SGT UNIVERSITY
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FACULTY OF ENGINEERING AND TECHNOLOGY

COMPUTER SCIENCE & ENGINEERING

Two-Year Full-Time Education Program

Master of Technology in Computer Science & Engineering/Master of Technology in Computer Science & Engineering (Big Data Analytics)

With effect from Session 2024 - 25

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Head of the Department

Dean

Dean – Academics

1. NATURE AND EXTENT OF THE PROGRAM

M.Tech CSE (Master of Technology in Computer science & engineering) is a 2-year postgraduate program that focuses on the design, development, and application of computer software and hardware. The program provides students with a strong foundation in the fundamental principles of Computer science & engineering.

The nature of the M.Tech CSE program is technical and hands-on. Students learn to write code, build software applications, and design hardware systems. They also gain knowledge in computer architecture, algorithms, operating systems, database management, programming languages, and web technologies.

The extent of the M.Tech CSE program is vast and covers a wide range of topics. Some of the core subjects that students study in this program include:

Distributed Computing
Machine learning
Medical image processing
Advance Software Engineering & Testing

The M.Tech CSE program also includes practical training in the form of internships, projects, and laboratory sessions, where students can apply their theoretical knowledge to real-world problems. The program also provides opportunities for students to specialize in various areas such as artificial intelligence, cybersecurity, cloud computing, data analytics, and more.

Overall, the M.Tech CSE program is designed to equip students with the knowledge and skills required to become competent computer professionals who can meet the demands of the industry.

2. PROGRAM EDUCATION OBJECTIVES (PEOs)

After completing (M.Tech in CSE)), students will be able to:

PEO No.	Education Objective
PEO1	Professionalism: Postgraduates will be able to function effectively as ethical and socially responsible professionals in the field of Computer science & engineering.
PEO2	Technical Skills: Postgraduates will have a strong foundation in the principles of Computer science & engineering and will be able to apply their knowledge to solve complex problems.
PEO3	Adaptability: Postgraduates will be able to adapt to new and emerging technologies and will be able to continuously learn and update their skills.
PEO4	Communication Skills: Postgraduates will be able to communicate effectively and work collaboratively with others, including technical and non-technical stakeholders.
PEO5	Entrepreneurship: Postgraduates will have an entrepreneurial mindset and will be able to identify and pursue opportunities in the field of Computer science & engineering.
PEO6	Leadership: Postgraduates will have the ability to take on leadership roles and work effectively in teams, and will have an understanding of the social, economic, and environmental impacts of their work.

3. POST GRADUATE ATTRIBUTES

Sl. No.	Attributes	Description
1	Professional / Disciplinary Knowledge	As a language model, I can provide you with general information about the professional and disciplinary knowledge associated with a Master of Technology (M.Tech) degree in Computer science & engineering (CSE). M.Tech in CSE typically covers a broad range of topics related to computer hardware, software, algorithms, data structures, and programming languages.
2	Technical / Laboratory / practical skills	M.Tech CSE students need to have a strong foundation in computer science concepts and programming languages such as Java, C++, Python, etc. In a M.Tech CSE program, laboratory skills may involve setting up and configuring computer systems, installing software, and troubleshooting hardware and software issues. Students may also need to work on simulation projects to design and test new software systems. M.Tech CSE students need to have practical skills in software development methodologies such as Agile, Scrum, and Waterfall. They need to be able to write code that is well-documented, modular, and maintainable. In summary, a M.Tech CSE program requires a combination of technical, laboratory, and practical skills.

3	Communication Skill	Communication skills are an essential part of M.Tech CSE education and can help students excel in various aspects of their career. M.Tech CSE students must develop excellent communication skills to become successful software professionals.
4	Cooperation/Team work	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
5	Professional ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
6	Research / Innovation-related Skills	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques, and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
7	Critical thinking and problem solving	Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
8	Reflective thinking	Observe and examine critically the outcomes of one's actions and make corrective measures

		subsequently and learn from mistakes without depending on external feedback.
9	Information/digital literacy	Think laterally and originally, conceptualize, and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
10	Multi-cultural competence	Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity, and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
11	Leadership readiness/qualities	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economic and financial factors.
12	Lifelong Learning	Recognize the need for and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

4. QUALIFICATION DESCRIPTORS:

M.Tech in Computer science & engineering (CSE) is an postgraduate program that prepares students for a career in the field of computer science and technology. Some of the qualification descriptors for M.Tech CSE program are:

Technical knowledge: M.Tech CSE postgraduates should have a strong foundation in computer science concepts and should be familiar with Data Science with Python, Advanced DBMS, and other related technologies.

Analytical skills: M.Tech CSE postgraduates should possess strong analytical skills to analyze and solve complex problems related to computer systems and software applications.

Creativity: M.Tech CSE postgraduates should be able to think creatively to design and develop innovative software applications, websites, and computer systems.

Teamwork: M.Tech CSE postgraduates should be able to work collaboratively in a team environment to develop and implement software applications and computer systems.

Communication skills: M.Tech CSE postgraduates should possess excellent communication skills to articulate technical concepts and ideas to a diverse audience.

Project management skills: M.Tech CSE postgraduates should have project management skills to plan, organize, and execute software development projects successfully.

Ethical and professional conduct: M.Tech CSE postgraduates should adhere to ethical and professional conduct in their work and be aware of the impact of technology on society and the environment.

5. PROGRAM OUTCOME

PO No.	Attribute	Competency
PO1	**Engineering Knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in Computer science & engineering for the solution of complex engineering problems.
PO2	**Problem Analysis**	Identify, formulate, review research literature, and analyze complex Computer science and engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**	Design solutions for complex Computer science & engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tools Usage**	Create, select, and apply proper procedure, resources, and current engineering and mechanical tools including prediction and modelling to complex engineering activities in Computer science and engineering with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning inferred by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7	**Environment and Sustainability**	Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO9	**Individual and Team work**	Function effectively as an individual, and as a member or leader in diverse teams, and multidisciplinary settings.
PO10	**Communication**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Lifelong Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

6. PROGRAM SPECIFIC OUTCOME

PSO No.	Competency
PSO1	Postgraduates of the program will be able to design, implement, and maintain complex software systems using a range of programming languages and tools.
PSO2	Postgraduates of the program will be able to analyze and solve complex problems in Computer science & engineering using a range of algorithms and data structures.
PSO3	Postgraduates of the program will be able to communicate effectively with technical and non-technical audiences, and work collaboratively in teams to solve complex problems.
PSO4	Postgraduates of the program will be able to demonstrate ethical and professional behavior, and understand the social and ethical implications of Computer science & engineering in a global and societal context.

7. COURSE STRUCTURE

SEMESTER – I

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
	Data Science with Python	3	0	0	3	40	60	100
	Data Science with Python lab	0	0	2	1	20	30	50
	Medical image processing	3	0	0	3	40	60	100
	Medical image processing lab	0	0	2	1	20	30	50
	Advanced DBMS	3	0	0	3	40	60	100
	Advanced DBMS lab	0	0	2	1	20	30	50
	Program elective Course - I	3	0	0	3	40	60	100
	Program elective Course – I Lab	0	0	2	1	20	30	50
Total		12	0	8	16	240	360	600
Course for Specialization for Big Data Analytics		3	0	0	3	40	60	100
Course for Specialization for Big Data Analytics Lab		0	0	2	1	20	30	50
Total		15	0	10	20	300	450	750

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

SEMESTER – II

Course Code	Course Title	Credit Distribution (Hours/Week)	Marks Distribution

		L	T	P	C	IAE	ESE	Total
	Advance Software Engineering & Testing	3	0	0	3	40	60	100
	Advance Software Engineering & Testing lab	0	0	2	1	20	30	50
	Agile Software Development	3	0	0	3	40	60	100
	Data Mining	3	0	0	3	40	60	100
	Data Mining lab	0	0	2	1	20	30	50
	Operational research	2	0	0	2	40	60	100
	Program elective Course - II	3	0	0	3	40	60	100
	Program elective Course – II Lab	0	0	2	1	20	30	50
Total		14	0	6	17	260	390	650
Course for Specialization for Big Data Analytics		3	0	0	3	40	60	100
Course for Specialization for Big Data Analytics Lab		0	0	2	1	20	30	50
Total		17	0	8	21	320	480	800

SEMESTER – III

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
	Distributed Computing	3	0	0	3	40	60	100
	Distributed Computing lab	0	0	2	1	20	30	50
	AI & Soft Computing	3	0	0	3	40	60	100

	AI & Soft Computing lab	0	0	2	1	20	30	50
	Program elective Course - III	3	0	0	3	40	60	100
	Program elective Course – III Lab	0	0	2	1	20	30	50
	Program elective Course - IV	3	0	0	3	40	60	100
	Program elective Course - III	3	0	0	3	40	60	100
	Program elective Course – III Lab	0	0	2	1	20	30	50
Total		15	0	8	19	280	420	700
Course for Specialization for Big Data Analytics		3	0	0	3	40	60	100
Course for Specialization for Big Data Analytics Lab		0	0	2	1	20	30	50
Total		18	0	10	23	340	510	850

SEMESTER – IV

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
	Dissertation	0	0	20	20	80	120	200
Total		0	0	20	20	80	120	200

Program Electives pool

Program Elective Course-I	Program Elective Course-II	Program Elective Course-III	Program Elective Course-IV	Program Elective Course-V
Micro Systems & Hybrid Technology	Cloud and Fog Computing	Microcontrollers for IoT Prototyping	Wireless Sensor Networks and IoT	Signal Processing and Data Analytics
IoT and Cloud Computing	NoSQL Databases	Information Visualization	Web Intelligence and Big Data	Bigdata Frameworks
Mobile and Wireless Security	Malware Analysis	Cyber Attacks Detection and Prevention Systems	Knowledge Engineering and Intelligent Systems	Digital Forensics
Bio-Inspired Computing	Machine Learning for Signal Processing	Soft Computing Techniques	Cryptosystem	Deep Learning and its Applications

	I sem	II sem	III sem
Course for Specialization for Big Data Analytics	Machine learning	Streaming Data Analytics	Domain Specific Predictive Analytics

OVERALL CREDIT DISTRIBUTION TABLE FOR CSE

SEMESTER	HOURS PER WEEK			Total Credit	Marks Distribution		
SEMESTER – I	12	0	8	16	240	360	600
SEMESTER – II	14	0	6	17	260	390	650
SEMESTER – III	15	0	8	19	280	420	700
SEMESTER – IV	0	0	20	20	80	120	200
Total	41	0	42	72	860	1290	2150

Note – L: Lecture Hour, T: Tutorial Hour, P: Practical Hour, TC: Total Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

OVERALL CREDIT DISTRIBUTION TABLE FOR SPECIALIZATION (Big Data Analytics)

SEMESTER	HOURS PER WEEK			Total Credit	Marks Distribution		
SEMESTER – I	15	0	10	20	300	450	750
SEMESTER – II	17	0	8	21	320	480	800
SEMESTER – III	18	0	10	23	340	510	850
SEMESTER – IV	0	0	20	20	80	120	200
Total	50	0	48	84	1040	1560	2600

Note – L: Lecture Hour, T: Tutorial Hour, P: Practical Hour, TC: Total Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

8. SEMESTER-WISE COURSE DETAILS

SEMESTER - I

Course Code	Course Title
	Data Science with Python
	Data Science with Python lab
	Medical image processing
	Medical image processing lab
	Advanced DBMS
	Advanced DBMS lab
Program Elective Course - I	
	Micro Systems & Hybrid Technology
	IoT and Cloud Computing
	Mobile and Wireless Security
	Bio-Inspired Computing
Course for Specialization for Big Data Analytics	
	Machine learning
	Machine learning lab

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Data Science with Python
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Student having knowledge about python programming
Course Synopsis	To provide the students with sufficient knowledge in calculus and matrix algebra, this can be used in their respective fields.

