NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY
(ISO 9001:2015 Certified), Accredited with 'A' Grade by NAAC
☎: 08258 - 281039 – 281263, Fax: 08258 – 281265

Department of Artificial Intelligence and Machine Learning Engineering

Proposed Scheme

For Academic Year 2023 – 24

Effective for the batch 2021-25 (VTU NEP)

SEMESTER V AND VI

Bachelor of Engineering (B.E) in Artificial Intelligence & Machine Learning (AI & ML)

Faculty

Sl. No.	Faculty Name	Qualification	Designation
1.	Dr. Sharada Udaya Shenoy	B.E, M.Tech., Ph.D	Professor & HOD
2.	Mr. Sudesh Rao	B.E, M.Tech., (Ph.D)	Asst. Prof Gd II
3.	Mrs. Disha D N	B.E, M.Tech., (Ph.D)	Asst. Prof Gd II
4.	Mr. Mahesh B L	B.E, M.Tech (Ph.D).	Asst. Prof Gd II
5.	Mrs. Swathi Pai	B.E, M.Tech., (Ph.D)	Asst. Prof Gd II
6.	Mrs. Rakshitha	B.E, M.Tech., (Ph.D)	Asst. Prof Gd I
7.	Mrs. Sneha Shetty R	B.E, M.Tech., (Ph.D)	Asst. Prof Gd I
8.	Mr. Anirudhan Adukkathayar C	B.E, M.Tech., (Ph.D)	Asst. Prof Gd I

VISION

To be a center of excellence in Artificial Intelligence and Machine Learning Engineering education and research, to produce comprehensively trained, technically skilled, ethically strong, innovative engineers to excel globally, take future challenges and contribute to social welfare.

MISSION:

- To provide excellent academic environment to students for continuous improvement in Computer Science, Artificial Intelligence and Machine learning specialization by imparting education with innovation, skills, and positive attitude to make them competent engineers and leaders to solve the real-world problems to inculcate values of professional ethics, leadership qualities and lifelong learning.
- To strengthen the industry partnership for collaborative work and prepare graduates in cutting edge Artificial Intelligence technologies in par with industrial standards by undertaking collaborative projects which offer opportunities for long term interaction between academia and industry.
- To inculcate research, ethical values, professionalism, lifelong learning to make them globally competent and socially committed.

- To provide resources that contribute to congenial learning environment and encourage students to pursue higher education and take competitive exams.

Program Educational Objectives (PEOs)

After few years of graduation, the graduates of B. E in **Artificial Intelligence & Machine Learning** will:

1. Demonstrate technical skills, competency in computer science, artificial intelligence and machine learning and exhibit team management capability with effective communication and responsibility in their career.
2. Emerge as engineering professionals, innovators or entrepreneurs engaged in technology deployment and support the growth of economy of a country with a lifelong learning attitude.
3. Use basic science and engineering ideas to carry out research, pursue higher studies in the multidisciplinary areas to address the basic needs of the society.

Program Outcomes (POs):

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. 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.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. 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.

11. 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.

12. Life-long 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.

Program Specific Outcomes (PSOs)

1. Gain both theoretical and practical knowledge of human cognition, Artificial Intelligence, Machine Learning, Deep learning and data engineering for designing intelligent systems.
2. Apply computational knowledge, tools, techniques and project development skills to provide innovative solutions for social wellbeing.

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B.E. in Artificial Intelligence and Machine Learning

Scheme of Teaching and Examination 2023-24

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

V SEMESTER

SN	Course Category	Course Code	Course Title	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Mini project Component	Duration	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	21AM501	Neural Network and Deep Learning	AME	3	-	2	-	3	50	50	100	4
2	PCC	21AM502	Computer Network and Data Communication	AME	3	-	-	-	3	50	50	100	3
3	PCC	21AM503	Artificial Intelligence	AME	3	-	-	-	3	50	50	100	3
4	PCC	21AM504	Computer Vision	AME	3	-	-	-	3	50	50	100	3
5	PCC	21AM505	Artificial Intelligence and Computer Vision Lab	AME	-	-	2	✓	3	50	50	100	1
6	AEC	21HU511	Research Methodology & Intellectual Property Rights	CV/ME	2	-	-	-	3	50	50	100	2
7	HSMC	21CV512	Environmental Studies	CV	1	-	-	-	1	50	50	100	1
8	AEC	21AMA5X	Ability Enhancement Course - V	AME	1	-	-	✓	1	50	50	100	1
TOTAL					**16**	**-**	**4**	**2**	**-**	**400**	**400**	**800**	**18**

Note: PCC: Professional Core, PEC: Professional Elective, BS: Basic Science, HSMC: Humanities, OE: Open Elective

Ability Enhancement Course – V	
21AMA51	Data Visualization Techniques and Tools
21AMA52	Mobile Application Development

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Scheme of Teaching and Examination 2023-24

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

VI SEMESTER

SN	Course Category	Course Code	Course Title	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Mini project Compo	Duration	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	21AM601	Internet of Things	AME	3	-	2	✓	3	50	50	100	4
2	PCC	21AM602	Natural Language Processing	AME	3	-	-	-	3	50	50	100	3
3	HSMC	21AM603/ 21CC603	Management & Entrepreneurship (Common with CCE)	AME	3	-	-	-	3	50	50	100	3
4	PEC	21AMEXX	Professional Elective Course - 1	AME	3	-	-	-	3	50	50	100	3
5	OEC	21ZZ8XYY	Open Elective Course - 1	AME	3	-	-	-	3	50	50	100	3
6	PCC	21AM604	Natural Language Processing Lab	AME	-	-	2	✓	3	50	50	100	1
7	PROJ	21AM605	Mini Project	AME	-	-	2	✓	-	100	-	100	1
8	INT	21INT61	Innovation/Entrepreneurship/Social based Internship (4 Weeks)	AME	-	-	-	-	-	100	-	100	3
TOTAL					**15**	**0**	**6**	**3**	**-**	**500**	**300**	**800**	**21**

Note: PCC: Professional Core, PEC: Professional Elective, BS: Basic Science, HSMC: Humanities, OE: Open Elective

Value Added Course												
PCC	21AMV02	Software Engineering and Testing	AME	0	0	2	✓	03	50	50	100	0

Professional Electives

Professional Elective Course - 1 (Group 1)				
Course Code	**Course Title**		**Course Code**	**Course Title**
21AME101	Angular and ReactJS		21AME121	Graphics and Animation
21AME102	Artificial Intelligence and Machine Learning in Healthcare		21AME122	High Performance Computing
21AME103	Artificial Intelligence in Agriculture		21AME123	Human Computer Interaction
21AME104	Augmented and Virtual Reality		21AME124	Introduction to Data Science
21AME105	Autonomous Systems		21AME125	Introduction to Drones
21AME106	Big Data Analytics		21AME126	Micro controllers and embedded systems
21AME107	Bio Informatics		21AME127	Mobile Application Development with Flutter
21AME108	Blockchain Technology		21AME128	Operation Research
21AME109	Business Intelligence		21AME129	Pattern Recognition
21AME110	Cloud Computing		21AME130	Prompt Engineering
21AME111	Compiler Design		21AME131	Semantic Web
21AME112	Computer Vision with Embedded Machine Learning		21AME132	Social and Web Analytics
21AME113	Cryptography and Cyber Security		21AME133	Soft Computing

