis and Reporting:</b>  Nature and Causes of Accidents, Accident Prevention and Control Techniques, Accident Reporting and Investigation, Accident Analysis and Recommendations.	6	10
<b>Total</b>		<b>60</b>	<b>100</b>

Reference Books	
1.	<b>Indian Standard 14489:2018 - Standard for Occupational Health and Safety Audit.</b>
2.	<b>Industrial Accident Prevention (TextBook)</b> H.W. Heinrich, Dan Petersen, and Nestor Roos; McGraw-Hill Book Company; 5th edition (1 January 1980) ,January, 1980
3.	<b>Industrial Safety: Concepts and Practices (TextBook)</b> K.T. Kulkarni; Vidyarthi Griha Prakashan; NF ,March, 2005
4.	<b>Fundamental of Industrial Safety &amp; Health (TextBook)</b> y Dr. K U Mistry; Shyamaraj Global Commerce (9 May 2022); 2022 ,June, 2006
5.	<b>Occupational Safety Management &amp; Engineering (TextBook)</b> Willi Hammer; Pearson; 4th edition (1 October 1988); 1 October 1988 ,April, 2022

Course Outcome
<b>After Learning the Course the students shall be able to:</b>
After learning the course, the students shall be able to: 1. Explain about Industrial Safety and Safety Audit. 2. Illustrate different Standards, Acts and Rules related to Management of Health & Safety and Safety Audit. 3. Discuss Physical and Chemical Hazards and Preventive Steps to avoid it. 4. Apply methods for Prevention and Extinguishing of Fire. 5. Discuss Importance of Industrial Hygiene and Occupational Health in Work Place. 6. Explain process of Accident Analysis and Reporting.

## 03020702UE01 - IOT and Smart Cities

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	-	
<b>Rationale</b>	-	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Unit I Introduction to IoT for Smart Cities</b> <ul style="list-style-type: none"> <li>• Definition and characteristics of smart cities</li> <li>• IoT-based solutions in domains: Smart Home, Transport &amp; Traffic management</li> <li>• Smart city planning &amp; infrastructure essentials</li> <li>• Role of AI/ML/DL in IoT-enabled smart cities</li> </ul>	<b>8</b>	<b>18</b>
<b>2</b>	<b>Unit II- Technologies for IoT</b> <ul style="list-style-type: none"> <li>• IoT communication technologies &amp; recent protocols</li> <li>• Secure IoT architectures overview</li> <li>• Services powered by IoT within smart cities</li> <li>• Cellular IoT, Cloud IoT platforms</li> <li>• Case study: Compare MQTT, WebSocket &amp; HTTP via Node-RED in smart-room setups</li> </ul>	<b>10</b>	<b>22</b>
<b>3</b>	<b>Unit III - Smart Transportation and Energy Systems</b> <ul style="list-style-type: none"> <li>• Traffic management systems &amp; sensor networks</li> <li>• Electric vehicles (EVs) &amp; EV charging infrastructure</li> <li>• Renewable energy integration and smart distribution</li> <li>• Smart grid concepts</li> <li>• Image-processing for traffic control &amp; bus movement analysis case study</li> </ul>	<b>8</b>	<b>18</b>

	<ul style="list-style-type: none"> <li>• Fundamentals of Smart Infrastructure</li> <li>• Smart water management systems</li> <li>• Infrastructure for Connectivity &amp; Monitoring (Wi-Fi, 5G, LPWAN, NB-IoT infrastructure)</li> <li>• Rainwater harvesting and solar-based automation</li> </ul>		
<b>5</b>	<b>Unit V - Security, Privacy, and Blockchain in IoT</b>	<b>6</b>	<b>13</b>
	<ul style="list-style-type: none"> <li>• Privacy and social values in smart urban environments</li> <li>• IoT information security challenges</li> <li>• Blockchain applications in IoT</li> <li>• Case studies: smart homes, building, street-lighting, parking, irrigation, &amp; food-supply chain traceability</li> <li>• Threats and mitigation mechanisms</li> </ul>		
<b>6</b>	<b>Unit-VI Mini Project / Case Study</b> Applications & Lab-Based Work	<b>4</b>	<b>9</b>
	<b>Total</b>	<b>45</b>	<b>100</b>

## 03022002UE01 - Waste to Energy

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic knowledge of environmental science, thermodynamics, and chemical engineering processes.	
<b>Rationale</b>	This course focuses on the technological advancements and engineering principles used to convert waste materials into energy. It gives students an in-depth understanding of thermochemical, biochemical, and physicochemical conversion techniques. The course emphasizes sustainability, energy recovery efficiency, and waste management practices in line with environmental regulations.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
4	-	-	4.00	60	20	-	-	100

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Introduction to Waste Management and Energy Conversion</b> Definition of waste, types of waste, need for energy recovery, classification of waste-to-energy technologies, and energy flow in ecosystems.	9	15
2	<b>Thermochemical Conversion</b> Incineration, pyrolysis, gasification - processes, reaction mechanisms, products, design considerations, advantages & limitations.	15	25
3	<b>Biochemical Conversion</b> Anaerobic digestion, fermentation - microbial pathways, process parameters, biogas production, biodiesel from waste oil, landfill gas recovery.	12	20
4	<b>Physicochemical Conversion</b> Transesterification, refuse-derived fuels (RDF), briquetting, pelletisation.	9	15
5	<b>Waste to Energy Technologies and Case Studies</b> Overview of WTE plants, Integrated MSW systems, success stories from India and abroad.	9	15
6	<b>Environmental and Economic Aspects</b> Emissions, ash disposal, life-cycle analysis, policy and regulatory frameworks, cost-benefit analysis.	6	10
<b>Total</b>		<b>60</b>	<b>100</b>