Course Outcomes:

At the end of the course students will be able to:

CO1	Identify the need for data science and solve basic problems using Python built-in data types and their methods
CO2	Employ efficient storage and data operations using NumPy arrays.
CO3	Apply powerful data manipulations using Pandas.
CO4	Do data preprocessing and visualization using Pandas.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	-	-	-	-	-	-	1	1	1	-	1	-
CO2	3	2	1	1	1	-	-	-	-	-	1	1	1	-	1	-
CO3	3	2	1	1	1	-	-	-	-	-	1	1	1	-	1	-
CO4	3	1	1	1	-	-	-	-	-	-	1	1	1	-	1	-
Average	3	1.75	1	1	0.5	-	-	-	-	-	1	1	1	-	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content and Competency
1	1. Explain Data Science. (C2: Comprehension) 2. Describe Essential Python libraries. (C2: Comprehension) 3. Demonstrate Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments. (C3: Application) 4. Identify Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. (C1: Knowledge) 5. Define Decision Making- Looping- Loop Control statement Math and Random number. (C1: Knowledge) 6. Illustrate User defined functions - function arguments & its types. (C3: Application)
2	1. Describe NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays. (C2: Comprehension) 2. Implement Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing- Transposing Arrays and Swapping Axes. (C6: Evaluation) 3. Define Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting Unique and Other Set Logic. (C1: Knowledge)
3	1. Describe Introduction to pandas Data Structures. (C2: Comprehension) 2. Define Essential Functionality: Dropping. (C1: Knowledge) 3. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. (C1: Knowledge) 3. Demonstrate Reading and Writing Data in Text Format. (C3: Application) 4. Define Concept of Data Visualization. (C1: Knowledge) 5. Explain Libraries for Data Visualization. (C2: Comprehension) 6. Implement Matplotlib in-depth and Seaborn in-depth. (C6: Evaluation)
4	1. Describe Data Cleaning and Preparation. (C2: Comprehension)

	2. Explain Data Transformation: Removing Duplicates,Replacing Values, Detecting and Filtering Outliers. (C2: Comprehension) 3. Explain String Manipulation. (C2: Comprehension) 4.Define Machine Learning, Machine Learning algorithms, Supervised Learning, Unsupervised Learning, Reinforcement Learnin. (C1: Knowledge)

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	Textbooks: 1. Rajkumar Buyya, Amir Vahid Dastjerdi," Internet of Things: Principles and Paradigms", Elsevier,2016. 2. R. Chandrasekaran," Essentials of Cloud computing", 2nd Edition, Chapman and Hall/CRC, 2015. 3. Amita Kapoor, "Hands on Artificial intelligence for IoT", 1 st Edition, Packt Publishing, 2019.
	References: 1. . John Soldatos, "Building Blocks for IoT Analytics", River Publishers,2016. 2. John E. Rossman, "The Amazon way on IoT", Volume 2, John E. Rossman publication, 2016.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Data Science with Python Lab
Academic Year	I

Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	Basic statistical analysis and machine learning methods.

Course Outcomes:

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

CO1	Apply data visualization in Data sets.
CO2	Utilize EDA, inference and regression techniques.
CO3	Apply data pre-processing techniques.
CO4	Apply Basic Machine Learning Algorithms.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O 4
CO1	2	-	1	0	3	-	-	-	-	2	-	-	3	2	1	-
CO2	2	1	1	1	3	-	-	-	-	2	-	-	3	2	1	-
CO3	2	1	1	1	3	-	-	-	-	2	-	-	3	2	1	-
CO4	2	1	1	1	3	-	-	-	-	2	-	-	3	2	1	-
Average	2	0. 75	1	0. 75	3	-	-	-	-	2	-	-	3.0	2.0	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Unit	Content & Competency
1	Merging two Data Frames. (C1-C3)
2	Applying functions to Data Frames. (C1-C4)
3	Descriptive Statistics in Python. (C1-C4)
4	Creating and manipulating a List and an Array. (C1-C3)

5	Creating a Data Frame and Matrix-like Operations on a Data Frame. (C1-C3)
6	Reading and writing different types of data sets. (C1-C3)
7	Data Visualizations. (C1-C3)
8	Correlation and Covariance. (C1-C3)
9	Regression Model. (C1-C3)
10	Simulate Machine Learning Algorithms. (C1-C4)
Note:	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1,2, End term
Viva-voce	--
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars	Multiple Choice Questions (MCQ)

Problem-Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination (OSPE)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through google forms. 3. Course Exit Survey will be taken at the end of the semester.	
References:	(List of reference books)
	1. John Soldatos, "Building Blocks for IoT Analytics", River Publishers,2016 2. John E. Rossman, "The Amazon way on IoT", Volume 2, John E. Rossman publication, 2016

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering

Name of the Program	Master of Technology
Course Code	
Course Title	Medical Image Processing
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	-NIL
Course Synopsis	To acquire the student with the techniques of shape analysis and image.

Course Outcomes:

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

CO1	Comprehend image sampling and DFT.
CO2	Apply compression techniques and morphological operations for segmentation.
CO3	Design and develop algorithms to process and visualize images from different modalities.
CO4	Develop algorithms to process and visualize images from different modalities for diagnostic application.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO3
CO1	2	1	1	0	3	-	-	-	-	1	-	1	3	-	1
CO2	2	1	1	1	3	-	-	-	-	1	-	1	3	-	1
CO3	2	1	1	1	3	-	-	-	-	1	-	1	3	-	1
CO4	2	1	1	1	3	-	-	-	-	1	-	1	3	-	1
Average	2	1	1	0.75	3	-	-	-	-	1	-	1	3.0	-	1

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week

3	0	0	3

Unit	Content & Competency
1	1.Importance of Image perception. (C1: Knowledge) 2.Understanding the significance of Image model, Image sampling and quantization in 2D DFT and DCT. (C1: Knowledge) 3.Exploring the Image Enhancement by using Histogram model. (C1: Knowledge) 4.Introduction to Image restoration. (C1: Knowledge- C2: Comprehension) 5.Overview of Image degradation model. (C1: Knowledge) 6.Familiarization with Wiener filtering, Maximum entropy restoration. (C2: Comprehension) 7.Understanding of Noise models. (C2: Comprehension)
2	1.Generalize the concept of Image compression. Explain Lossy and lossless Compression. (C5: Synthesis) 2. Explain the concepts of Predictive techniques - Dilation, Erosion, Open, Close, Skeleton operations, Top-hat algorithm - Morphology based segmentation. (C2: Comprehension) 3. Define Image Segmentation : Machine Learning based segmentation algorithms. (C2: Comprehension) 4. Singular Value Decomposition (SVD) - Principal Component Analysis and its applications. (C1: Knowledge) 5. Explain Support Vector Machine and its applications. . (C2: Comprehension) 6. Independent Component Analysis and its application. (C4: Analysis)
3	1. Explain the concepts of Image Registration - Medical image Fusion, SPECT/CT, MR/CT, PET/CT. (C2: Comprehension) 2. Recall the purpose and importance of Image visualization - Volume Rendering, Surface rendering and Maximum Intensity Projection. (C1: Knowledge) 3. Describe Shape Analysis and Image Classification: Topological attributes - Shape orientation descriptors, Fourier descriptors. (C2: Comprehension) 4. Outline the purpose and significance of K means clustering, machine learning, Neural Network approaches- Statistical Parametric. (C1: Knowledge)

	5. Explain the principles of Mapping in Imaging - Regression analysis. (C2: Comprehension)
4	1. Recall the purpose and Applications of Computer Aided Design (CAD). (C1: Knowledge) 2. Explain the principles of General Linear Model (GLM) and its application in functional brain mapping. (C2: Comprehension) 3. Generalize the concept of Group analysis using t-test. (C5: Synthesis) 4.Defining and calling Computer Aided Manufacturing (CAM) in Medical Imaging applications. (C2: Comprehension) 5.Explain Patient specific modelling - Brain Computer Interface (BCI) and its applications in Neuroscience. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1

Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid-Semester Examination 1	✓	✓	✓	✓
Mid-Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through google forms. 3. Course Exit Survey will be taken at the end of the semester.	
References:	(List of reference books)
	i) Reiner Salzer, "Biomedical Imaging: Principles and applications", 2012, 1st Edition, Wiley, New Jersey ii) Jonathan Wolpaw, Elizabeth Winter, (Eds.) "Brain-Computer Interfaces: Principles and Practice", 2012, 1st Edition, Oxford University Press, Oxford. iii) Pears, Nick, Liu, Yonghuai, Bunting, Peter (Eds.) "3D Imaging, Analysis and Applications", 2012, 2nd Edition, Springer, Berlin

Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Medical Image Processing Lab
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	

Course Outcomes:

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

CO1	Comprehend image sampling and DFT.
CO2	Apply compression techniques and morphological operations for segmentation.
CO3	Design and develop algorithms to process and visualize images from different modalities.
CO4	Develop algorithms to process and visualize images from different modalities for diagnostic application.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	2	1	1	0	3	-	1	-	-	2	1	1	3	2	1	-
CO2	2	1	1	1	3	-	-	-	-	2	1	1	3	2	1	-
CO3	2	1	1	1	3	-	-	-	-	2	1	1	3	2	1	-
CO4	2	1	1	1	3	-	1	-	-	2	1	1	3	2	1	-
Average	2	1	1	0.75	3	-	0.5	-	-	2	1	1	3.0	2.0	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week

0	**0**	2	**2**

Unit	Content & Competency
1	Using spatial filters enhance the given noisy image. Compare the performance of various filters. (C1-C3)
2	Design suitable filters in frequency domain for noise removal from the given image. (C1-C4)
3	Using region growing algorithm segment the gray matter, white matter and CSF from the given MR brain image. (C1-C4)
4	Extract the features of interest from the given CT abdomen images and classify. (C1-C3)
5	Read the given PET and CT image and register. (C1-C3)
6	Fourier Transform a) Discrete Fourier Transform (DFT) b) Fast Fourier Transform (FFT). (C1-C3)
Note:	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative

Multiple Choice Questions (MCQ)	Mid Semester Examination 1,2, End term
Viva-voce	--
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars	Multiple Choice Questions (MCQ)
Problem-Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination (OSPE)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey
Students Feedback is taken through various steps • Regular feedback through the Mentor Mentee system. • Feedback between the semester through google forms. • Course Exit Survey will be taken at the end of the semester.	
References:	(List of reference books)
	1. Reiner Salzer, "Biomedical Imaging: Principles and applications", 2012, 1st Edition, Wiley, New Jersey

	2. Jonathan Wolpaw, Elizabeth Winter, (Eds.) "Brain-Computer Interfaces: Principles and Practice", 2012, 1st Edition, Oxford University Press, Oxford. 3. Pears, Nick, Liu, Yonghuai, Bunting, Peter (Eds.) "3D Imaging, Analysis and Applications", 2012, 2nd Edition, Springer, Berlin

FACULTY OF ENGINEERING AND TECHNOLOGY		
Name of the Department	Computer science & engineering	
Name of the Program	Master of Technology	
Course Code		
Course Title	Advanced DBMS	
Academic Year	I	
Semester	I	
Number of Credits	3	
Course Prerequisite	Basic aspects of DBMS.	
Course Synopsis	This course gives idea about basic database management.	
Course Outcomes: At the end of the course students will be able to:		
CO1	To understand the basic concepts and terminology related to DBMS and Relational Database Design.	
CO2	To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports.	
CO3	Exposure for students to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.	
CO4	Understand about file organization, Query Optimization, Transaction management, and database administration techniques.	
Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:		

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	1	-	1	-	-	-	-	2	1	-	-	-
CO2	3	2	1	-	1	-	1	-	-	-	-	2	1	1	1	-
CO3	3	2	1	-	1	1	1	-	-	-	-	2	1	-	1	-
CO4	3	2	1	-	-	1	1	-	-	-	-	2	1	-	-	-
Average	3	2	1	-	0.75	1	1	-	-	-	-	2	1	0.25	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content and Competency
1	1. Explain Formal review of relational database and FDs Implication. (C2: Comprehension) 2. Define Closure, its correctness. (C1: Knowledge) 3. Implement 3NF and BCNF. (C2: Comprehension) 4. Decomposition and synthesis approaches. (C2: Comprehension) 5. Define Basics of query processing. (C1: Knowledge) 6. Overview of external sorting, file scans. (C1: Knowledge)
2	1. Explain Processing of joins. (C2: Comprehension) 2. Describe materialized vs. pipelined processing. (C2: Comprehension) 3. Implement query transformation rules. (C6: Evaluation) 4. Explain DB transactions. (C2: Comprehension) 5. Explain ACID properties. (C2: Comprehension) 6. Describe interleaved executions. (C2: Comprehension)

	7. Describe schedules, serializability. (C2: Comprehension)
3	1. Explain Correctness of interleaved execution. (C2: Comprehension) 2. Describe Locking and management of locks. (C2: Comprehension) 3. Describe 2PL. (C2: Comprehension) 4. Demonstrate deadlocks. (C3: Application) 5. Define multiple level granularity. (C1: Knowledge) 6. Define CC on B+ trees. (C1: Knowledge) 7. Demonstrate Optimistic CC. (C5: Application)
4	1. Explain Time stamped. (C2: Comprehension) 2. Implement lock based techniques. (C6: Evaluation) 3. Define Multiversion approaches. (C1: Knowledge) 4. Comparison of CC methods. (C2: Comprehension) 5. Application of dynamic databases. (C3: Application) 6. Introduction to Failure classification. (C1: Knowledge) 7. Define recovery algorithm. (C1: Knowledge) 8. Explain XML and relational databases. (C2: Comprehension)

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4

Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	Textbooks: 1. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.
	References: 1. K. V. Iyer. Lecture notes available as PDF file for classroom use.

	2. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer Science & Engineering
Name of the Program	Master of Technology
Course Code	
Course Title	ADBMS Lab
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	The aim of this course is to introduce students to the advanced concepts of database systems, focusing on the relational algebra and data model, query optimization and transactions.