21AME114	Cyber Forensics		21AME134	Solve Business Problems with AI
21AME115	Data and Visual Analytics in AI		21AME135	Speech processing
21AME116	Data mining and Data Warehousing		21AME136	System Modelling and Simulation
21AME117	Distributed Systems		21AME137	Text Mining
21AME118	Full Stack Development		21AME138	UNIX System Programming
21AME119	Fundamentals of Image Processing		21AME139	Web Applications using ML
21AME120	Game Theory and Applications		21AME140	Wireless Sensor Networks

Open Elective (TO BE UPDATED BY Dean office)

Group I		Group II	
20HU7X1	Introduction to Yoga	20EE8X1	Non-conventional energy systems
20CV7X2	Environment Impact Assessment	20EC8X2	Consumer Electronics
20HU7X3	Introduction to German	20HU8X3	Professional and Cognitive Communique
20HU7X4	Philosophy	20ME8X4	Operations Management and Entrepreneurship
20HU7X5	Intellectual Property Rights	20BT8X5	Solid waste and E-Waste management
20HU7X6	Physical Education Principles	20HU8X6	Introduction to Japanese language

Teaching Departments:

BT: Department of Biotechnology Engineering
CV: Department of Civil Engineering
EC: Department of Electronics and Communication
EE: Department of Electrical and Electronic Engineering
HU: Department of Humanities
MA: Department of Mathematics
ME: Department of Mechanical Engineering

V Semester

NEURAL NETWORKS AND DEEP LEARNING (Effective from the academic year 2023 -2024) SEMESTER – V			
Course Code	21AM501	**CIE Marks**	50
Number of Contact Hours/Week	3:0:2	**SEE Marks**	50
Total Number of Contact Hours	39 _26	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

This Course will enable students to:

1. Understand the neural network and artificial neurons
2. Learn about how to train neural networks with different optimizers
3. Describe the operation of deep convolutional neural networks
4. Outline the concepts Recurrent neural networks
5. Learn about performance metric and different applications of neural networks

UNIT – I	**Contact Hours**

Introduction to artificial neural networks: From biological to artificial neurons, the perceptron, Multilayer perceptron, Activation Functions and types, Feed forward neural networks, Back propagation algorithm, Fine tuning neural network hyperparameters: Number of hidden layers, number of neurons per hidden layer, learning rate, batch size and other hyperparameters **Optimizers:** Gradient descent, stochastic gradient descent, mini-batch stochastic gradient descent, AdaGrade optimizers, AdaDelta optimizers, learning rate scheduling, avoiding overfitting through regularization, L1 and L2 regularization, Drop-out layers **Training deep neural networks:** Vanishing Gradient problems Exploding gradient problem, Glorot and He Initialization, Batch normalization, Gradient clipping	15
UNIT – II	
Convolutional Neural Networks: The convolution operation, motivation, Padding in convolution network, Operation of CNN, Max pooling in CNN, Data augmentation, Variants of the basic convolution function, Structured Outputs, Data types, Efficient convolution algorithms **Sequence modeling: Recurrent and Recursive Nets:** Unfolding computational graphs, Recurrent neural networks, Bidirectional RNNS, Encoder-Decoder Sequence to Sequence Architecture, Deep Recurrent networks, Recursive neural networks, LSTM Recurrent neural network, optimization for long term dependencies learning in CNN	15
UNIT - III	
Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, **Applications:** Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications	9

Course Outcomes:

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

1. Describe the concepts of perceptron, neurons, back propagation algorithm
2. Implement neural networks with different optimizers and loss function calculation
3. Analyze the operations involved in deep convolution neural networks
4. Apply the concepts sequence modeling using Recurrent neural networks
5. Describe the performance metric and different applications of neural networks

TEXTBOOKS:

1. Hands-on-machine learning with Scikit-Learn, Keras and Tensorflow Concepts, tools and Techniques to build Intelligent Systems, Aurélien Géron, 2nd edition, 2019.
2. Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, YoshuaBengio, Aaron Couville-2016

REFERENCE BOOKS:

1. Introduction to Artificial Neural Systems, Zurada and Jacek M, 1992, West PublishingCompany, ISBN: 9780534954604
2. Neural Networks Design, M T Hagan, H B Demoth, M Beale, 2002, Thomson Learning,ISBN-10: 0-9717321-1-6/ ISBN-13: 978-0-9717321-1-7

E Books / MOOCs/ NPTEL

1. deeplearning.net
2. deeplearning.stanford.edu
3. deeplearning.cs.toronto.edu
4. https://www.coursera.org/specializations/deep-learning
5. Deep Learning, Self-Taught Learning and Unsupervised Feature Learning by AndrewNg

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		2							2	3	
CO2	3	2	2		2							2	3	
CO3	3	2	2		2							2	3	
CO4	3	2	2		2							2	3	
CO5	3	2	2		2							2	3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3, PO5, PO12	1.1.1, 1.2.2, 1.2.3, 3.2.1, 3.3.1, 5.1.2, 12.1.1	L3
CO2	PO1, PO2, PO3, PO5, PO12	1.1.1, 1.2.2, 1.2.3, 3.2.1, 3.3.1, 5.1.2, 12.1.1	L3
CO3	PO1, PO2, PO3, PO5, PO12	1.1.1, 1.2.2, 1.2.3, 3.2.1, 3.3.1, 5.1.2, 12.1.1	L3
CO4	PO1, PO2, PO3, PO5, PO12	1.1.1, 1.2.2, 1.2.3, 3.2.1, 3.3.1, 5.1.2, 12.1.1	L3
CO5	PO1, PO2, PO3, PO5, PO12	1.1.1, 1.2.2, 1.2.3, 3.2.1, 3.3.1, 5.1.2, 12.1.1	L3

NEURAL NETWORKS AND DEEP LEARNING LAB (Effective from the academic year 2023 -2024) SEMESTER – V			
Course Code	21AM501	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Contact Hours	26	**Exam Hours**	03
Credits – 1			

Course Objectives:

1) Learn about different healthcare applications
2) Implement different machine learning algorithms applicable in healthcare
3) Implement different deep learning algorithms applicable in healthcare
4) Understand and analyze the performance of the models on various datasets
5) Understand and apply CNN models for the analysis of medical images

PART A

1. Train a Deep learning model to classify a given image using pre trained model
2. Object detection using Convolution Neural Network
3. Recommendation system from sales data using Deep Learning
4. Improve the Deep learning model by tuning hyper parameters
5. Perform Sentiment Analysis in network graph using RNN Image generation using GAN
6. build a MLP s (feed-forward neural networks) and apply it to the MNIST dataset.
7. Implementation: Implement a simple feed-forward neural network

Mini Projects:

1. Feedforward Networks for Handwritten Digit Recognition
2. Sequence Labelling with Deep Recurrent Networks
3. Image Classification with Deep Convolutional Networks

PART B

1. Perform the survival analysis on cancer dataset using any suitable model
2. Perform the medical diagnosis to predict the covid 19 on chest X-Ray dataset using any suitable deep learning model
3. Classification of medical images of pathology using suitable deep learning model
4. Perform the image segmentation on any given images using threshold-based segmentation algorithms
5. Perform the image segmentation on any given images using edge-based image segmentation algorithms
6. Analysis of survival functions and estimation of survival model on The Veterans' Administration Lung Cancer Trial for survival function by treatment
7. Malaria detection using machine learning algorithms
8. Parkinson disease prediction using deep learning models
9. Melanoma skin cancer detection using image classification techniques
10. Leukaemia blood cancer detection using CNN model

Course Outcomes:

1) Implement image processing and segmentation algorithms in healthcare
2) Implement different machine learning algorithms applicable in healthcare
3) Implement different deep learning algorithms applicable in healthcare
4) Understand and analyze the performance of the models on various datasets
5) Understand and apply CNN models for the analysis of medical images

Table 1: Mapping Levels of COs to POs

Cos	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3		2							2	3	
CO2	3	3	3		2							2	3	
CO3	3	3	3		2							2	3	

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	PO1, PO2, PO3, PO5, PO12	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 5.1.2, 12.1.1	L3
CO2	PO1, PO2, PO3, PO5, PO12	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 5.1.2, 12.1.1	L3
CO3	PO1, PO2, PO3, PO5, PO12	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 5.1.2, 12.1.1	L3

COMPUTER NETWORK AND DATA COMMUNICATION (Effective from the academic year 2023 -2024) SEMESTER – V			
Course Code	21AM502	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives (CLO)

The primary Course Learning Objective is to introduce the

This course will enable students to:

1. Outline the concepts of basic data communications and networking.
2. Get the idea of signal transmission.
3. Understand the basic of data link layer functionalities and protocols.
4. Study the importance of network layer and differentiate various routing algorithms
5. Acquire the knowledge of working of transport layer, its protocols and some application layer protocols.