Reference Books	
1.	<b>Waste to Energy Conversion Technology (TextBook)</b> Naomi B Klinghoffer and Marco J. Castald; Woodhead Publishing, 2013
2.	<b>Waste-to-Energy Recent Developments and Future Perspectives towards Circular Economy</b> Abd El-Fatah Abomohra, Qingyuan Wang, Jin Huang; Springer Nature, 2022

3.	<b>Biomass to Renewable Energy Processes (TextBook)</b> Jay Cheng; CRC Press; 2nd, 2017
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<b>Course Outcome</b>
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<b>After Learning the Course the students shall be able to:</b>
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- Understand the fundamentals of waste classification and energy conversion pathways.
- Analyze thermochemical, biochemical, and physicochemical methods of energy recovery from waste.
- Evaluate real-world waste-to-energy systems in terms of efficiency, feasibility, and environmental compliance.
- Design conceptual WtE systems based on types of waste and energy needs.
- Interpret policy frameworks and perform economic assessments for waste-to-energy projects.

## 03023302MC01 - Indian Cyber Law and Ethics

<b>Course</b>	Master of Technology (MTech)	<b>Semester - 2</b>
<b>Type of Course</b>	-	
<b>Prerequisite</b>	Basic understanding of computers, internet, and cybersecurity concepts.	
<b>Rationale</b>	Equips students with legal and ethical knowledge to address cybercrimes, privacy issues, and digital rights in India's growing digital ecosystem.	
<b>Effective From A.Y.</b>	-	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				T	T	P	P	
2	-	-	0.00	-	-	-	-	50

**SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
<b>1</b>	<b>Foundations of Cyber Law</b> Introduction to Cyber Space and Cyber Crime, Evolution and Need for Cyber Laws in India, Overview of IT Act 2000 & Amendments (2008, 2021), Definitions under the IT Act: Data, Computer, Access, Legal Recognition of Electronic Records and Signatures, Authorities under IT Act: CERT-IN, Adjudicating Officers, Appellate Tribunal	<b>6</b>	<b>20</b>
<b>2</b>	<b>Cyber Crimes and Legal Provisions</b> Types of Cyber Crimes: Hacking, Phishing, Identity Theft, Financial Fraud, Cyber Stalking, Online Harassment, Cyber Terrorism and National Security, Social Media Abuse and Legal Liabilities, Legal Provisions, Case Studies: Avnish Bajaj (Bazee.com), Shreya Singhal v. Union of India	<b>6</b>	<b>20</b>
<b>3</b>	<b>Cyber Ethics and Digital Responsibility</b> Introduction to Cyber Ethics: Concepts & Importance, Ethical vs Unethical Hacking, Digital Citizenship and Responsible Internet Use, Ethical Issues in AI, Blockchain, IoT, IPR in Cyberspace – Copyrights, Patents, Software Licensing, Global Ethical Guidelines (ACM/IEEE Codes, GDPR Principles)	<b>6</b>	<b>20</b>
<b>4</b>	<b>Privacy, Data Protection &amp; Regulatory Frameworks</b> Understanding Privacy in the Digital Age, Right to Privacy – Puttaswamy Judgment, Digital Personal Data Protection Act (DPDP), 2023, GDPR vs. Indian Data Protection Laws – A Comparative View, Role and Responsibilities of Data Fiduciaries, Organizational Compliance – ISO 27001, Cybersecurity Policies	<b>6</b>	<b>20</b>
<b>5</b>	<b>Investigation, Enforcement &amp; Future Trends</b> Investigation of Cyber Crimes: Processes and Tools, Cyber Forensics: Basics and Tools Used, Jurisdictional Issues in Cyberspace, Role of Law Enforcement and Challenges in Prosecution, Future of Cyber Law: Metaverse, AI Regulations, Quantum Security.	<b>6</b>	<b>20</b>
<b>Total</b>		<b>30</b>	<b>100</b>

Reference Books	
1.	<b>Cyberlaw in India</b> Pavan Duggal
2.	<b>Information Technology Law and Practice</b> Vakul Sharma
3.	<b>Bare Act: Information Technology Act, 2000</b>
4.	<b>Digital Personal Data Protection Act, 2023</b>

Course Outcome
<b>After Learning the Course the students shall be able to:</b>
<ol style="list-style-type: none"> <li>1. Understand the evolution, scope, and foundational concepts of Indian Cyber Laws and the IT Act, 2000.</li> <li>2. Analyze various types of cybercrimes and identify applicable legal sections and penalties under the IT Act and other statutory frameworks.</li> <li>3. Evaluate ethical issues in cyberspace, including responsible digital behavior, cyber ethics, and intellectual property rights.</li> <li>4. Interpret and apply data protection and privacy-related laws such as the Digital Personal Data Protection Act, 2023, and international standards like GDPR.</li> <li>5. Demonstrate awareness of legal investigation procedures, digital evidence handling, and emerging trends such as AI regulations and cyber forensics.</li> </ol>