Course Outcomes:

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

CO1	Understand, appreciate and effectively explain the underlying concepts of database technologies.
CO2	Design and implement a database schema for a given problem-domain, and Normalize a database.
CO3	Understand the query a database using SQL DML/DDL commands.
CO4	Declare and enforce integrity constraints on a database using a state-of-the-art DBMS.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	2	-	1	0	3	-	-	-	-	2	-	-	3	2	1
CO2	2	1	1	1	3	-	-	-	-	2	-	-	3	2	1
CO3	2	1	1	1	3	-	-	-	-	2	-	-	3	2	1
CO4	2	1	1	1	3	-	-	-	-	2	-	-	3	2	1
Average	2	0.75	1	0.75	3	-	-	-	-	2	-	-	3.0	2.0	1

Course Content:			
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	0	**2**	**2**

Content & Competency

Unit	Title
1	Implementation of DDL commands of SQL with suitable examples : • Create table • Alter table • Drop table (C6: Evaluation)
2	Implementation of DML commands of SQL with suitable examples • Insert • Update • Delete. (C6: Evaluation)
3	Implementation of different types of function with suitable examples • Number function • Aggregate Function • Character Function • Conversion Function • Date Function. (C6: Evaluation)
4	Implementation of different types of operators in SQL • Arithmetic Operators • Logical Operators • Comparison Operator • Special Operator • Set Operation. (C6: Evaluation)
5	Implementation of different types of Joins • Inner Join • Outer Join • Natural Join etc. (C6: Evaluation)
6	Study and Implementation of • Group By & having clause • Order by clause • Indexing. (C6: Evaluation)
7	Study & Implementation of • Sub queries • Views (C6: Evaluation)
8	Study & Implementation of different types of constraints. (C6: Evaluation)

9	Study & Implementation of Rollback, Commit, Save point. • Creating Database /Table Space • Managing Users: Create User, Delete User • Managing roles:- Grant, Revoke. (C1: Knowledge)
10	Study & Implementation of SQL Triggers.. (C1: Knowledge)
11	Study & Implementation of PL/SQL. (C6: Evaluation)
Note:	Faculty should add 10 to 15 more practical

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutori:	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1,2, End term
Viva-voce	--
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars	Multiple Choice Questions (MCQ)
Problem-Based Learning (PBL)	Short Answer Questions (SAQ)

Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination (OSPE)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	Textbooks: 1. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.
	References: 1. K. V. Iyer, Lecture notes available as PDF file for classroom use. 2. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004.

Program Elective Courses-1

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Micro Systems & Hybrid Technology
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	This course is aimed to introduce the fundamental concepts of MEMS based sensors and actuators.

Course Outcomes:

At the end of the course students will be able to:

CO1	Identify and understand the fundamental concepts and background of MEMS and Microsystems
CO2	Familiar with the basics of various sensors and actuators.
CO3	Recognize and interpret various micromachining techniques and design, analysis and applications of various MEMS devices micromachining tools and techniques
CO4	Incorporate simulation and micro-fabrication knowledge for developing various MEMS devices.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO2	3	1	-	-	-	1	-	-	-	-	-	-	1	1	1	-
CO3	3	1	-	1	-	1	-	-	-	-	-	-	1	1	1	-
CO4	3	2	1	2	2	1	-	-	3	-	1	-	1	1	1	-
Average	3	1.25	0.5	1	0.5	1	-	-	0.75	-	0.5	0.5	1	1	1	-

Course Content:			
L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3
Unit	Content and Competency		
1	1.Explain the MEMS and Microsystems. (C2: Comprehension) 2. Explain the Miniaturization. (C2: Comprehension) 3. Recall the Benefits of Microsystems. (C1: Knowledge) 4. Recite the concept of MEMS, Typical MEMS and Microsystems products. (C1: Knowledge) 5. Analyze Evolution of Micro fabrication and Applications. (C4: Analysis)		
2	1.Generalize the concept Various domains and classification of transducers: electrostatic, piezoelectric, thermal. (C5: Synthesis) 2. Explain the concepts of Sensing principles: electrostatic, resistive, chemical etc. SAW devices. (C2: Comprehension) 3. Define Micro actuators. (C2: Comprehension) 4. Design of Micro accelerometers. (C6:Evaluation) 5. Analyze the Engineering Science for Microsystem design and fabrication. (C4: Analysis)		
3	1.Overview of silicon processes techniques, Photolithography, Ion Implantation, Diffusion. (C1: Knowledge) 2.Explain the concepts of Chemical Vapor Deposition, Physical vapor Deposition. (C2: Comprehension) 3. Recall the purpose and importance of Epitaxy, Etching, Bulk micromachining, Surface Micromachining, LIGA and other techniques. (C1: Knowledge) 4. Describe MEMS and micro systems applications: Details of application in actual systems, introduction to RF- MEMS, MOEMS, future of smart structures and MEMS leading to NEMS. (C2: Comprehension)		

	5. Outline the purpose and significance Packaging, test and calibration of MEMS. (C1: Knowledge)
4	1. Recall the purpose and basic functions of Thick-film and hybrid technology in sensor production. (C1: Knowledge) 2. Explain the principles of Basic materials, components, manufacturing Screen manufacturing. (C2: Comprehension) 3. Generalize the concept of Screen printing, Parameters, Comparison: thick- vs. thin film technology Structure dimensions. (C5: Synthesis) 4.Define Assembly and packaging Surface mount technology (SMT) Active and passive devices (SMD). (C2: Comprehension) 5.Explain Standard Connection technologies, Packaging. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1

Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	Textbooks: 1. G.K.Ananthasuresh, K J Vinoy, S Gopalakrishnan, KN Bhatt, V K Aatre," Micro and smart systems", 2012, 1st ed., Wiley, New York. 2. Tai-Ran Hsu, "MEMS & Microsystem, Design and Manufacture", 2017, 1st ed., McGraw Hill India, New Delhi.
	References: 1. Mahalick NP, "MEMS", 2017, 1st ed., Tata McGraw Hill, New Delhi 2. Wolfgang Menz, Jürgen Mohr, Oliver Paul, "Microsystem Technology", 2011, 2nd ed., Wiley, New York. 3. Banks H.T, Smith R.C. and Wang Y.Smart, 'Material Structures – Modeling, Estimation and Control', 2011, 1st ed., John Wiley & Sons, NewYork

	4. Massood Tabib – Arar, 'Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures', 2014, 1st ed., Kluwer Academic publishers, New York

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Micro Systems & Hybrid Technology Lab
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	Understand the concept of various sensors and actuators.

Course Outcomes:

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

CO1	Identify and understand the fundamental concepts and background of MEMS and Microsystems
CO2	Familiar with the basics of various sensors and actuators.
CO3	Recognize and interpret various micromachining techniques and design, analysis and applications of various MEMS devices micromachining tools and techniques
CO4	Incorporate simulation and micro-fabrication knowledge for developing various MEMS devices.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PS O3	PS O4
CO1	3	1	2	-	3	1	-	-	-	-	-	1	3	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	2	3	3	2	-	-

CO3	3	2		-	-	-	-	-	-	-	1	3	3	2	-	-
CO4	3	2	3	3	1	-	-	-	-	-	2	3	3	2	1	-
Average	3.0	1.8	2.3	0.8	1.0	0.5	-	-	-	-	1.3	2.5	3.0	2.0	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title	
1	a) Write a C program to find sum and average of three numbers. (C1: Knowledge) b) Write a C program to find the sum of individual digits of a given positive integer. (C1: Knowledge)	
2	a) Write a C program to generate the first n terms of the Fibonacci sequence. (C1: Knowledge) b) Write a C program to generate prime numbers from 1 to n. (C1: Knowledge) c) Write a C program to check whether given number is Armstrong Number or not. (C1: Knowledge)	
3	a) Write a C program to check whether given number is perfect number or not. (C1: Knowledge) b) Write a C program to check whether given number is strong number or not. (C1: Knowledge)	
4	a) Write a C program to find the roots of a quadratic equation. (C1: Knowledge) b) Write a C program to perform arithmetic operations using switch statement. (C1: Knowledge)	
5	a) Write a C program to find factorial of a given integer using non-recursive function. (C1: Knowledge) b) Write a C program to find factorial of a given integer using recursive function. (C1: Knowledge)	
6	a) Write C program to find GCD of two integers by using recursive function. b) Write C program to find GCD of two integers using non-recursive function.	
7	a) Write a C program to find both the largest and smallest number in a list of integers. (C1: Knowledge)	

	b) Write a C program to Sort the Array in an Ascending Order. (C1: Knowledge) c) Write a C program to find whether given matrix is symmetric or not. (C1: Knowledge)
8	a) Write a C program to perform addition of two matrices. (C1: Knowledge) b) Write a C program that uses functions to perform multiplication of two Matrices. (C1: Knowledge)
9	a) Write a C program to use function to insert a sub-string in to given main string from a given position. (C1: Knowledge) b) Write a C program that uses functions to delete n Characters from a given position in a given string. (C1: Knowledge)
10	a) Write C program to count the number of lines, words and characters in a given text. (C1: Knowledge) b) Write a C program to find the sum of integer array elements using pointers. (C1: Knowledge)
11	a) Write a C program to Calculate Total and Percentage marks of a student using structure. (C1: Knowledge)
Note:	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book / Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through google forms. Course Exit Survey will be taken at the end of the semester.	

References:

Textbooks:

1. G.K.Ananthasuresh, K J Vinoy, S Gopalakrishnan, KN Bhatt, V K Aatre," Micro and smart systems", 2012, 1st ed., Wiley, New York.
2. Tai-Ran Hsu, "MEMS & Microsystem, Design and Manufacture", 2017, 1st ed., McGraw Hill India, New Delhi.

	References: 1. Mahalick NP, "MEMS", 2017, 1st ed., Tata McGraw Hill, New Delhi 2. Wolfgang Menz, Jürgen Mohr, Oliver Paul, "Microsystem Technology", 2011, 2nd ed., Wiley, New York. 3. Banks H.T. Smith R.C. and Wang Y.Smart, 'Material Structures – Modeling, Estimation and Control', 2011, 1st ed., John Wiley & Sons, NewYork. 4. Massood Tabib – Arar, 'Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures', 2014, 1st ed., Kluwer Academic publishers, New York

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	IoT and Cloud Computing
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	This course is aimed to provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities

Course Outcomes:

At the end of the course students will be able to:

CO1	Understand sensors and communication protocols to use in a particular IoT system.
CO2	Deploy Cloud Services using different cloud technologies.
CO3	Implement cloud computing elements such virtual machines, web apps, mobile services, etc.
CO4	Implement security features to protect data stored in the cloud.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:																
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO2	3	1	-	-	-	1	-	-	-	-	-	-	1	1	1	-
CO3	3	1	-	1	-	1	-	-	-	-	-	-	1	1	1	-
CO4	3	2	1	2	2	1	-	-	3	-	1	-	1	1	1	-
Average	3	1.25	0.5	1	0.5	1	-	-	0.75	-	0.5	0.5	1	1	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content and Competency
1	1.Explain the Trends of Computing. (C2: Comprehension) 2. Recite the Introduction of IoT. (C1: Knowledge)
2	1.Generalize the concept of IoT. (C5: Synthesis) 2. Explain the IoT Architectures. (C2: Comprehension) 3. Define IoT Devices and Sensors. (C2: Comprehension) 4. Analyze the IoT communication and protocols. (C4: Analysis)
3	1. Explain the concepts of Cloud Computing Fundamentals. (C2: Comprehension) 2. Recall the purpose and importance of Cloud Computing Architectures. (C1: Knowledge) 3. Describe Cloud Types and Services. (C2: Comprehension) 4. Outline the purpose and significance of Virtualization and Resource Management. (C1: Knowledge)
4	1. Recall the purpose and basic functions of IoT and cloud integration. (C1: Knowledge)

	2. Explain Application development and cloud processing. (C2: Comprehension) 3. Generalize the concept of Security and Privacy for IoT/Cloud Computing. (C5: Synthesis)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4

Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	Botta A, De Donato W, Persico V, Pescapé A, "Integration of Cloud computing and Internet of Things: A survey", 2015

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	IoT and Cloud Computing Lab
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	This course is aimed to provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities.

Course Outcomes:

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

CO1	Understand sensors and communication protocols to use in a particular IoT system.
CO2	Deploy Cloud Services using different cloud technologies.
CO3	Implement cloud computing elements such virtual machines, web apps, mobile services, etc.

CO4	Implement security features to protect data stored in the cloud.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PS O3	PS O4
CO1	3	2	2	-	3	1	-	-	-	-	-	1	3	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	2	1	3	2	-	-
CO3	3	2	2	-	-	-	-	-	-	-	1	1	3	2	-	-
CO4	3	2	2	4	1	-	-	-	-	-	2	1	3	2	1	-
Average	3	2	2	1	1	0.5	-	-	-	-	1.3	1	3.0	2.0	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title
1	Installation of Raspbian OS or Ubuntu ARM OS on a Rasberry Pi Platform (C1: Knowledge)
2	Setting the networking parameters for Raspbian OS like Ethernet, WLAN, Bluetooth, etc (C1: Knowledge)
3	Enabling Security or SELinux in Raspbian OS or Ubuntu OS (C1: Knowledge)
4	Accessing IBM Bluemix from IoT Devices (C1: Knowledge)
5	Data visualization using d3.js or any other tool. (C1: Knowledge)
6	Contiki OS Installation and Simple IoT network configuration using Contiki.
7	Implementation of CoAP protocol using Contiki OS. (C1: Knowledge)
8	Energy, power, duty cycle calculation of IoT devices in Contiki OS. (C1: Knowledge)

9	Simple application deployment in Google Cloud Engine or Juju Framework. (C1: Knowledge)
10	Simple application deployment with PubNub cloud services. (C1: Knowledge)
Note:	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through google forms. Course Exit Survey will be taken at the end of the semester.	
References:	Botta A, De Donato W, Persico V, Pescapé A, "Integration of Cloud computing and Internet of Things: A survey", 2015

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Mobile and Wireless Security
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	This course is aimed to Identify and analyze various the security issues in wireless mobile communication.
Course Outcomes:	

At the end of the course students will be able to:	
CO1	Identify the requirement of security and various issues at wireless and mobile network.
CO2	Analyze the threats in wireless environment including device, networks and servers.
CO3	Select an appropriate solution for security and Justify and demonstrate the usage of preventive measures and countermeasures.
CO4	Implement the security solution for various environment in wireless network.