Unit I	**Contact Hours**
I**ntroduction to data communications**: Components, Networks, Network Types, Protocol Layering, TCP/IP Protocol Suite, The OSI Model. (Chapter 1) **Physical Layer**: Signals, Signal Impairment, Digital Transmission, Analog Transmission, Multiplexing. (Chapter 2) **Data-Link Layer**: **Data-link control:** Framing, Error Control. **Media Access Protocols:** Carrier Sense Multiple Access, CSMA/CD. Link-Layer Addressing: Three Types of Addresses (Chapter 3) **Local Area Networks:** Ethernet, Standard Ethernet Frame Format. (Chapter 4) **Tutorials:** Create Simple network using Packet tracer, Basic Switch Setup using Packet tracer, Basic Router Setup using Packet tracer.	15
Unit II	

Network Layer: Data Transfer: Services, Packet Switching, Performance, IPv4: IPv4 Addressing, Main and Auxiliary Protocols. IPv6: IPv6 Addressing, The IPv6 Protocol. (Chapter 7) **Network Layer: Routing of Packets**: General Idea, Least-Cost Routing, Routing Algorithms: Distance-Vector Routing, Link-State Routing, Path-Vector Routing, OSPF, BGP4, Multicast Routing: Unicasting, Multicasting, Distance Vector Multicast Routing Protocol. IGMP. (Chapter 8) **Tutorials:** Demonstrate OSPF, RIP protocol working using packet tracer, Simulate Simple network using wireshark, Simulate the transmission of ping messages over a network topology consisting of 3 nodes n0, n1 and n2, where node n0 and n1 are the pingers. Analyze the working of ping using wireshark.	15
Unit III	
Transport Layer: Transport-Layer Services, Transport-Layer Protocols, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Stream Control Transmission Protocol (SCTP). (Chapter 9) **Application Layer**: Introduction, Client/Server Paradigm, Standard Applications. (Chapter 10) **Tutorials:** Demonstration of HTTP request and HTTP response in real time client server communication.	9

Course Outcomes (COs):

Upon completion of this course, students will be able to:

1. Describe the basics of Data Communication and understand the working of signals in physical layer.
2. Understand the working of data link layer, the protocols and differentiate the types of LAN.
3. Comprehend the basic data transfer in network layer.
4. Distinguish between various routing algorithms.
5. Portray the transport layer protocols and the list some of the services in application layer.

Textbooks:

1. Data Communications and Networking with TCP/IP Protocol Suite, Behrouz A. Forouzan, 6th Edition, 2022, McGraw Hill, ISBN 978-1-26-436335-3

Reference Books:

1. Computer Networks by Andrew S. Tanenbaum (Fifth Edition), Pearson Education.
2. Data Communication and Networking by Behrouz A. Forouzan (Fifth Edition), Tata McGraw Hill.
3. Computer Networking. A Top-down Approach, James F. Kurose, Keith W. Ross, Pearson, ISBN: 1292153598, 2017.
4. Data and Computer Communications, 10th Edition, William Stallings, Pearson Education, 2013, ISBN: 0133506487,9780133506488.
5. Data and Computer Communication, 8th Edition, William Stallings, Prentice Hall, 0132433109, 2007.

6. An Introduction to Computer Networks, Peter L Dordal, Open Book, http://intronetworks.cs.luc.edu/ 2020.
7. William A. Shay, "Understanding Data Communications and Networks", 2nd Edition, Thomson.

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COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2												2
CO2	2	2												2
CO3	3	2												2
CO4	2	2												2
CO5	3	3												2

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2	1.3.1, 1.4.1, 2.1.3	L2
CO2	1,2	1.4.1, 2.1.3, 2.3.1, 2.2.1, 2.2.2	L2, L4
CO3	1,2	1.4.1, 2.1.2, 2.1.3, 2.4.1, 2.3.2	L2
CO4	1,2	1.3.1, 1.4.1, 2.1.3	L2, L3
CO5	1,2	1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.4.1	L2, L3

ARTIFICIAL INTELLIGENCE (Effective from the academic year 2023-2024) SEMESTER-V			
Course code	**21AM503**	**CIE Marks**	**50**
Total number of Contact hours/Week	3:0:0	**SEE Marks**	**50**
Total Number of Contact Hours	**39**	**Exam Hours**	**03**
Credits-3			

Course Learning Objectives:

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

1. Understanding history of Artificial Intelligence (AI) and its foundation.
2. Learn basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning
3. Analyze various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Identify and explain the proficiency developing applications of AI language, expert system shell, or data mining tool.
5. Determine an ability to share in discussions of AI, its current scope and limitations.

Unit-I	**Contact Hours**
Introduction: what is AI, Acting Humanly: The Turing Test approach, Thinking Humanly: The cognitive modelling approach, Thinking rationally: The laws of thought apprach, Acting Rationally: The rational agent approach. The state of art **Intelligent Agents:** Agents and Environments, Good behaviour: The concept of rationality, The nature of environments, properties of task environments, Structure of Agents: Agent Programs, Types of agent programs **Solving Problems by Searching:** Problem solving Agents, well defined problems and solutions, formulating problems, Example problems: Toy problems: Vacuum world, 8-Queen's problem, Real world problem: Airline Route finding problem	**10**
Unit-II	

Searching for solutions: Infrastructure for search algorithms, measuring problem solving performance, Uninformed search strategies: Breadth first search, Cost search, Depth first search, Informed search strategies: Greedy best search, A* algorithms, Heuristic functions **Quantifying Uncertainty:** Acting under uncertainty, summarizing uncertainty, Uncertainty and rational decisions, Basic probability notation, what probabilities are about. The language of propositions in probability assertions, Inference using full joint distribution, Bayes' rule and its use, Applying Bayes' rule for simple use case **Probability Reasoning Over time:** Time and Uncertainty, States and observations, Transition and Sensor models, Inference in temporal models, Smoothing, Hidden Markov model, Simplified matrix algorithms, Hidden Markov model: Localization, Kalman Filter basics.	**12**
Unit-III	
Reinforcement Learning: Introduction, Passive reinforcement learning, Generalization in reinforcement learning, Applications of reinforcement learning, **Q-Learning Intuition:** Plan of attack, Bellman Equation, The Plan, Markov Decision Process, Policy vs Plan, Adding Living penalty, Temporal Difference	**10**
Course Outcomes: At the end of the course student will be able to: 1. Explain the fundamental understanding of the history of Artificial Intelligence (AI) and its foundation. 2. Interpret the basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning 3. Describe the awareness and fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models. 4. Identify and explain the proficiency developing applications of AI language, expert system shell, or data mining tool 5. Determine an ability to share in discussions of AI, its current scope and limitations.	
Reference Books: 1. Artificial Intelligence by Rich and Knight, The McGraw Hill, 2017 2. Artificial Intelligence: A new synthesis by Nils and Nilson, Elsevier, 1997. 3. Artificial Intelligence by Luger, Pearson Education, 2002. 4. Artificial Intelligence by Padhy, Oxford Press, 2005.	
E Books / MOOCs/ NPTEL 1. https://www.edx.org/course/artificial-intelligence-ai	