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

Cos	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O4
CO1	3	1	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO2	3	1	1	-	-	1	-	-	-	-	-	-	1	1	1	-
CO3	3	1	1	1	-	1	-	-	-	-	-	-	1	1	1	-
CO4	3	1	1	2	2	1	-	-	3	-	1	-	1	1	1	-
Average	3	1	1	1	0.5	1	-	-	0.75	-	0.5	0.5	1	1	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content and Competency
1	1.Explain the Mobile Communication History. (C2: Comprehension) 2. Explain the Security Wired Vs Wireless, Security Issues in Wireless and Mobile Communications Security of Device. (C2: Comprehension) 3. Recall the purpose Network, and Server Levels:s. (C1: Knowledge) 4. Recall the concept of Mobile Devices Security Requirements. (C1: Knowledge) 5. Analyze Mobile Wireless network level Security and Server Level Security. (C4: Analysis) 6. Analyze Application Level Security in Wireless Networks. (C4: Analysis)

	7.Design and implementation WLANs, Wireless Threats,. (C5: Synthesis) 8.Discribe Security for 2G Wi-Fi Applications. (C2: Comprehension) 9. Recent Security Schemes for Wi-Fi Applications. (C2: Comprehension)
2	1.Generalize the concept of Generations of Cellular Networks. (C5: Synthesis) 2. Explain the concepts of Security Issues and attacks in cellular networks. (C2: Comprehension) 3. Define GSM, GPRS and UMTS security for applications. (C2: Comprehension) 4. Analyze the 3G security for applications. (C4: Analysis)
3	1. Explain the concepts of MANETs, applications of MANETs, MANET Features, Security Challenges in MANETs, Security Attacks on MANETs. (C2: Comprehension) 2. Recall the purpose and importance of Application Level Security in Ubiquitous Networks: Ubiquitous Computing, Need for Novel Security Schemes for UC, Security Challenges for UC. (C1: Knowledge)
4	1. Recall the purpose and basic functions of Heterogeneous Wireless network architecture, Heterogeneous network application in disaster management, Security problems and solutions in heterogeneous wireless networks. (C1: Knowledge) 2. Explain the principles of Wireless Sensor Network Security: Attacks on wireless sensor networks and counter measures. (C2: Comprehension) 3. Generalize the concept of Prevention mechanisms: authentication and traffic protection centralized and passive intruder detection decentralized intrusion detection. (C5: Synthesis)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1

Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	Student's Feedback			
References:	1. Pallapa Venkataram, Satish Babu, Wireless and Mobile Network Security, First Edition, Tata McGraw Hill, 2010.			

	2. Hakima Chaouchi, Maryline Laurent-Maknavicius, Wireless and Mobile Network Security Security Basics, Security in On-the-shelf and Emerging Technologies, Wiley, 2009 3. Tara M. Swaminathan and Charles R. Eldon, Wireless Security and Privacy- Best Practices and Design Techniques, Addison Wesley, 2002.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Mobile and Wireless Security Lab
Academic Year	1
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	This course is aimed to Identify and analyze various the security issues in wireless mobile communication.

Course Outcomes:

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

CO1	Identify the requirement of security and various issues at wireless and mobile network.
CO2	Analyze the threats in wireless environment including device, networks and servers.
CO3	Select an appropriate solution for security and Justify and demonstrate the usage of preventive measures and countermeasures.
CO4	Implement the security solution for various environment in wireless network.

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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4

CO1	3	2	2	-	3	1	-	-	-	-	-	1	3	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	2	3	3	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	1	3	3	2	-	-
CO4	3	2	1	4	1	-	-	-	-	-	2	3	3	2	1	-
Average	3.0	2	1.5	1	1.0	0.5	-	-	-	-	1.3	2.5	3.0	2.0	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title
1	Design and Implementation of Security algorithm for Wireless networks. (C1: Knowledge)
2	Implementation of security protocol for mobile network. (C1: Knowledge)
3	Test the different sections of mobile phone.(such as ringer section, dialer section, receiver section and transmitter section) (C1: Knowledge)
4	Perform the process of call connection and call release of cellular Mobile system. (C1: Knowledge)
5	Transfer an image, audio and video file using Bluetooth protocol with varying distance between two devices and analyze the performance. (C1: Knowledge)
6	Configure Wi-Fi setting in mobile devices using mobile tethering to connect two devices such as mobile phone to mobile phone, mobile phone to laptop. (C1: Knowledge)
7	Apply RFID technology for real life applications using RFID kit. (C1: Knowledge)
8	Establish seamless wireless connectivity using multiple access point. (C1: Knowledge)
9	Develop a mobile application for wireless technology using any wizards such as available on www.appypie.com or any other. (C1: Knowledge)

10	Simulate the line coding techniques using MATLAB and Simulink. (C1: Knowledge)
Note:	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book / Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

Students Feedback is taken through various steps

1. Regular feedback through the Mentor-Mentee system.
2. Feedback between the semester through google forms.

Course Exit Survey will be taken at the end of the semester.

References:

1. Pallapa Venkataram, Satish Babu, Wireless and Mobile Network Security, First Edition, Tata McGraw Hill, 2010.
2. Hakima Chaouchi, Maryline Laurent-Maknavicius, Wireless and Mobile Network Security Security Basics, Security in On-the-shelf and Emerging Technologies, Wiley, 2009
3. Tara M. Swaminathan and Charles R. Eldon, Wireless Security and Privacy- Best Practices and Design Techniques, Addison Wesley, 2002.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Bio-Inspired Computing
Academic Year	I
Semester	I

Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	An introduction to self-adapting methods also called artificial intelligence or machine learning. Schemes for classification, search and optimization based on bio-inspired mechanisms are introduced. This includes evolutionary computation, artificial neural networks and more specialized approaches like e.g. swarm intelligence and artificial immune systems. Further, an overview of alternative traditional methods will also be included.

Course Outcomes:

At the end of the course students will be able to:

CO1	Understand basic concepts of evolutionary algorithm.
CO2	Understand the basic features of neural and immune systems and able to build the neural model.
CO3	Explain how complex and functional high-level phenomena can emerge from low-level interactions.
CO4	Implement simple bio-inspired algorithms like genetic and Particle Swarm Optimization.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	-	1	-	-	-	-	-	1	1	1	1	-
CO2	3	1	-	-	-	1	-	-	-	-	-	-	1	1	1	-
CO3	3	1	-	1	-	1	-	-	-	-	-	-	1	1	1	-
CO4	3	2	1	2	2	1	-	-	3	-	1	-	1	1	1	-
Average	3	1.25	0.5	1	0.5	1	-	-	0.75	-	0.5	0.5	1	1	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week

3	-	-	3

Unit	Content and Competence
1	1.Explain Evolutionary algorithm, components of evolutionary algorithm representation (definition of individuals), Evaluation function (Fitness function). (C2: Comprehension) 2. Explain the Population, parent selection Mechanism, Variation Operators, Survivor Selection Mechanism (Replacement), Initialization, Termination Condition. (C2: Comprehension) 3. Evolutionary algorithm case study Cellular systems, cellular automata, modeling with cellular systems, other cellular systems, computation with cellular systems. (C1: Knowledge) 4. Recite the concept of artificial life: analysis and synthesis of cellular systems. (C1: Knowledge)
2	1.Generalize the concept of Biological nervous systems, artificial neural networks, neuron models, architecture, signal encoding ,synaptic plasticity. (C5: Synthesis) 2. Explain the concepts of unsupervised learning, supervised learning, reinforcement learning. (C2: Comprehension) 3. Define evolution of neural networks, hybrid neural systems, case study Rewriting system, synthesis of developmental system, evolutionary rewriting systems. (C2: Comprehension) 4. Analyze the evolutionary developmental programs, biological immune systems, lessons for artificial immune systems, algorithms and applications, shape space, negative selection algorithm. (C4: Analysis)
3	1. Explain the concepts of Behavior is cognitive science, behavior in AI, behavior based robotics, biological inspiration for robots, robots as biological models, robot learning. (C2: Comprehension) 2. Recall the purpose and importance of evolution of behavioral systems, learning in behavioral systems, co-evolution of body and control, towards self-reproduction, simulation and Reality. (C1: Knowledge)

	3. Describe Representation of Individuals, Mutation, Recombination, Population Models, Parent Selection, Survivor Selection, Example Application: Solving a Job Shop Scheduling Problem. (C2: Comprehension)
4	1. Recall the purpose and basic functions of Biological self-organization, Particle Swarm Optimization (PSO),ant colony optimization (ACO), swarm robotics, co-evolutionary dynamics, artificial evolution of competing systems, artificial evolution of cooperation. (C1: Knowledge) 2. Explain the principles of Introduction to Local Search, Structure of a Memetic Algorithm, Heuristic or Intelligent Initialization. (C2: Comprehension) 3. Generalize the concept of Hybridization within Variation Operators: Intelligent Crossover and Mutation, Local Search Acting on the output from Variation Operators. (C5: Synthesis) 4.Explain Hybridization During the Genotype to Phenotype Mapping, Design Issues for Memetic Algorithms. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:

1. D. Floreanoand C. Mattiussi, "Bio-Inspired Artificial Intelligence", MIT Press, 2008.
2. Tao Song, Pan Zheng, Mou Ling Dennis Wong, Xun Wang, "Bio-inspired Computing Models and Algorithms", ISBN: 978-981-3143-19-7, world scientific, 2019F.
3. Neumann and C. Witt, "Bioinspired Computation in combinatorial optimization: Algorithms and their computational complexity", Springer, 2010

Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Bio-Inspired Computing lab
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	Course Description: An introduction to self-adapting methods also called artificial intelligence or machine learning. Schemes for classification, search and optimization based on bio-inspired mechanisms are introduced. This includes evolutionary computation, artificial neural networks and more specialized approaches like e.g. swarm intelligence and artificial immune systems. Further, an overview of alternative traditional methods will also be included.

Course Outcomes:

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

CO1	Understand basic concepts of evolutionary algorithm.
CO2	Understand the basic features of neural and immune systems and able to build the neural model.
CO3	Explain how complex and functional high-level phenomena can emerge from low-level interactions.
CO4	Implement simple bio-inspired algorithms like genetic and Particle Swarm Optimization.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3	PSO 4
CO1	3	1	2	-	3	1	-	-	-	-	-	1	3	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	2	3	3	2	-	-

CO3	3	2		-	-	-	-	-	-	-	1	3	3	2	-	-
CO4	3	2	3	3	1	-	-	-	-	-	2	3	3	2	1	-
Average	3.0	1.8	2.3	0.8	1.0	0.5	-	-	-	-	1.3	2.5	3.0	2.0	0.5	-

Course Content:			
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	0	2	2

Content & Competency

Sr. No.	Title
1	Write a program to find evolutionary algorithm. (C1: Knowledge)
2	Write a program to find the artificial neural network. (C1: Knowledge)
3	Write a program to find biological inspiration for robots. (C1: Knowledge)
4	Write a program to find the a Job Shop Scheduling Problem. (C1: Knowledge)
5	Write a program to find Particle Swarm Optimization (PSO). (C1: Knowledge)
6	Write a program to find ant colony optimization (ACO). (C1: Knowledge)
7	Write a program to find the Memetic Algorithm. (C1: Knowledge)
Note:	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--

Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through google forms.	

Course Exit Survey will be taken at the end of the semester.	
References:	1.D. Floreanoand C. Mattiussi, "Bio-Inspired Artificial Intelligence", MIT Press, 2008. 2. Tao Song, Pan Zheng, Mou Ling Dennis Wong, Xun Wang, "Bio-Inspired Computing Models and Algorithms", ISBN: 978-981-3143-19-7, world scientific, 2019F. 3. Neumann and C. Witt, "Bioinspired Computation in combinatorial optimization: Algorithms and their computational complexity", Springer, 2010

Course for Specialization for Big Data Analytics

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Machine Learning
Academic Year	1
Semester	1
Number of Credits	3
Course Prerequisite	A course on "Design and Analysis of Algorithms"
Course Synopsis	To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities
Course Outcomes: At the end of the course students will be able to:	
CO1	Possess the skill for representing knowledge using the appropriate technique for a given problem.