2. https://www.udemy.com/course/artificial-intelligence-az/

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		2								3	
CO2	3	2	2		2								3	
CO3	3	2	2		2								3	
CO4	3	2	2		2								3	
CO5	3	2	2		2								3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 3.2.1, 5.1.1	L3
CO2	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 3.2.1, 5.1.1	L3
CO3	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 5.1.1	L3
CO4	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 5.1.1	L3
CO5	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 3.2.1, 5.1.1	L3

COMPUTER VISION (Effective from the academic year 2023 -2024) SEMESTER – V			
Course Code	21AM504	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1. To impart the knowledge on image processing measures, colors , shadows and filters.
2. To develop the ability to apprehend and implement various object identification techniques
3. Understand various texture analysis and synthesis on images.
4. Analyze various segmentation techniques.
5. To facilitate students to comprehend on various pattern and motion analysis schemes for machine vision applications.

Unit I	**Contact Hours**
Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases. **Sources, Shadows, And Shading:** Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models. **Color:** The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color. **Linear Filters:** Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates.	15
Unit II	
Edge Detection: Noise, Estimating Derivatives, Detecting Edges. **Texture:** Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.	15

The Geometry of Multiple Views: Two Views. **Stereopsis:** Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras. **Segmentation by Clustering:** What Is Segmentation?, Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering.	
Unit III	
Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness **Segmentation and Fitting Using Probabilistic Methods:** Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, **Tracking With Linear Dynamic Models:** Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Discover and understand enhancement, segmentation and morphological operations on images for further analysis.
2. Acquire the knowledge of various edge detection and analysis for better interpretation.
3. Experiment the various segmentation techniques on images.
4. Design and implement various probabilistic methods for images.
5. Analyze and explore various liner dynamic models

Textbooks:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th Edition, Cengage Learning, USA, 2014
3. Jurgen Beyerer, Fernando Puente Leon, Christian Frese,”Machine Vision Automated Visual Inspection: Theory, Practice and Applications”, 2016, Springer.
4. Oge Marques, Practical Image and Video Processing using MATLAB, IEEE Press, Wiley Publications, 2011
5. R. C. Gonzalez and R. E. Woods, “Digital Image Processing (4th Edition), 2018.
6. R. Szeliski, “Computer vision: algorithms and applications”, ISSN 1868-095X, 2nd Edition,Springer Nature Switzerland AG, 2022.

E Books / MOOCs/ NPTEL:

1) https://nptel.ac.in/courses/106105216

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		2								3	
CO2	3	2	2		2								3	
CO3	3	2	2		2								3	
CO4	3	2	2		2								3	
CO5	3	2	2		2								3	

1: Low, 2: Medium, 3: High

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 3.2.1, 5.1.1	L3
CO2	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 3.2.1, 5.1.1	L3
CO3	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 5.1.1	L3
CO4	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 5.1.1	L3
CO5	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.3, 3.2.1, 5.1.1	L3

ARTIFICIAL INTELLIGENCE AND COMPUTER VISION LAB

(Effective from the academic year 2023 -2024)

SEMESTER – V

Course Code	21AM505	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Contact Hours	26	**Exam Hours**	03

Credits – 1

Course Learning Objectives:

This course will enable students to:

1. Implement and evaluate AI algorithms in Python programming language.
2. Apply the knowledge of AI and carry out a mini project on game design.
3. Demonstration of the Predicate logic/classification algorithms.
4. Design and implementation of image and video using open CV.
5. Evaluate different algorithms using given data set.

List of Experiments: the students must carry out minimum following experiments and not restricted to.
This lab contains a mini project.

PART-A

1. Implement and Demonstrate Depth First Search Algorithm on Water Jug Problem
2. Implement and Demonstrate Best First Search Algorithm on any AI problem
3. Implement AO* Search algorithm.
4. Solve 8-Queens Problem with suitable assumptions
5. Implementation of TSP using heuristic approach
6. Implementation of the problem-solving strategies: either using Forward Chaining or Backward Chaining
7. Implement resolution principle on FOPL related problems
8. Implement K- means algorithm.
9. Implement K- nearest neighbour algorithm
10. Implement SVM

PART-B

1. Write a program in python to demonstrate working with images and videos using OpenCV.
2. Write a program in python to demonstrate Bitwise Operations on Binary Images using OpenCV.

3. Write a program in python to Draw different geometric shapes and to write text on images using OpenCV.
4. Write a program in python to perform different Morphological operations on images based on OpenCV
5. Implement different Thresholding techniques, Edge detection and Contour detection on images using openCV.
6. Demonstrate Haar feature-based cascade classifiers for Face and Eye Detection on images and videos.
7. Develop a classification model using YOLO object detection algorithm using OpenCV.
8. Write a program in python to demonstrate Handwritten Digit Recognition on MNIST dataset.
9. Develop a classification model to detect dogs and cat from a given dataset

Course Outcomes: The student should be able to:

1. Implement and demonstrate AI algorithms for informed and uninformed searches.
2. Implementation of the problem-solving strategies.
3. Demonstration of the Predicate logic/classification algorithms.
4. Design and implementation of image and video using open CV.
5. Evaluate different algorithms using given data set.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3		2							2	3	
CO2	3	3	3		2							2	3	
CO3	3	3	3		2							2	3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level

CO1	PO1, PO2, PO3, PO5, PO12	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 5.1.2, 12.1.1	L3
CO2	PO1, PO2, PO3, PO5, PO12	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 5.1.2, 12.1.1	L3
CO3	PO1, PO2, PO3, PO5, PO12	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 5.1.2, 12.1.1	L3

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS			
Course Code	**21HU511**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S)	**2:0:0:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**25**	**Total Marks**	**100**
Credits	**2**	**Exam Hours**	**3**

Course objectives:

1. To explain the significance of carrying out research work,
2. To explain the Research Problem, Review the literature.
3. To understand Research Design, methodological way of execution.
4. To understand Data Collection, and Interpretation and Report Writing.
5. To appreciate the importance of Intellectual property rights protection.

Unit-1

Research Methodology:

Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem:

Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature:

Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Unit-2

Research Design:
Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Design of Sample Surveys:
Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Data Collection:
Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Interpretation and Report Writing:
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout.

Interpretation and Report Writing (continued):
of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Pedagogy	Chalk and talk, Power point presentation, Videos

Unit-3

Intellectual Property:
The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other

Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.	
Pedagogy	Chalk and talk, Power point presentation, Videos

Course outcome (Course Skill Set)

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

CO1: Explain the significance of carrying out research work,

CO2: Explain the Research Problem, Review the literature.

CO3: Describe Research Design, methodological way of execution.

CO4: Execute Data Collection, and Interpretation and Report Writing.

CO5: Explain the importance of Intellectual property rights protection.

PO-CO mapping

Course Outcomes (CO)	Program Outcomes (PO)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	**2**	1								3					**1**
CO 2	1	2	**1**												**1**
CO 3	2	2	**1**				1								**1**
CO 4	3	3	3			1									**1**
CO 5	1	1				3	2	2		3					**1**

1: Low 2: Medium 3: High

ENVIRONMENTAL STUDIES

Course Code:	21CV512	**Course Type**	**MNC**
Teaching Hours/Week (L: T: P)	**1:0:0**	**Credits**	**00**
Total Teaching Hours	**15+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Civil Engineering

Course Objectives:

1. To raise consciousness about environmental conditions and to imbibe environmentally appropriate behaviour.
2. To equip the engineering undergraduates to identify the significance of environmental practice in their daily life and in the engineering practices.
3. To make them conscious of understanding the environment where we live and act up on.

UNIT-I

03 Hours

Environment

Definition, significance of environmental studies- current scenario, local, regional, national and global problems

Components of environment: atmosphere, hydrosphere, lithosphere, and biosphere. Layers of atmosphere and its role.

Parts of Earth- lithosphere and its role; hydrological cycle

Eco system - Definition, ecology and environment, ecosystem components: biotic and abiotic components; ecological balance; elements of ecosystem: biotic, abiotic; producers, consumers and decomposers.

Habitat, range of life, Biome, balanced eco- system, food chain, food web and ecological pyramids

Human activities - The Anthropogenic System- human activities like growing food, building shelter and other activities for economy and social security. Soil erosion, water logging -definition. Organic farming- definition.

Natural resources **03 Hours**

Resources - Natural resources, water, minerals, Fossil fuels and energy

Water resources - Global water resources: distribution, uses of water for irrigation, domestic and industrial purposes in India.

Quality aspects - Water quality parameters, drinking water standards for turbidity, pH value, total hardness, iron, fluoride, lead, arsenic, nitrate

Mineral resources- Metallic minerals, non-metallic minerals Fossil fuels - Coal and petroleum

Forest Wealth - Components of the forest, key benefits of forests. Deforestation-environmental effects of deforestation and remedies Sustainable development- definition, objectives

Material cycles - Carbon, Nitrogen, and Sulphur cycles.

UNIT-II	
Environmental pollution: Definition, harmful effects related to public health	**03 Hours**
Water pollution: Definition, types, and sources – agriculture (pesticides and fertilizers), industry, domestic and mining, harmful effects, water borne and water induced diseases- definition, common diseases and their causatives, Fluoride problem in drinking water **Land pollution**: Definition, sources_ agriculture, housing, industry, mining, transportation. Types of municipal Solid waste Disposal (Sanitary landfills, composting, incineration (in brief) and effects **Air Pollution**: Definition, types, and sources: industry, mining, agriculture, transportation, and effects **Noise pollution**: Definition, sources, mining, industries, rail-roads, aviation, effects and control measures	
Energy	**02 Hours**
Different types of energy- Non-renewable energy; fossil fuels- coal, oil, and natural gas- brief description only. Nuclear energy- nuclear power plants, Renewable energy: solar energy- Photovoltaic systems for street and domestic lighting, solar water heating-brief description only Wind energy- definition, merits and demerits, Hydro power- definition, merits, and demerits. Biomass energy- definition, sources of bioenergy, biogas, biofuels, India's position in renewable energy Hydrogen as an alternative future source of energy- brief scope, fuel cells.	
UNIT-III	
Current environmental issues of importance	**04 Hours**
Population growth- Definition, growth rate, effects, remedies Urbanization - Definition, environmental impacts and remedies Global warming and climate change- Concept of greenhouse effect, sources of greenhouse gases, effects, and remedial measures of greenhouse gases Acid rain:Definition, causes and effects, control measures. Ozone Depletion: Definition, causes, effects, and control measures. Environmental Impact Assessment- EIA definition, objectives, and benefits of EIA.	

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

1. Identify the significance of environmental practice in their daily life and in the Engineering practices.
2. Create awareness about environmental conditions.
3. Follow environmentally appropriate behaviour.
4. Understand the importance of their surroundings.
5. Understand Current environmental issues of importance

Course Outcomes Mapping with Program Outcomes & PSO

Program Outcomes→	1	2	3	4	5	6	7	8	9	10	11	12	PSO↓		
↓ Course Outcomes													1	2	3
CO1	-	2	-	-	-	-	-	2	-	-	-	-	1	-	-
CO2	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-
CO3	1	-	-		1	-	-	-	-	-	-	-	1	-	-
CO4	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	3	-	-	-	-	-	-	-	3	-	1	-	-

1: Low 2: Medium 3: High

TEXTBOOKS:

1. Benny Joseph, “Environmental Studies”, Tata McGraw Hill Publ. Co., New Delhi, 2005.
2. Rajagopalan, R., “Environmental Studies: From Crisis to Cure”, Oxford University Press, London, 2005.

REFERENCE BOOKS:

1. Balasubramanya, N and Chatwal, Gurdeep R., “Environmental Studies”, Himalaya Publishing House, Mumbai, 2007.
2. Barucha, E., “Environmental Studies”, University Grants Commission, New Delhi, 2004.
3. Bhatia, S. C., “Environmental Chemistry”, CBS Publishers, New Delhi, 2005.
4. De, A.K. and De, A. K., “Environmental Studies”, 2006.
5. Keller, Edward A., “Environmental Geology”, CBS Publishers and Distributors, Delhi, 1985.

ABILITY ENHANCEMENT COURSE-V

DATA VISUALIZATION TECHNIQUES AND TOOLS (Effective from the academic year 2023 -2024)			
Course Code	21AMA51	**CIE Marks**	50
Number of Contact Hours/Week	**0:0:2**	**SEE Marks**	50
Total Number of Contact Hours	26	**Exam Hours**	03
Credits – 1			

Course Learning Objectives:

This Course will enable students to:

1) Comprehensive understanding of data visualization principles and techniques.
2) Familiar with popular data visualization tools and software, such as Tableau, Power BI, or Python libraries like Matplotlib and Seaborn.
3) Gain proficiency in using the tools to create interactive and visually appealing visualizations.
4) Understand the importance of data preparation and exploration in the context of data visualization.
5) Able to draw insights from the data and apply their knowledge and skills in real-world projects or case studies.

	Contact Hours
Introduction to Data Visualization using Tableau: • Getting familiar with the Tableau interface and terminologies. • Tableau Data Sources-Custom data view, Extracting data, Fields operations, Editing metadata, Data joining, Data blending. • Tableau Worksheets-operations. • Tableau Calculations • Tableau Sort & Filters • Visualizations in Tableau-bar charts, line charts, scatter plots, gantt chart, histogram, waterfall charts • Dashboard Design and Layout • Tableau Formatting and Forecasting **Introduction to Data Visualization using PowerBI:**	26

- Overview, advantages
- PowerBI desktop
- PowerBI workspace
- Transforming data-create column, remove column
- Reports
- Dashboards
- PowerBI's Integration with R & Python
- Saving and publishing.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply knowledge of Tableau and PowerBI to real-world datasets.
2. Familiarize on data visualization tools and software, such as Tableau, Power BI, and Python libraries.
3. Design and customize different chart types, including bar charts, line charts, scatter plots, histograms, heat maps, and so on.
4. Perform various worksheet operations using different tools.
5. Create interactive dashboards, developing visualizations for specific business scenarios, or analyzing data for decision-making.