CO2	Possess the ability to apply AI techniques to solve problems of game playing, and machine learning.
CO3	Understand the concepts of computational intelligence like machine learning.
CO4	Understand the Neural Networks and its usage in machine learning application.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	1	1	1	1	–	–	1	1	1	1	–	–
CO2	3	2	1	2	-	1	-	1	–	–	1	1	1	1	–	–
CO3	3	2	1	1	1	-	-	1	–	–	1	1	1	1	–	–
CO4	3	2	1	2	–	–	–	–	–	–	–	1	1	–	–	–
Average	3	2	1	1.5	0.5	0.5	0.25	0.75	–	–	0.75	1	1	0.75	–	–

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content and Competency
1	1.Explain Problem Solving by Search-I. (C2: Comprehension) 2. Define Intelligent Agents Problem Solving by Search –II: Problem-Solving Agents, Searching for Solutions. (C1: Knowledge) 3. Recall the purpose and importance of Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepening Depth-first search, Bidirectional search. (C1: Knowledge) 4. Explain Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Heuristic Functions, Beyond Classical Search: Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces, Searching with Non-

	Deterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environment, (C2: Comprehension)
2	1. Analyze the Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm. (C4: Analysis) 2. Analyze the Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks. (C4: Analysis) 3.Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms. (C6: Evaluation)
3	1. Generalize the concept of Bayesian learning –Bayes theorem and concept learning. (C5: Synthesis) 2. Explain the Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm. (C2: Comprehension) 3. Describe the Computational learning theory, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning. (C2: Comprehension) 4. Recall the Instance-Based Learning- Introduction, k-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning. (C1: Knowledge)
4	1. Explain the principles and mechanisms of Genetic Algorithms an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms. (C2: Comprehension) 2. Analyze the Learning Sets of Rules, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution. (C4: Analysis)

	3. Describe Combining Inductive and Analytical Learning, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis. (C1: Knowledge)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓

Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process:	Student's Feedback			
References:	Textbooks: 1. Artificial Intelligence A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education. 2. Machine Learning – Tom M. Mitchell, - MGH			
	References: 1. Artificial Intelligence, 3rd Edn, E. Rich and K.Knight (TMH) 2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education. 3. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis			

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M. Tech.
Course Code	
Course Title	Machine Learning Lab
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	Nil.
Course Synopsis	The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python.
Course Outcomes:	

At the end of the course, students will be able to:	
CO1	Understand complexity of Machine Learning algorithms and their limitations.
CO2	Understand modern notions in data analysis-oriented computing.
CO3	Be capable of confidently applying common Machine Learning algorithms in practice and implementing their own.
CO4	Be capable of performing experiments in Machine Learning using real-world data.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3	PSO4
CO1	3	2	1	1	1	1	1	1	–	–	1	1	1	1	–	–
CO2	3	2	1	2	-	1	-	1	–	–	1	1	1	1	–	–
CO3	3	2	1	1	1	-	-	1	–	–	1	1	1	1	–	–
CO4	3	2	1	2	–	–	–	–	–	–	–	1	1	–	–	–
Average	3	2	1	1.5	0.5	0.5	0.25	0.75	–	–	0.75	1	1	0.75	–	–

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title
1	The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is theprobability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%) (C1: Knowledge)
2	Extract the data from database using python. (C1: Knowledge)
3	Implement k-nearest neighbours classification using python. (C6: Evaluation)
4	Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and

	VAR2 <0.606, using the result of k means clustering with 3 means (i.e., 3 centroids) VAR1 VAR2 CLASS 1.713 1.586 0 0.180 1.786 1 0.353 1.240 1 0.940 1.566 0 1.486 0.759 1 1.266 1.106 0 1.540 0.419 1 0.459 1.799 1 0.773 0.186 1 (C1: Knowledge)
5	The following training examples map descriptions of individuals onto high, medium and low credit-worthiness. medium skiing design single twenties no -> highRisk high golf trading married forties yes -> lowRisk low speedway transport married thirties yes -> medRisk medium football banking single thirties yes -> lowRisk high flying media married fifties yes -> highRisk low football security single twenties no -> medRisk medium golf media single thirties yes -> medRisk medium golf transport married forties yes -> lowRisk high skiing banking single thirties yes -> highRisk low golf unemployed married forties yes -> highRisk Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset? (C1: Knowledge)
6	Implement linear regression using python. (C6: Evaluation)
7	Implement Naïve Bayes theorem to classify the English text. (C6: Evaluation)
8	Implement an algorithm to demonstrate the significance of genetic algorithm. (C6: Evaluation)
9.	Implement the finite words classification system using Back-propagation algorithm. (C6: Evaluation)
Note:	Faculty should add 10 to 15 more practical.

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20

Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	-	-	-	-
VIVA	✓	✓	✓	✓
Assignment / Presentation	-	-	-	-
Unit test	-	-	-	-
Practical Log Book / Record Book	✓	✓	✓	✓
Mid-Semester Examination 1	-	-	-	-
Mid-Semester Examination 2	-	-	-	-
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	Textbooks: 1. Artificial Intelligence A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education. 2. Machine Learning – Tom M. Mitchell, - MGH
	References: 1. Artificial Intelligence, 3rd Edn, E. Rich and K.Knight (TMH) 2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education. 3. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis

SEMESTER - II

Course Code	Course Title
	Advance Software Engineering & Testing
	Advance Software Engineering & Testing Lab
	Agile Software Development
	Data Mining
	Data Mining Lab
	Operational research
Program elective Course - II	
	Cloud and Fog Computing
	Cloud and Fog Computing Lab
	NoSQL Databases
	NoSQL Databases Lab
	Malware Analysis
	Malware Analysis lab
	Machine Learning for Signal Processing
	Machine Learning for Signal Processing lab
Course for Specialization for Big Data Analytics	
	Streaming Data Analytics
	Streaming Data Analytics Lab

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M.Tech
Course Code	
Course Title	Advance Software Engineering & Testing
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.

Course Outcomes:

At the end of the course students will be able to:

CO1	Able to define software engineering process and practices, and demonstrate various process models
CO2	Able to identify different types of risks in software development.
CO3	Able to distinguish different testing strategies and it's working
CO4	Able to Estimate the quality of software process and develop the SRS document for project.

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

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO 4
CO1	3	2	1	2	2	-	-	-	1	-	1	1	-	1	1	-
CO2	3	3	1	2	-	-	-	-	1	-	1	1	1	1	1	-
CO3	3	3	1	2	2	2	-	2	1	-	1	1	1	1	1	-
CO4	3	2	1	2	2	2	-	2	1	-	1	-	-	1	1	-

Average	3	1.5	1	2	1.5	1	-	1	1	-	1	0.75	0.5	1	1	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content & Competency
1	1. Discuss the evolving role of software, changing nature of software, and software myths. (C2: Comprehension) 2. Explain a Generic view of process and Software engineering layered technology. (C2: Comprehension) 3. Generalize the concept of the capability maturity model integration (CMMI), 4. Discuss the following terms: process patterns, process assessment, personal and team process models. (C2: Comprehension) 5. Explain the following Process models: The waterfall model, incremental process models, evolutionary process models, the unified process. (C2: Comprehension)
2	1. Explain the characteristics and purpose of functional and non-functional requirements. (C2: Comprehension) 2. Analyze user requirements to identify and prioritize software features that meet user needs. 3. Recall the role and significance of system requirements in software development. 4. Explain the importance of well-defined interfaces for software integration and interoperability. (C2: Comprehension) 5. Recite the purpose and objectives of Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management in the requirements engineering process. (C1: Knowledge) 6. Describe the following System models: Context models, behavioral models, data models, object models, structured methods. (C2: Comprehension)
3	

	1. Explain the importance of design quality in software engineering. (C2: Comprehension) 2. Recall the fundamental design concepts and principles in software engineering. (C1: Knowledge) 3. Explain how the design model represents the structure and behavior of a software system. (C2: Comprehension) 4. Explain software architecture and architectural design: software architecture, data design, architectural styles and patterns, architectural design. (C2: Comprehension) 5. Recall the purpose and components of the conceptual model in the Unified Modeling Language (UML). (C1: Knowledge) 6. Discuss following terms: basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams. (C2: Comprehension) 7. Illustrate strategic approaches to software testing. 8. Explain following testing techniques in detail: black-box and white-box testing, validation testing, system testing, the art of debugging. (C2: Comprehension)
4	1. Outline Software quality and metrics for analysis model. (C1: Knowledge) 2. Explain metrics for design model, metrics for source code, metrics for testing and metrics for maintenance. (C2: Comprehension) 3. Explain following in Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. (C2: Comprehension) 4. Discuss following Quality Management Concepts: Quality concepts, software quality assurance, software reviews, 5. Explain formal technical reviews. (C2: Comprehension) 6. Describe statistical software quality assurance and software reliability. (C2: Comprehension) 7. Explain the ISO 9000 quality standards. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓

University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	Textbooks: 1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition. 2. Software Engineering- Sommerville, 7th edition, Pearson Education. 3. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.
	References: 1. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley. 2. Software Engineering principles and practice- Waman S Jawadekar, The Mc Graw-Hill Companies. 3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M. Tech.
Course Code	
Course Title	Advance Software Engineering & Testing Lab
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	A course on "Programming for Problem Solving"

Course Synopsis	To have hands-on experience in developing a software project by using various software engineering principles and methods in each of the phases of software development.

Course Outcomes:

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

CO1	Able to Plan a software engineering process life cycle.
CO2	Able to elicit, analyze and specify software requirements.
CO3	Able to Analyze and translate a specification into a design.
CO4	Able to Built an SRS documents :Realize design practically, using an appropriate software engineering

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3	PSO4
CO1	3	2	2	2	1	-	-	-	-	1	1	-	-	-	-	-
CO2	3	2	2	2	1	-	-	-	1	1	-	-	3	-	-	-
CO3	3	2	2	2	1	-	-	-	-	-	1	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	-	1	1	-	3	-	-	-
Average	3	2	2	2	1	-	-	-	0.25	0.75	0.75		1.5	-	-	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title	Competency
1	Draft a project plan for any Project. (C1: Knowledge)	

2	Development of SRS document. (C1: Knowledge)
3	To draw different levels of DFD. (C1: Knowledge)
4	To draw an ER diagram. (C1: Knowledge)
5	To draw a use case diagram. (C1: Knowledge)
6	To draw a sequence diagram and collaboration diagrams. (C1: Knowledge)
7	To draw a class diagram. (C1: Knowledge)
8	To draw a Gantt chart and network diagram. (C1: Knowledge)
9	To draw a structured chart. (C1: Knowledge)
10	Development of design Document. (C1: Knowledge)
Note:	Faculty should add 10 to 15 more practical.

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination

Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	Textbooks: 1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition. 2. Software Engineering- Sommerville, 7th edition, Pearson Education. 3. The unified modeling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M.Tech
Course Code	

Course Title	Agile Software Development
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	This course covers the concept of software management and its different phases.

Course Outcomes:

At the end of the course students will be able to:

CO1	Understand the fundamental principles of Agile Software Development & will also have a good knowledge of responsibilities of project manager and how to handle these.
CO2	Be familiar with the different methods and techniques used for project management.
CO3	Will also be able to understand why majority of the software projects fails and how that failure probability can be reduced effectively.
CO4	Will be able to do the to do the Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	1	-	1	-	1	-
CO2	3	-	1	2	2	-	-	-	-	1	1	1	1	1	1	1
CO3	3	3	1	2	2	-	-	-	-	-	1	-	1	-	1	-
CO4	3	2	1	2	2	-	-	-	-	1	1	1	1	1	1	1
Average	3	1.75	1	1.5	1.5	-	-	-	-	0.5	1	0.5	1	0.5	1	0.5

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content & Competency
1	1.Describe Project life cycle models-ISO 9001 model-Capability Maturity Model-Project Planning-Project tracking-Project closure. (C2: Comprehension) 2. Evolution of Software Economics. (C6: Evaluation) 3.Discuss Basic concept of Software Management Process Framework: Phases, Artifacts, Workflows, Checkpoints . (C2: Comprehension) 4. Explain Software Management Disciplines: Planning / Project Organization and Responsibilities / Automation / Project Control . (C2: Comprehension) 5.Recognize Modern Project Profiles. (C2: Comprehension)
2	1.Explain Problems in Software Estimation. (C2: Comprehension) 2.Recognize Algorithmic Cost Estimation Process. (C2: Comprehension) 3.Define Function Points, SLIM (Software Life cycle Management), COCOMO II (Constructive Cost Model). (C1: Knowledge) 4. Estimating Web Application Development. (C2: Comprehension) 5. Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card. (C2: Comprehension)
3	1.Discribe Software Quality Factors – Software Quality Components – Software Quality Plan – Software Quality Metrics – Software Quality Costs – Software Quality Assurance Standard – Certification – Assessment. (C2: Comprehension) 2.Generalize Software Configuration Management. (C5: Synthesis) 3.Analysis Risk Management: Risk Assessment: Identification / Analysis / Prioritization. Risk Control: Planning / Resolution / Monitoring.. (C4: Analysis) 4. Describe Software Metrics – Classification of Software Metrics: Product Metrics: Size Metrics, Complexity Metrics, Halstead's Product Metrics, Quality Metrics, and Process metrics. (C2: Comprehension)

4	1.Generalize Strategic Assessment and Technical Assessment. (C5: Synthesis) 2. Evaluate Cost Benefit Analysis–Cash Flow Forecasting–Cost Benefit Evaluation Technique. (C5: Synthesis) 3. Risk Evaluation–Software Effort Estimation. (C5: Synthesis) 4. Describe Emerging Trends: Import of the internet on project Management – people Focused Process Models. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	Student's Feedback			

References:	1.Ramesh Gopalaswamy , "Managing and global Software Projects", Tata McGraw Hill Tenth Reprint, 2011. 2. Fenton, N.E., and Pfleeger, S.L., "Software Metrics: A Rigorous and Practical Approach, Revised" Brooks Cole, 1998. 3. Kaplan, R.S., Norton, D.P. "The Balanced Scorecard: Translating Strategy into Action", Harvard Business School Press, 1996. 4. Boehm, B. W. "Software Risk Management: Principles and Practices" in IEEE Software, January 1991, pp32-41. 5. Roger S.Pressman, "Software Engineering- A Practitioner's Approach", 7th Edition ,McGraw Hill, 2010.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M.Tech
Course Code	
Course Title	Data Mining
Academic Year	I
Semester	II
Number of Credits	3

Course Prerequisite	NIL
Course Synopsis	Here students will be exposed to multiple techniques of understanding and analyzing the data from a mathematical point of view. In addition, they will also use multiple predictive models to analyze the future trend. This will be done in a purely statistical manner.