Textbooks:

1. Data Visualization with Python and JavaScript: Scrape, Clean, Explore & Transform Your Data, Kyran Dale, O'Reilly, 2016

References:

https://www.tutorialspoint.com/tableau/index.htm
https://www.javatpoint.com/tableau
https://www.analyticsvidhya.com/blog/2021/04/from-scratch-to-a-story-introduction-to-tableau/
https://www.analyticsvidhya.com/blog/2021/10/step-by-step-guide-data-visualization-tableau/

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2

CO1	3	2	3		2							3	
CO2	3	2	3		2							3	
CO3	3	2	3		2							3	
CO4	3	2	3		2							3	
CO5	3	2	2		2							3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO2	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3

MOBILE APPLICATION DEVELOPMENT
(Effective from the academic year 2023 -2024)

Course Code	21AMA52	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Contact Hours	26	**Exam Hours**	03

Credits – 1

Course Learning Objectives:
This Course will enable students to:

1. Describe the architecture and overview of android.
2. Develop a mobile application on Android Platform using UI components and Android Components.
3. Develop applications supporting services and broadcast receivers.
4. Manage the data handling of the app using databases, shared preferences.
5. Support the application with the graphical features or animations and sensors.

Unit I	Contact Hours
INTRODUCTION AND OVERVIEW: Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android Platform, setting up the mobile app development environment along with an emulator in Android Studio, Hello World Example. **USER INTERFACE DESIGNING:** App user interface designing – mobile UI Layout (Layout, View) UI Control (TextView, EditText, Button, ImageButton, ToggleButton, RadioGroup, RadioButton, CheckBox, ProgressBar, Spinner, DayPicker, TimePicker), Draw-able, Menu(Option, Context, Popup). **Hands-on exercises:** • Design four checkboxes namely any four food items and one button. Find total amount of food items selected in Toast message after clicking the button. • Create an application which generates a random color on each click. • Implement option menu concept in application to choose between two activities. • Implement context menu concept in application to change the background color.	10

Unit II	
ANDROID APPLICATION COMPONENT: Activity –states and life cycle, interaction amongst activities. Services – state and lifecycle. Notifications, Broadcast Receivers, Content Provider, Fragments. **Intents**: Implicit and Explicit Intent **APP FUNCTIONALITY BEYOND USER INTERFACE**: Threads, Async task, Notification, Location Based Service, Telephony and SMS APIs, Text to Speech, Camera **Hands-on exercises:** 1. Write an application to send SMS using Intent class. 2. Implement phone call concept in application by passing number from the user. 3. Demonstrate the sending of an email with the help of a registered email client on your android phone. 4. Write an app to capture the image using camera and set it as background for your app.	10
Unit III	
DATA HANDLING: Shared preferences, mobile data bases such as SQLite and enterprise data access, Android multimedia**:** Multimedia-audio/video playback and record. Sensors**:** Location awareness and native hardware access (sensors such as accelerometer and gyroscope).Android Web Service, Android Google Maps, Android Bluetooth, Navigation. **Hands-on exercises:** 1. Write an application to insert the data entered by a user into a database and display all the values in database. 2. Write an application to search for a given USN from a student database and call to that student. 3. Write an application to toast your joining date and course selected for engineering using date picker and list view.	06
Course Outcomes: Upon completion of this course, students will be able to: 1. Use the IT tool like Android Platform and Android Studio Environment to develop android application. 2. Design the user interface using the Android UI Components and Android Application Components. 3. Use the concepts like SQLite, shared preference, files, broadcast, notifications, and other APIs for developing the android applications. 4. Develop Application using Sensor telephony APIs. 5. Apply the google APIs for the app development. **Textbooks:** 1. Anubhav Paradhan, Anil V Deshpande, “Mobileapps Development”, First Edition, Wiley,2014. 2. Barry Burd , “Android Application Development All in one for Dummies”, Second Edition Wiley,2015.	

3. SAMS,"Teach Yourself Android Application Development in 24 Hours",FirstEdition,SamsPublishing,2010.	
Reference Books: 1. Wei-Meng Lee, "Beginning Android Application Development", WroxPublication, 2011. 2. Reto Meier, "Professional Android 4 Application Development", WroxPublication,2012.	

VI Semester

INTERNET OF THINGS (Effective from the academic year 2023 -2024) SEMESTER – VI			
Course Code	21AM601	**CIE Marks**	50
Number of Contact Hours/Week	3:0:2	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 4			

Course Objectives:

1. Assess the genesis and impact of IoT applications, architectures in real world.
2. Illustrate diverse methods of deploying smart objects and connect them to network.
3. Compare different Application protocols for IoT.
4. Infer the role of Data Analytics and Security in IoT.
5. Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Unit I	**Contact Hours**
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoTArchitecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack. Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks **Textbook 1: Ch.1, 2, 3**	15
Unit II	

Connecting Smart Objects, Communications Criteria, IoT Access Technologies (IEEE 802.15.4, LoRaWAN, NB-IoT and Other LTE Variations) IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods. **Textbook 1: Ch.4, 5, 6**	15
Unit III	
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR **Textbook 1: Ch.7, 8**	9
Following are the Lab experiments can be carried in Internet of things Lab and not limited to. **This contains a mini project component.** 1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation. 2. Introduction of Arduino IDE. Demonstrate setup(), serial.analogRead() and loop() functions, serial.begin() serial.print(), serial.available(), serial.read() and serial.write() statement. 3. Write an arduino program to demonstrate user defined functions, data types, variables, constants, operators, if statements, switch case, loops, arrays etc. 4. Write an arduino program to demonstrate strings, string object. 5. Write an arduino program to demonstrate time based functions. 6. Write an arduino program to demonstrate random numbers generation 7. Write an arduino program to demonstrate the 7-segment display. 8. To interface Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds. 9. To interface Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED at sensor detection. 10. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. 11. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.	26

12. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it. 13. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth. 14. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth. 15. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to things peak cloud. 16. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from things peak cloud. 17. Write a program on Arduino/Raspberry Pi to publish temperature to MQTT broker. 18. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it. 19. Write a program to create a TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested. 20. Write a program to create a UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested. 21. Transmit a string using UART. 22. Point-to-Point communication of two Motes over the radio frequency. 23. Multi-point to single point communication of Motes over the radio frequency. 24. LAN (Subnetting). 25. I2C protocol study	

Course Outcomes:

Upon completion of this course, students will be able to:

1. Interpret the impact and challenges posed by IoT networks leading to new architectural models.
2. Compare and contrast the deployment of smart objects and the technologies to connect them to network.
3. Appraise the role of IoT protocols for efficient network communication.
4. Elaborate the need for Data Analytics and Security in IoT.
5. Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Textbooks:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education
2. Vijay Madisetti, ArshdeepBahga, "Ïnternet of Things- A Hands on Approach", UniversityPress

Reference Books:

1. Adrian McEwen, "Designing the Internet of Things",Wiley
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1 st Edition, McGraw Hill Education, 2017
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media

E-Books / Online Resources/ MOOC:

1. https://www.tutorialspoint.com/internet_of_things/internet_of_things_tutorial.pdf
2. www2.datainnovation.org/2013-internet-of-things.pdf
3. https://onlinecourses.nptel.ac.in/noc17_cs22/preview
4. https://www.coursera.org/learn/iot
5. https://www.class-central.com/mooc/6748/coursera-introduction-to-architecting-smart-iot-devices.