Course Outcomes:

At the end of the course students will be able to:

CO1	Understand pattern discovery, clustering, text retrieval, text mining and analytics, and data visualization.
CO2	Illustrate data mining techniques for both structured and unstructured data.
CO3	Learn to carry out exploratory data analysis to gain insights and prepare data for predictive modelling, an essential skill valued in the business.
CO4	Understand the concept of Regression techniques.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	-	-	-	-	-	-	1	1	-	-	-
CO2	3	3	1	2	2	-	-	-	-	-	-	1	1	-	-	-
CO3	3	3	1	2	2	-	-	-	-	-	-	1	1	-	-	-
CO4	3	2	1	2	2	-	-	-	-	-	-	1	1	-	-	-
Average	3	2.5	1	2	2	-	-	-	-	-	-	1	1	-	-	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit wise Content & Competency

1	1. Explain definition, traditional and modern approaches, functionality, major issues in Data mining. (C2: Comprehension) 2. Discuss Knowledge data discovery process: Data, attribute types, properties, Discrete and continuous attribute, dataset types, data quality. (C2: Comprehension) 3. Measure Data pre-processing: Aggregation, sampling, dimensionality reduction, subset selection, creation, discretization, binarization, attribute transformation, correlation. (C6: Evaluation) 4. Explain the following concepts in Association rule mining: Mining task, frequent itemset, apriori algorithm, rule generation. (C2: Comprehension)
2	1. Explain Classification definition, classification task. 2. Categorize Classification techniques: Decision tree, rule-based, memory-based reasoning, artificial neural networks, naïve bayes, support vector machine. (C3: Application) 3. Discuss Clustering algorithms types: k-means, single linkage, complete linkage, DBSCAN, clustering validation: Dimensionality reduction. (C2: Comprehension)
3	1. Describe Exploratory data analysis for predictive modelling. (C2: Comprehension) 2. Explain modelling techniques for prediction of continuous and discrete outcomes. (C2: Comprehension) 3. Explain graphs to explore and display datasets, fundamental concepts of predictive modelling. (C2: Comprehension)
4	1. Outline the Regression techniques: linear, multivariate, non-linear; Cross-validation, model selection, overfitting. (C1: Knowledge) 2. Compare design of predictive models using XLMiner tools; Logistic regression of binary variables, cross validation and confusion matrix, cost sensitive classification, and ROC curves. (C3: Application) 3. Explain Implementation of trees and other advanced predictive models by using the software tool XLMiner. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓

University Examination	✓	✓	✓	✓
Feedback Process	Student's Feedback			
References:	1. Larose and Larose, Data Mining and Predictive Analytics "Wiley Series on Methods and Applications in Data Mining" (1 ed.), Wiley, 2016. ISBN 978- 8126559138. 2. Bruce Ratner, Statistical and Machine-Learning Data Mining: Techniques for Better Predictive Modeling and Analysis (3 ed.), Chapman and Hall/CRC, 2017. ISBN 978-1498797603.			

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M. Tech.
Course Code	
Course Title	Data Mining Lab
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	-
Course Synopsis	Here students will be exposed to multiple techniques of understanding and analyzing the data from a mathematical point of view. In addition, they will also use multiple predictive models to analyze the future trend. This will be done in a purely statistical manner.
Course Outcomes: At the end of the course, students will be able to:	
CO1	Ability to add mining algorithms as a component to the existing tools.
CO2	Demonstrate the classification, clustering and etc. in large data sets.
CO3	Ability to apply mining techniques for realistic data.
CO4	Ability to apply mining techniques for WEKA Tool.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	1	1	-	-	-	-	-	1	1	-	-	-	-
CO2	3	2	-	1	1	-	-	-	-	-	1	1	1	-	-	-
CO3	3	2	1	1	1	-	-	-	-	-	1	1	1	-	-	-
CO4	3	2	3	1	1	1	1	-	-	-	1	1	1	-	-	-
Average	3	1.5	1	1	1	0.25	0.25	-	-	-	1	1	0.75	-	-	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title
1	Installation of WEKA Tool. (C1: Knowledge)
2	Creating new Arff File. (C5: Synthesis)
3	Data Processing Techniques on Data set. (C1: Knowledge)
4	Data cube construction – OLAP operations. (C1: Knowledge)
5	Implementation of Apriori algorithm. (C3: Application)
6	Implementation of FP- Growth algorithm. (C3: Application)
7	Implementation of Decision Tree Induction. (C3: Application)
8	Calculating Information gains measures. (C3: Application)
9	Classification of data using Bayesian approach. (C3: Application)
10	Implementation of K-means algorithm. (C3: Application)
Note	Faculty should add 10 to 15 more practical.

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				

Unit Test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	1. Larose and Larose, Data Mining and Predictive Analytics "Wiley Series on Methods and Applications in Data Mining" (1 ed.), Wiley, 2016. ISBN 978- 8126559138. 2. Bruce Ratner, Statistical and Machine-Learning Data Mining: Techniques for Better Predictive Modeling and Analysis (3 ed.), Chapman and Hall/CRC, 2017. ISBN 978-1498797603.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M.Tech
Course Code	
Course Title	Operational research
Academic Year	I
Semester	II
Number of Credits	2
Course Prerequisite	NIL
Course Synopsis	This course covers the concept of basic maths.
Course Outcomes:	
At the end of the course, students will be able to:	
CO1	Understand the objectives, phases, models, used in operation research
CO2	Solve linear programming problems using simplex method ,Big M method 2- phase method.

CO3	Solve linear programming problems using duality theory and post optimality analysis.
CO4	Solve problems on transportation, assignment problems and game theory.

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

Cos	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O4
CO1	3	3	1	-	1	-	-	-	-	-	1	-	1	-	1	-
CO2	3	2	1	2	1	-	-	-	-	1	1	1	1	1	1	1
CO3	3	3	1	2	1	-	-	-	-	-	1	-	1	-	1	-
CO4	3	2	1	2	1	-	-	-	-	1	1	1	1	1	1	1
Ave rage	3	2.5	1	1.5	1	-	-	-	-	0.5	1	0.5	1	0.5	1	0.5

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	**Total Hour/Week**
2	-	-	**2**

Unit	Content & Competency
1	1. Evolution of OR – Fundamentals of OR Modelling Approach – Linear Programming – Assumptions. (C6: Evaluation) 2. Formulation -graphical method -simplex method – dualitytheory- primal-dual relationships -sensitivity analysisTransportation and Assignment Problems. (C6: Evaluation) 3.Discuss Basic concept of Specific features and methods of transportation problem - Hungarian method for solving assignment problems – travelling salesman problem. (C2: Comprehension) 4. Explain Dynamic Programming – Characteristics – optimality principle -deterministic problems. (C2: Comprehension)

2	1.Explain Network Models- Project Networks- CPM / PERT- Project Scheduling – crashing networks and cost considerations. (C2: Comprehension) 2.Recognize Resource leveling and smoothing, shortest route problem – minimal spanning tree problem. (C2: Comprehension) 3.Define maximal flow problem Decision Theory – Decision making under uncertainty. (C1: Knowledge) 4. Estimating decision trees – decision under risk – EMV, EOL, EVPI – Game theory – mixed strategies – dominance property – 2 x n and m x 2 games.. (C2: Comprehension)
3	1.Describe Flow shop scheduling– Johnsons algorithm for n jobs and two machines and n jobs and m machines. (C2: Comprehension) 2.Generalize Inventory Models. (C5: Synthesis) 3. Deterministic manufacturing and purchase model. (C4: Analysis) 4. Describe quantity discounts Queueing models. (C2: Comprehension)
4	1.Generalize Poisson arrival and exponential service times. (C5: Synthesis) 2. Evaluate Single server and multi-server model Simulation. (C5: Synthesis) 3. Monte Carlo simulation – simple problems. (C5: Synthesis) 4. Describe CPM and PERT and CPM-crashing networks. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	20
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	1
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	1
Revision	4

Others If any:	
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	Student's Feedback			
References:	1. Taha, H A, "Operations Research – An Introduction", Sixth Edition, Prentice Hall of India Private Limited, N. Delhi, 2004. 2.Ravindran, A., Phillips, D.L. and Solberg, J.J., "Operations Research-Principles and Practice", John Wiley & Sons, 2005.			

Program Elective Courses-II

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Malware Analysis
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	1. Computer networks 2. Network Security 3. Cyber security Basics
Course Synopsis	This comprehensive course delves into the intricate world of malware analysis, equipping participants with the skills and knowledge necessary to dissect and understand malicious software. As cyber threats continue to evolve in sophistication, the ability to analyze and counteract malicious code is crucial for cyber security professionals.

Course Outcomes:

At the end of the course students will be able to:

CO1	Identify various malwares and understand the behaviour of malwares in real world applications.
CO2	Implement different malware analysis techniques.
CO3	Analyse the malware behaviour in windows and android.
CO4	Identify the various tools for malware analysis.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	1	-	-	-	-	-	1	1	-	1	1	-

CO2	**3**	3	3	2	1	-	-	-	-	-	1	-	1	1	1	-
CO3	**3**	3	3	2	1	-	-	-	-	-	1	-	1	1	-	-
CO4	**3**	2	3	-	1	-	-	-	-	-	1	-	1	1	-	-
Average	**3**	2.5	3	1.5	1	-	-	-	-	-	1	0.25	0.75	1	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	**Total Hour/Week**
3	-	-	**3**

Unit	**Content & Competency**
1	1. Describe Malware Analysis. (C2: Comprehension) 2. Construct Goals of Malware Analysis. (C3: Application) 3. Techniques of Static and Dynamic Analysis. (C1: Knowledge) 4. Types of Malware Backdoor, Botnet, Downloader, Information Stealing malware, Launcher, Rootkit, Scareware, Worm or Virus. . (C1:Knowledge) 5. Non-Volatile Data Collection Inspect Prefetch Files, Examine the File System . (C4: Analysis) 6. Data Collection Methods. Volatile Data Collection Methodology-Preservation of Volatile Data, Physical Memory Acquisition on a Live Windows System, Identifying Users Logged into the System. (C2-Comprension) 7. Examine Web Browsing Activities, Examine Cookie Files.(C6-Evaluation) 8. Remote Registry Analysis. (C2: Comprehension)
2	1. Explain Introduction to Windows Malware (C2: Comprehension) 2. Windows Basics Relevant to Malware Behavior-File System and Directory structure (C2: Comprehension) 3. Registry, Boot Sequence (C1: Knowledge) 4. Malware payloads. (C3: Analysis)
3	1. Explain Malware activities. (C2: Comprehension)

	2. Explain the Self-Start techniques. (C2: Comprehension) 3. Essential setup for executing malware (C4: Analysis) 4. Executing DLL files (C1: Knowledge) 5. Classifying Malware Based on their Behavior. (C1: Knowledge) 6. Explain Basic Static Analysis: Number System Static Analysis with File Attributes and PE Header Packet Identification (C1: Knowledge)
4	1. Advanced Static Analysis Reverse Engineering Assembly level computing Standard x86 instructions. (C4: Analysis) 2. Differentiate Introduction to IDA, OllyDbg (C4: Analysis) 3. Explain Advanced Malware Analysis Virus, Trojan. Parsing Basic Analysis of an APK. (C2: Comprehension) 4. Define Android Malware Analysis: APK File Structure Security Model Android Root. (C1: Knowledge) 5. Explain Spreading and Distribution Introduction to Android Debugging Tools and Their Usage Dex Structure Parsing Basic Analysis of an APK. (C2: Comprehension) 6. Explain Exploits Master Key Vulnerability Filename Length. (C2: Comprehension) 7. Define Vulnerability Introduction to Obfuscation DEX code obfuscation. (C1: Knowledge)

Teaching Learning Strategies and **Contact Hours**

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others, if any:	

Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	Textbooks: 1. Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware Forensics Field Guide for Windows Systems, Syngress, Elsevier, 2012 2. Christopher C. Elisan , Advanced Malware Analysis, Tata McGraw Hill, 2015
	References: 1. John Aycock, Computer Viruses and Malware, Springer, 2006.

	2. EreiFilio, Computer Viruses: from theory to applications, Springer, 2005

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Malware Analysis lab
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	This course is aimed to recognize the types of malware through analysis methods .

Course Outcomes:

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

CO1	Identify various malwares and understand the behavior of malwares in real world applications.
CO2	Implement different malware analysis techniques
CO3	Analyse the malware behaviour in windows and android.
CO4	Identify the various tools for malware analysis

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	PSO 2	PS O3	PS O4
CO1	3	1	2	-	3	1	-	-	-	-	-	-	3	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	-	-	3	2	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	2	-	-
CO4	3	2	3	3	1	-	-	-	-	-	-	-	3	2	1	-
Average	3.0	1.8	2.5	0.8	1.0	0.5	-	-	-	-	-	-	3.0	2.0	0.5	-

Course Content:			
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	0	2	**2**

Content & Competency	
Sr. No.	Title
1	Write programs Packet sniffing with Wire shark. (C1: Knowledge)
2	Write programs Capturing intruders through packet inspection.(C1: Knowledge)
3	Write a program to Analyze various Malware types and behavior. (C1: Knowledge)
4	Write a program to implement Basic Static Analysis. (C1: Knowledge)
5	Write a program to illustrate Basic Dynamic Analysis. (C1: Knowledge, C3 : Application)
6	Write a program to illustrate the Analyzing windows programs. (C1: Knowledge, C3 : Application)
7	Write a program to illustrate the Android malware analysis. (C1: Knowledge, C3 : Application)
8	Write a program to illustrate the Data encoding and malware countermeasures. (C1: Knowledge, C3 : Application)
9	Write a program for Comparative study of various malware analysis tools. . (C1: Knowledge)
10	Understanding Tools available for Antivirus Application . (C1: Knowledge)
Note:	Faculty should add 10 to 15 more practical

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--

Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others, if any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
Viva	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-semester Examination I				

Mid-Semester Examination 2					
University Examination		✓	✓	✓	✓
Feedback Process	Student's Feedback				
References:	Textbooks 1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley 2. Advanced programming in the UNIX environment, W.R. Stevens, Pearson education				
	References: 1. Ken Dunham, Saeed Abu-Nimeh, Michael Becher and Seth Fogie, Mobile Malware Attacks and Defense, Syngress, Elsevier, 2009 2. Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware 3 Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware Forensics Field Guide for Linux Systems, Syngress, Elsevier, 2014 .				

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	No SQL Databases
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	A course on "Databases"

Course Synopsis	This course is aimed to Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.

Course Outcomes:

At the end of the course students will be able to:

CO1	Explain the detailed architecture, Database properties and storage requirements.
CO2	Differentiate and identify right database models for real time applications.
CO3	Gain practical knowledge of how to Outline Key value architecture and characteristics.
CO4	Design Schema and implement CRUD operations, distributed data operations.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	1	-	-	-	-	-	1	1	-	1	1	-
CO2	3	2	2	1	1	-	-	-	-	-	1	-	1	1	1	-
CO3	3	2	2	-	1	-	-	-	-	-	1	-	1	1	-	-
CO4	3	2	-	-	1	-	-	-	-	-	1	-	1	1	-	-
Avg.	3	2	1.5	0.5	1	-	-	-	-	-	1	0.25	0.75	1	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content & Competency
1	1. Describe Data base revolutions: First generation, second generation, third generation. (C2: Comprehension) 2. Managing Transactions and Data Integrity. (C3: Application) 3. ACID and BASE for reliable database transactions. (C1: Knowledge) 4. Speeding performance by strategic use of RAM. (C4: Analysis)

	5. Recognize SSD, and disk. (C2-Comprension) 6. Justify Achieving horizontal scalability with database sharding. **(C6-Evaluation)** 7. Explain Brewers CAP theorem. (C2: Comprehension)
2	1. Explain NoSQL Data model: Aggregate Models. (C2: Comprehension) 2. Describe Document Data Model, Key-Value Data Model Columnar Data Model, Graph Based Data Model, Graph Data Model. (C2: Comprehension) 3. Outline NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query. (C1: Knowledge) 4. Categorize hash rings to distribute the data on clusters, replication to scale reads. (C4: Analysis) 5. Demonstrate Database distributes queries to data nodes. (C3: Application)
3	1. Describe array to Key value databases. (C2: Comprehension) 2. Explain the Essential features of key value Databases. (C2: Comprehension) 3. Categorize Properties of Keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value Architecture and implementation Terms. (C4: Analysis) 4. Identify Designing Structured Values, Limitations of Key Value Databases. (C1: Knowledge) 5. Design Patterns for Key-Value Databases. (C1: Knowledge) 6. Explain Case Study: Key-Value Databases for Mobile Application Configuration. (C2: Comprehension)
4	1. Differentiate Document, Collection, Naming. (C4: Analysis) 2. Differentiate CRUD operation, querying, indexing, Replication, Sharding, Consistency. (C4: Analysis) 3. Explain Implementation of Distributed consistency. (C2: Comprehension) 4. Define Eventual Consistency. (C1: Knowledge) 5. Explain Capped Collections. (C2: Comprehension) 6. Explain Case studies: document oriented database: MongoDB and/or Cassandra. (C2: Comprehension)

Teaching Learning Strategies and Content

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Other Hours:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Practical	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	
References:	Textbooks:

3. An introduction to Information Retrieval, **Christopher D.manning,** Prabhakar Raghavan, Hinrich Schutze
4. TheDesignandImplementationofModernColumn-OrientedDatabaseSystems Daniel Abadi YaleUniversity
5. Next Generation Database : NoSQL and big **data by GuyHarrison**

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	NO SQL Databases lab
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	Nil
Course Synopsis	This course is aimed to Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.

Course Outcomes:

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

CO1	Explain the detailed architecture, Database properties and storage requirements.
CO2	Differentiate and identify right data models for real time applications
CO3	Design Schemas and implement CRUD operations, distributed data operations
CO4	Choose and implement Advanced query and data model functions for the real time applications

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

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	1	2	-	1	1	-	-	-	-	-	-	3	2	1	-
CO2	3	1	2	-	2	1	-	-	-	-	-	-	3	2	-	-
CO3	3	1	3	-	2	-	-	-	-	-	-	-	3	2	-	-
CO4	3	1	3	3	2	-	-	-	-	-	-	-	3	2	1	-
Average	3.0	1	2.5	0.8	1.8	0.5	-	-	-	-	-	-	3.0	2.0	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title	
1	Import the HubwaydataintoNeo4jandconfigureNeo4j.Then, answer the following questions using the Cypher Query Language: a) List top 10 stations with most outbound trips (Show station name and number of trips) b) Listtop10stationswithmostinboundtrips(Show station name and number of trips) c) List top 5 routes with most trips (Show starting station name, ending station name and number of trips) d) List the hour number(forexample13means1pm-2pm)and number of trips which end at the station "B.U. Central" . (C1: Knowledge)	
2	Download a zip code dataset at http://media.mongodb.org/zips.json .Use mongo import to import the zip code dataset into MongoDB. After importing the data, answer the following questions by using aggregation pipelines: (1) Find all the states that have a city called "BOSTON". (2) Find all the states and cities whose names include the string "BOST". (3) Each city has several zip codes. Find the city in each state with the most number of zip codes and rank those cities along with the states using the city populations.	

	(4) MongoDB can query on spatial information. (C1: Knowledge)
3	Create a database that stores [illegible]. Cars have a manufacturer, a type. Each car has a maximum. (C1: Knowledge)
4	Master Data Management using Neo4j: Manage your master data more effectively The world of master data is changing. Data architects and application developers are swapping their relational databases with graph databases to store their master data. This switch enables them to use a data store optimized to discover new insights in existing data, provide a360-degree view of master data and answer questions about data relationships in real time. (C1: Knowledge)
5	Shopping Mall case study using [illegible], where we have many customers ordering items from the mall and we have suppliers who deliver them their ordered items. (C1: Knowledge, C3: Application)
Note:	Faculty should add 16 to [illegible] practical

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	16
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours →	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce

Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Name of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid Semester Examination 1				
Mid Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

Recommended:	Textbooks: 1. Next Generation database: NoSQL and big data by GuyHarrison

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	M.Tech
Course Code	
Course Title	Cloud and Fog Computing
Academic Year	I

Semester	II
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	This course [illegible] students an insight into the basics of cloud computing [illegible] of the fastest growing domains from a while now. It will [illegible] the students basic understanding about cloud.

Course Outcomes:

At the end of the course students will be able [illegible]

CO1	Understand the concept of cloud comp[illegible]
CO2	Understand the concept of Fog [illegible]
CO3	Understand the concept of cloud depl[illegible] [illegible].
CO4	Understand the concept of cloud [illegible]

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	-	-	-	[illegible]	[illegible]	-	-	1	1	1	1	1
CO2	3	3	1	2	-	-	[illegible]	[illegible]	[illegible]	-	-	1	1	1	1	1
CO3	3	3	1	2	-	[illegible]	[illegible]	[illegible]	[illegible]	-	-	1	1	1	1	1
CO4	3	2	1	2	-	[illegible]	[illegible]	[illegible]	-	-	-	1	1	-	1	1
Average	3	2.5	1	2	-	-	-	[illegible]	-	-	-	1	1	0.75	1	1

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-		3

Unit	Content & Competency
1	1. Describe [illegible] Cloud [illegible] (C2: Comprehension) 2. Explain Cloud comp[illegible] characteristics. (C2: Comprehension)

	3. State On-demand self service. (C1: Knowledge) 4. Discuss Broad network access. (C1: Knowledge) 5. Explain Location independent resource pooling. (C2: Comprehension) 6. Compare cloud providers with traditional IT service providers. (C3: Application) 7. Explain Roots of cloud computing. (C2: Comprehension)
2	1. Discuss Architectural influences of fog. (C1: Knowledge) 2. Prioritize High-performance computing, Utility and Enterprise grid computing. (C4: Analysis) 3. Discuss Cloud scenarios – Benefits: scalability, simplicity, vendors, security. (C1: Knowledge) 4. Explain the Limitations – Sensitive information - Application development-security level of third party - security benefits, Regularity issues: Government policies. (C2: Comprehension)
3	1. Explain all the Layers in cloud architecture. (C2: Comprehension) 2. Describe Software as a Service (SaaS) and its benefits. (C2: Comprehension) 3. Describe Platform as a Service (PaaS) and its benefits. (C2: Comprehension) 4. Describe Infrastructure as a Service (IaaS) and its benefits. (C2: Comprehension) 5. Outline Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing. (C1: Knowledge)
4	1. State Introduction to Simulator, understanding CloudSim simulator. (C1: Knowledge) 2. Explain CloudSim Architecture (User code, CloudSim, GridSim, SimJava). (C2: Comprehension) 3. Explain working platform for CloudSim, Introduction to GreenCloud. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2

Small group discussion (SGD)	
Self-directed learning (SDL) / Tutorial	
Problem Based Learning (PBL)	
Case/Project Based Learning (CBL)	
Revision	
Others If any:	
Total Number of Contact Hours	

Assessment Methods:

Formative	...ive
Multiple Choice Questions (MCQ)	...ester Examination 1
Quiz	...ester Examination 2
Seminars	...ty Examination
Problem Based Learning (PBL)	...t Questions (SAQ)
Journal Club	...Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	...back		...edback	

Re[illegible]nces:	Textbooks: 1.Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010. 2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008.
	References: 1.Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010. 2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Na[illegible] of the Department	Computer science & engineering
Na[illegible] of the Program	M. Tech.
Co[illegible]e Code	
Co[illegible]e Title	Cloud and Fog Computing Lab
Ac[illegible]mic Year	I
Se[illegible]ter	II
Nu[illegible]er of Credits	1
Co[illegible]e Prerequisite	NIL
Co[illegible]e Synopsis	This course gives students an insight into the basics of cloud computing is one of the fastest growing domain from a while now. It will provide the students basic understanding about cloud.
Co[illegible]e Outcomes:	
At [illegible]end of the course, students will be able to:	
C[illegible]	Understand the concept of cloud computing.
C[illegible]	Understand the concept of private cloud aregitectures.
C[illegible]	Understand the concept of cloud deployment model.
C[illegible]	Understand the concept of cloud simulator.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	[illegible]	-	[illegible]	[illegible]	-	1	-	-	-	-
CO2	3	2	1	-	-	2	-	2	[illegible]	[illegible]	-	1	1	-	-	-
CO3	3	2	1	-	-	2	1	2	[illegible]	[illegible]	-	1	-	-	-	-
CO4	3	2	1	1	1	2	3	2	[illegible]	[illegible]	-	1	1	-	-	-
Average	3	2	1	0.25	0.25	1.5	1	1.5	[illegible]	[illegible]	-	1	0.5	-	-	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	[illegible]	2

Content & Competency

Sr. No.	Title
1	Use gcc to compile [illegible] programs to different modules and create an application [illegible] (C3: Application)
2	Use version control [illegible] commit, push, fetch, pull, checkout, reset, [illegible] (C3: Application)
3	Install VirtualBox/VMware [illegible] different flavours of linux or windows OS on top of windows [illegible] Evaluation)
4	Install a C compiler [illegible] created using virtual box and execute Simple Programs [illegible]
5	Install Google App Engine [illegible] app and other simple web applications [illegible]
6	Use GAE launcher [illegible] (C3: Application)
7	Simulate a cloud [illegible] run a scheduling algorithm that is not present in CloudSim [illegible]
8	Find a procedure to [illegible] virtual machine to another virtual machine (C[illegible] Knowledge)
9	Find a procedure to [illegible] trystack (Online Openstack Demo Version) [illegible]

10	Install Hadoop single node cluster and run simple applications like wordcount. (C6: Evaluation)
No.	Faculty should add 10 to 15 more practical.