Table 1: Mapping Levels of COs to Pos

Cos	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3			3	2								3
CO2	3	3			3	2								3
CO3	3	3			3	2								3
CO4	3	3			3	2								3
CO5	3	3			3	2								3

Table 2: Mapping of Cos to PIs, Pos and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 3.2.1,5.1.1, 9.1.1, 10.1.1	L2, L3
CO2	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 3.2.1,5.1.1, 9.1.1, 10.1.1	L2, L3
CO3	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3,5.1.1, 9.1.1, 10.1.1	L2, L3
CO4	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 5.1.2, 9.1.1, 10.1.1	L2, L3
CO5	1, 2	1.3.1,1.4.1, 2.1.3	L2

NATURAL LANGUAGE PROCESSING **(Effective from the academic year 2023 -2024)** **SEMESTER – VI**			
Course Code	21AM602	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Objectives:

This Course will enable students to:

1) Analyze language and the tools available for processing the text.
2) Efficiently analyse the large collections of text.
3) Discuss how word level language is generated.
4) Understand the syntactic analysis of the given words and sentences.
5) Outline and understand design features of information retrieval.

Unit I	Contact Hours
Overview and Language Modeling: **Overview:** Definition, Origins of NLP, Language and Knowledge-Levels, Role of grammar in language processing, Transformational grammar, Challenges of NLP, Applications of NLP, Information retrieval. **Language Modeling:** Various Grammar based Language Models Generative grammars, Hierarchical grammar, Paninian Framework, Karaka Theory. Statistical Language Model- n-gram model, Add-one Smoothing, Good-Turing Smoothing, Caching Techniques.	15
Unit II	
Word Level and Syntactic Analysis: **Word Level Analysis:** Regular Expressions- Introduction, Finite State Automata Morphological parsing, Spelling Error Detection and Correction, Word and word classes, Part-of Speech Tagging-Rule based, Stochastic and hybrid taggers. **Syntactic Analysis:** Introduction, Context-Free Grammar, Constituency. Parsing-Top-down Parsing, Bottom-up Parsing, A-basic Top-down Parser, Early Parser. **Natural Language Understanding (NLU):** Definition, Approaches in NLU, Comparison between NLP and NLU , Approaches of machine translation in NLU	15
Unit III	
Information Retrieval and Lexical Resources: **Information Retrieval:** Design features of Information Retrieval Systems, Classical, Non classical, Alternative models of Information Retrieval. **Lexical Resources:** Word Net, Frame Net, Stemmers, POS Tagger.	9
Course Outcomes: 1. Understand and analyse the natural language text.	

2. Acquaint with the tools, techniques, resources, applications and challenges in NLP
3. Learn natural language processing with manual and automated approaches.
4. Learn syntactic analysis for natural language processing.
5. Design different models of information retrieval systems.

Textbooks:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.

Reference Books:

1. NLP: A Paninian Perspective by Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, Prentice Hall, 2016.
2. Natural Language understanding by James Allen, Pearson Education, 2002.
3. Meaning and Grammar by G. Chirchia and S. McConnell Ginet, MIT Press, 1990.
4. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition by Daniel Jurafsky and James H. Martin, Pearson Education, 2006.

E Books / MOOCs/ NPTEL

1. https://www.coursera.org/specializations/natural-language-processing
2. https://en.wikipedia.org/wiki/Natural-language_understanding

Table 1: Mapping Levels of COs to POs														
Cos	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											2	
CO2	3	2	2										2	
CO3	3	2	2										2	
CO4	3	2	2										2	
CO5	3	2	2										2	

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2	L2
CO2	PO1, PO2, PO3	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2, 3.3.3	L3
CO3	PO1, PO2, PO3	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2	L3
CO4	PO1, PO2, PO3	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2	L3
CO5	PO1, PO2, PO3	1.1.2, 1.1.3, 1.2.1, 2.1.2, 2.2.1, 3.1,2	L3

MANAGEMENT AND ENTREPRENEURSHIP (Effective from the academic year 2023 -2024) SEMESTER – VI			
Course Code	21AM603/21CC603	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits–3			

Unit-I	**Contact Hours**
Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as art or science, art or profession-Management & Administration-Roles of Management, Levels of Management, Development of Management Thought - early management approaches –Modem management approaches. **Planning**: Nature, importance and purpose of planning process objectives - Types of plans (meaning only) - Decision making, Importance of planning - steps in planning & planning premises-Hierarchy of plans. **Organizing and staffing**: Nature and purpose of organization, Principles of organization–Typesoforganization-DepartmentationCommittees-CentralizationVsDecentralization of authority and responsibility - Span of control - MBO and MBE (Meaning only)Nature and importance of staffing--:Process of Selection &Recruitment(in brief). **Directing**: Meaning and nature of directing Leadership styles, Motivation, Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of coordination. **Controlling**: Meaning and steps in controlling - Essentials of a sound control system –Methods of establishing control (in brief).	15
Unit-II	
Entrepreneur: Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship-its Barriers. **Small scale industries**: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans.	14

Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition Only). **Institutional support**: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.	
Unit-III	
Preparation of project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of. Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. **Industrial ownership**: Definition and meaning of Partnership, Characteristics of Partnership, Kinds of Partners, Partnership Agreement or Partnership Deed, Registration of Partnership Firm, Rights, Duties and Liabilities of Partners, Advantages and Disadvantages of Partnership, Sole proprietorship, Features, Scope Advantages and Disadvantages of Sole Proprietorship.	10
Course Outcomes: Upon completion of this course, students will be able to: 1. Explainmanagementfunctionsofamanager.Alsoexplainplanninganddecisionmakingprocesses. 2. Explain the organizational structure, staffing and leadership processes. 3. UnderstandingofEntrepreneurshipsandEntrepreneurshipdevelopmentprocess. 4. Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur. 5. Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership.	
Text Books: 1. Principles of Management–P.C.Tripathi, P.N.Reddy–Tata McGraw Hill. 2. Dynamics of Entrepreneurial Development & Management-Vasant Desai, Himalaya Publishing House. 3. Entrepreneurship Development – Poornima.M.Charantimath, Small Business Enterprises– Pearson Education-2006	
Reference Books: 1. Management Fundamentals - Concepts, Application, Skill Development – Robers Lusier, Thomson. 2. Entrepreneurship Development -S.S.Khanka, S.Chand & Co. NewDelhi. 3. Management-Stephen Robbins, Pearson Education/PHI-17thEdition, 2003.	

NATURAL LANGUAGE PROCESSING LAB (Effective from the academic year 2023 -2024) SEMESTER – VI			
Course Code	21AM604	**CIE Marks**	50
Number of Contact Hours/Week	0:0:2	**SEE Marks**	50
Total Number of Contact Hours	26	**Exam Hours**	03
Credits – 1			

Course Learning Objectives:

1. Analyze language and the tools available for processing the text.
2. Efficiently apply the techniques to the large collections of text.
3. Understand how word level language is generated.
4. Design the syntactic analysis of the given words and sentences.
5. Outline the features of information retrieval.

Students must carry out experiments from 21AM602 and not limited to following:
part-a

1. Perform word tokenization and sentence tokenization for the long paragraph using NLP libraries like:
   a. Tokenization Using Python's Inbuilt Method
   b. Tokenization Using Regular Expressions(RegEx)
   c. Tokenization Using NLTK
   d. Tokenize as a list Using SpaCy
   e. Tokenization using Keras
   f. Check token is Alphabet/Punctuation/Number/Currency or Not using Spacy and display appropriate messages for every token.