Teaching - Learning Strategies and **Contact Hours**

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Quiz/Essay:	--
Total Number of Contact Hours	60

Assessment **Methods**:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of **Assessment with COs**

Name of Assessment	CO1	CO2	CO3	CO4

Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	[illegible]

References:	Textbooks: 1.Cloud computing [illegible] Anthony T.Velte , Toby J. Velte Robert [illegible], [illegible], New Delhi – 2010. 2. Cloud Computing: We[illegible] [illegible]tions That Change the Way You Work and Collaborate [illegible] Miller - Que 2008.
	References: 1.Cloud computing [illegible] Hurwitz , Robin Bloor , Marcia Kaufman ,Fern [illegible], W[illegible] [illegible] Inc, 2010. 2. Cloud Computing [illegible] [illegible]), Edited by Rajkumar Buyya, [illegible], A[illegible] [illegible], John Wiley & Sons, Inc. 2011.

FACULTY OF [illegible] TECHNOLOGY	
Name of the Department	[illegible]
Name of the Program	[illegible]
Course Code	
Course Title	[illegible] Signal Processing
Academic Year	[illegible]
Semester	[illegible]

Number of Credits	3
Course Prerequisite	NA
Course Synopsis	This course aims at introducing the students to the fundamentals of machine learning (ML) techniques useful for various signal processing applications. It will discuss various mathematical methods involved in ML, thereby enabling the students to design their own models and optimize them efficiently. The lectures will focus on mathematical principles, and there will be coding based assignments for implementation. Prior exposure to ML is not required. The course will be focused on applications in signal processing and communication, and the theory will be tailored towards that end.

Course Outcomes:

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

CO1	Understand the mathematical methods for implementing signal processing and machine learning techniques.
CO2	Develop methods of data representations for signal processing in machine learning environment.
CO3	Classify Machine Learning models for Non-linear systems.
CO4	Apply machine learning models in speech and image processing applications.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	1	-	-	-	-	-	1	1	-	3	1	-
CO2	3	1	3	2	1	-	-	-	-	-	1	-	1	3	1	-
CO3	3	1	3	2	1	-	-	-	-	-	1	-	1	3	-	-
CO4	3	1	2	-	1	-	-	-	-	-	1	-	1	3	-	-
Average	3	1	2.5	1.5	1	-	-	-	-	-	1	0.25	0.75	3	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week

3	-	-	3

Unit	Content & Competency
1	1. Describe Notion of a signal-Basic digital representation of data (text, speech, image, video). (C2: Comprehension) 2. Explain Complex Exponential functions. (C1: Knowledge) 3. Describe Shannon Information Theory. (C2: Comprehension) 4. Explain Convolution, Correlation and Covariance Functions. (C1: Knowledge) 5. Analysis Wavelets-Fourier Transform -DCT and Wavelets, Gaussian Processes. (C4: Analysis)
2	1. Explain Gradient ascent/descent-Basics of convex optimization-Constrained optimization. (C2: Comprehension) 2. Describe Convex sets, Hyperplanes/ Half spaces, Lagrange multipliers. (C2: Comprehension) 3. Outline projected gradients-Bio-Inspired Algorithms, Dictionary based representations. (C1: Knowledge) 4. Describe -Eigen representations –Karhunen Loeve Theorem. . (C2: Comprehension) 5. Demonstrate Principal Component Analysis-Properties-Independent Component Analysis (ICA)-ICA for representations and Denoising -Non-negative matrix factorization. (C3: Application)
3	1. Describe Delta and Related Functions-Linear Time Invariant Systems . (C2: Comprehension) 2. Explain the Essential features of LTI Signal Processing –Exploiting Statistical Stability for linear-Gaussian DSP-Kalman Filters. (C2: Comprehension) 3. Identify Running Window filters-Recursive filters-Global Non-linear Filter – Hidden Markov Modelling –Homomorphic Signal Processing. (C1: Knowledge)
4	1. Analysis of Statistical Machine Learning techniques. (C4: Analysis)

	2. Implementation for signal processing applications: Binary Classification -Linear classifiers –Perceptron's—SVM-Linear, Kernel SVM -Multiclass Problem -K-means -Nearest Neighbors -Linear regression -Regularization. (C4: Analysis) 3. Explain Machine Learning for Audio Classification -Time Series Analysis, LSTMs and CNNs. (C2: Comprehension) 4. Define Machine Learning for Image Processing -Transfer Learning, Attention models, Attribute-based learning. (C1: Knowledge)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	1.Max A. Little, Machine Learning for Signal Processing: Data Science, Algorithms, and Computational Statistics, Oxford Publisher, 2019. 2. Paolo Prandoni,Martin Vetterli, Signal Processing for Communications (Communication and Information Sciences), CRC Press, 2008. 3. Stephen Boyd, LievenVandenberghe, Convex Optimization,Cambridge University Press, 2004.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Machine Learning for Signal Processing lab
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	This course aims at introducing the students to the fundamentals of machine learning (ML) techniques useful for various signal processing applications. It will

	discuss various mathematical methods involved in ML, thereby enabling the students to design their own models and optimize them efficiently. The lectures will focus on mathematical principles, and there will be coding based assignments for implementation. Prior exposure to ML is not required. The course will be focused on applications in signal processing and communication, and the theory will be tailored towards that end

Course Outcomes:

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

CO1	Understand the mathematical methods for implementing signal processing and machine learning techniques.
CO2	Develop methods of data representations for signal processing in machine learning environment.
CO3	Classify Machine Learning models for Non-linear systems.
CO4	Apply machine learning models in speech and image processing applications.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	PSO 2	PS O3	PS O4
CO1	3	2	2	-	3	1	-	-	-	1	1	-	3	2	1	-
CO2	3	2	2	-	-	1	-	-	-	-	-	-	3	2	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	2	-	-
CO4	3	2	3	3	1	-	-	-	-	1	1	-	3	2	1	-
Average	3.0	2	2.5	0.8	1.0	0.5	-	-	-	0.5	0.5	-	3.0	2.0	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Content & Competency

Sr. No.	Title	
1	Implement Decision Tree learning and Logistic Regression. (C1: Knowledge)	

2	Implement classification using Multilayer perceptron and cassification using SVM. (C1: Knowledge)
3	Implement Adaboost and Bagging using Random Forests. (C1: Knowledge)
4	Implement k-nearest Neighbors algorithm. (C1: Knowledge)
5	Implement K-means, K-Modes Clustering to Find Natural Patterns in Data. (C1: Knowledge)
6	Implement Gaussian Mixture Model Using the Expectation Maximization. (C1: Knowledge)
7	Implement Principle Component Analysis for Dimensionality Reduction. (C1: Knowledge)
8	Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms. (C1: Knowledge)
Note:	Faculty should add 10 to 15 more practical

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce

Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	1.Max A. Little, Machine Learning for Signal Processing: Data Science, Algorithms, and Computational Statistics, Oxford Publisher, 2019. 2. Paolo Prandoni,Martin Vetterli, Signal Processing for Communications (Communication and Information Sciences), CRC Press, 2008. 3. Stephen Boyd, LievenVandenberghe, Convex Optimization,Cambridge University Press, 2004.

Course for Specialization for Big Data Analytics

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Streaming Data Analytics
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	NA
Course Synopsis	Process data in real-time by building fluency in modern da engineering tools, such as Apache Spark, Kafka, Spark Streaming, and Kafka Streaming. The components of data streaming systems and build a real-time analytics application. Students will compile data and run analytics, as well as draw insights from reports generated by the streaming console.

Course Outcomes:

At the end of the course students will be able to:

CO1	Recognize the characteristics of data streams that make it useful to solve real-world problems.
CO2	Identify and apply appropriate algorithms for analyzing the data streams for variety of problems.
CO3	Implement different algorithms for analyzing the data streams.
CO4	Identify the metrics and procedures to evaluate a model.

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

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O4
CO1	3	2	3	2	1	-	-	-	-	-	1	1	-	1	1	-
CO2	3	3	3	2	1	-	-	-	-	-	1	-	1	1	1	-
CO3	3	3	3	2	1	-	-	-	-	-	1	-	1	1	-	-

CO4	3	2	3	-	1	-	-	-	-	-	1	-	1	1	-	-
Average	3	2.5	3	1.5	1	-	-	-	-	-	1	0.25	0.75	1	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	-	-	3

Unit	Content & Competency
1	1. Describe Characteristics of the data streams, Challenges in mining data streams Requirements and principles for real time processing, Concept drift Incremental learning. Data Streams: Basic Streaming Methods, Counting the Number of Occurrence of the Elements in a Stream, Counting the Number of Distinct Values in a Stream,. (C2: Comprehension) 2. Outline Bounds of Random Variables, Poisson Processes, Maintaining Simple Statistics from Data Streams, Sliding Windows, Data Synopsis, Change Detection: Tracking Drifting Concepts, Monitoring the Learning Process.. (C1: Knowledge)
2	1. Explain The Very Fast Decision Tree Algorithm (VFDT), The Base Algorithm, Analysis of the VFDT Algorithm, Extensions to the Basic Algorithm: Processing Continuous Attributes, Functional Tree Leaves, Concept Drift. Clustering from Data Streams. (C2: Comprehension) 2. Describe Clustering Examples: Basic Concepts, Partitioning Clustering -The Leader Algorithm, Single Pass k-Means, Micro Clustering, Clustering Variables: A Hierarchical Approach.. (C2: Comprehension)
3	1. Describe Mining Frequent Item sets from Data Streams-Landmark Windows, Mining Recent Frequent Item sets, Frequent Item sets at Multiple Time Granularities Sequence Pattern Mining-Reservoir Sampling for Sequential Pattern Mining over data streams, Evaluating Streaming Algorithms. (C2: Comprehension)

	2. Explain Evaluation Issues, Design of Evaluation Experiments, Evaluation Metrics, Error Estimators using a Single Algorithm and a Single Dataset, Comparative Assessment, The 0-1 loss function, Evaluation Methodology in Non-Stationary Environments, The Page-Hinkley Algorithm... (C2: Comprehension)
4	1. Define Introduction to Complex Event Processing, Features of CEP, Need for CEP, CEP Architectural Layers, Scaling CEP, Events, Timing and Causality, Event Patterns. (C1: Knowledge) 2. Explain Rules and Constraint, STRAW-EPL, Complex Events and Event Hierarchies. (C2: Comprehension)

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)

Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	1.Joao Gama, "Knowledge Discovery from Data Streams", CRC Press,2010. 2. David Luckham, "The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems", Addison Wesley,2002.

FACULTY OF ENGINEERING AND TECHNOLOGY	
Name of the Department	Computer science & engineering
Name of the Program	Master of Technology
Course Code	
Course Title	Streaming Data Analytics Lab
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	NA
Course Synopsis	Process data in real-time by building fluency in modern data engineering tools, such as Apache Spark, Kafka,

	Spark Streaming, and Kafka Streaming. The components of data streaming systems and build a real-time analytics application. Students will compile data and run analytics, as well as draw insights from reports generated by the streaming console.

Course Outcomes:

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

CO1	Recognize the characteristics of data streams that make it useful to solve real-world problems.
CO2	Identify and apply appropriate algorithms for analyzing the data streams for variety of problems.
CO3	Implement different algorithms for analyzing the data streams.
CO4	Identify the metrics and procedures to evaluate a model.

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	PSO 2	PS O3	PS O4
CO1	3	2	1	-	3	1	-	-	-	-	-	-	3	2	1	-
CO2	3	2	1	-	-	1	-	-	-	-	-	-	3	2	-	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	3	2	-	-
CO4	3	3	-	3	1	-	-	-	-	-	-	-	3	2	1	-
Average	3.0	2.5	0.75	0.8	1.0	0.5	-	-	-	-	-	-	3.0	2.0	0.5	-

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	**0**	**2**	**2**

Content & Competency

Sr. No.	Title	
1	Exploring one stream processing engine like storm or STREAM etc..(C1: Knowledge)	

2	Implementation of algorithms for example: VFDT, CVFDT. (C1: Knowledge)
3	Implementation of Clustering. (C1: Knowledge)
4	Implementation of Frequent pattern mining. (C1: Knowledge)
5	Exploring one CEP engine like ESPER or DROOLS. (C1: Knowledge)
6	Exercise with continuous queries Logical operations on single stream. (C1: Knowledge)
7	Exercise with continuous queries Logical operations on multiple streams. (C1: Knowledge)
8	Exercise with continuous queries temporal operators on single stream. (C1: Knowledge)
9	Exercise with continuous queries temporal operators on multiple streams. (C1: Knowledge)
10	Exercise with complex continuous queries with logical, relational & temporal operators on multiple streams. (C1: Knowledge)
Note:	Faculty should add 10 to 15 more practical

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	30

Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Mid-Semester Examination 1				
Mid-Semester Examination 2				

University Examination		✓	✓	✓	✓
Feedback Process	Student's Feedback				
References:	1.Joao Gama, "Knowledge Discovery from Data Streams", CRC Press,2010. 2. David Luckham, "The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems", Addison Wesley,2002.				