2. Consider students.txt and perform the following operations:
   a. Tokenize the email ids from the given students.txt using Spacy
   b. Tokenize all email ids from the given students.txt using NLTK
   c. Collecting dataset websites from a book paragraph using Spacy
   Text='''

Look for data to help you address the question. Governments are good sources because data from public research is often freely available. Good places to start include http://www.data.gov/, and http://www.science.gov/, and in the United Kingdom, http://data.gov.uk/. Two of my favorite data sets are the General Social Survey at http://www3.norc.org/gss+website/, and the European Social Survey at http://www.europeansocialsurvey.org/. The current representation will be formed by a well-organized collection of agents, previously structured in a dynamic, control-based manner. This collection of agents will be built based on the analysis of activations of conception and structuring agents that intercommunicate. Having first deployed an intent, a global interpretation of the system's situation is formed by means of questionings, qualifying aspects of things, memorized cases, development of numerous cognitive aspects by activating agents that operate proper scaling up, all of which will allow for the efficient emergence of the representation. The system's interpretation of this collection of agents will take the form of http://www.systemsurvey.org/ a network of dynamic knowledge of apprehensions, operating through questions in a steadily activated loop. This knowledge network will be activated by the system and further developed based on inter-agent relations that will result in significant aggregations of knowledge, structures of dynamic knowledge with appropriate (domain.com) characteristics.

'''

d. Extract all money transaction from below sentence along with currency using Spacy.

Transactions = "Aron gave two $ to Shawn, Smith gave 500 $ to Johan"
Output should be,

two $

500 $

3. Implement text preprocessing techniques on email dataset using NLTK libraries and perform following operations:

a. Rename columns
b. Expand contractions
c. Lower case
d. Remove punctuations
e. Remove digits and word containing digits
f. Remove stop words and specified words

4. Perform following stop word operations on email dataset using Spacy, Gensim and NLTK libraries
   a. Display existing stop words in the default list
   b. Removing stop words from the default list
   c. Adding stop words to the default list

5. Generate n-gram representation for the given corpus and perform following operations on the corpus:
a. Preprocess the corpus for n-gram representation
b. Display all tokens, distinct tokens and frequency of tokens in the corpus
c. Bi-gram and frequency representation using user defined functions
d. Tri-gram and frequency representation using user defined functions

6. Implement following operations on the tweets dataset using NLTK libraries:
   a. Data cleaning
   b. Rank most frequently occurring 15 n-grams (bigram and trigrams) in the given tweets dataset
   c. Visualize most frequently occurring 15 n-grams (bigram and trigrams) in the given tweets dataset

7. Perform following operations on the given text data:
   a. Stemming using porter stemmer, snowball stemmer, lancaster stemmer
   b. Lemmatization using spacy lemmatizer, wordnet lemmatizer, textblob lemmatizer

PART-B

8. Visualize POS tagging for simple text using NLTK and SPACY libraries and perform following operations:
   a. Display dependency tagging for the text
   b. Display named entities in the taken text
   c. Visualize the text with appropriate user defined entities and tokens.

9. Perform minimum edit distance for the given two strings using:
   a. User defined function
   b. Built in function

10. Perform given vectorization techniques on the following datasets:
   a. Bag of Words (BOW) on 4 documents.

b. Term Frequency and Inverse Document Frequency (TF-IDF) on 4 documents.
c. Word2Vec model using CBOW for the large corpus in word2vec.txt by preprocessing the corpus.

11. Demonstrate question answering application using gradio with transformers.

12. Demonstrate sentence classification using pipeline.

13. Demonstrate text summarization on the given input file summary. txt by performing following operations using spacy library:
a. Display the content of summary.txt file.
b. Print word with its frequency to the given text file.
c. Display maximum frequency of word in the given text file.
d. Normalization.
e. Find out sentence scores.
f. Summarize 30% of the sentences with maximum score.

Design and Implement NLP mini project based on either text or audio or video documents

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand and apply the natural language text.
2. Analyze with different tools and techniques in NLP
3. Learn natural language processing with manual and automated approaches.
4. Apply syntactic analysis for natural language processing.
5. Design different models of information retrieval systems.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3		2								3	

CO2	3	2	3		2							3	
CO3	3	2	3		2							3	
CO4	3	2	3		2							3	
CO5	3	2	2		2							3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO2	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO3, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3

SOFTWARE ENGINEERING AND TESTING **(Effective from the academic year 2023 -2024)** Value added Course			
Course Code	21AMV02	**CIE Marks**	50
Number of Contact Hours/Week	**1:0:2**	**SEE Marks**	50
Total Number of Contact Hours	26	**Exam Hours**	03
Credits – 1			

Course Learning Objectives:
This Course will enable students to:

1. Learn the concepts and importance of software engineering and testing.
2. Learn strengths and weaknesses of various software engineering techniques used in industrial applications.
3. Select appropriate testing strategies based on the application
4. Analyze various software testing tools and techniques used in the industrial applications.
5. Able to construct software that is reasonably easy to understand, modify, maintain, reliable and test.

Unit I	**Contact Hours**
Introduction: Software Crisis, Need for Software Engineering. Professional Software Development, Software Engineering Ethics, Case Studies. Software Processes: Models: Waterfall Model Incremental Model and Spiral Model, Process activities. **Requirements Engineering:** Functional and non-functional requirements, Requirements Engineering Processes, Requirements Elicitation and Analysis, Requirements Specification, Software Requirements Document, Requirements Validation and Management. **System Models:** Context models, Interaction models, Structural models, Behavioral models.	10
Unit II	

Architectural Design: Architectural design decisions. Architectural Views and patterns, Application architectures. **Agile Software Development:** Coping with Change, The Agile Manifesto: Values and Principles, Agile methods and Extreme Programming, Plan-driven and agile development, Agile project management, Scaling agile methods. **Software Testing**: Introduction, Development testing, Test-driven development, Release testing, Test Automation. **Tutorials:** Introduction to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing.	10
Unit III	
Software Testing Strategies: A Strategic approach to software testing, Strategic issues, Test strategies for conventional software, Test strategies for object oriented software, Test strategies for Web Apps, Validation Testing, System Testing, White-box testing, Black box testing. **Tutorials:** Understanding TestNG framework with Selenium Web driver for automation testing, Introduction to Maven automation tool. **To work on mini projects developed in earlier semesters to apply software design and report making**.	6
Course Outcomes: After completion of course, students would be able to: 1. Understand the process of designing, creating and maintaining software. 2. Create software for various application domains using the strategies. 3. Illustrate the challenges of various software engineering techniques in large-scale software development. 4. Understand the basic concepts of software testing 5. Analyze the importance of software testing strategies and project planning.	
Textbooks: 1. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education, 2012. 2. Roger S. Pressman: "Software Engineering-A Practitioners approach", 7th Edition, Tata McGraw Hill, 2010.	

Reference Books:

1. Pankaj Jalote: "An Integrated Approach to Software Engineering", Wiley, India, 2010.
2. Software Engineering, N.S. Gill, Khanna Publishing Co., Delhi 2018.
3. An Integrated Approach to Software Engineering, Pankaj Jalote, Narosa, 2014
4. Fundamentals of Software Engineering, By Rajib Mall, PHI Learning Pvt. Ltd, 2014
5. Software Engineering (3rd ed.), By K.K Aggarwal & Yogesh Singh, New Age International Publishers, 2007
6. Rex Black , "Managing the Testing Process",2nd edition, John Wiley & Sons, 2001

E-Books / Online Resources:

1. https://www.softwaretestinghelp.com/selenium-tutorial-1/
2. http://softwaretestingfundamentals.com/software-testing-methods/
3. https://www.tutorialspoint.com/software_testing/software_testing_tutorial.pdf
4. http://docs.seleniumhq.org/docs/
5. http://www.seleniumhq.org/download/

MOOC:

1. http://nptel.ac.in/courses/106105150/
2. https://freevideolectures.com/course/3625/testing-with-selenium

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	3	2									3
CO2	3	3	2	3	2									2
CO3	3	3	2	2	3									2
CO4	3	3	1	2	3									2
CO5	3	3	1	2	3									2

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L2
CO3	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L3
CO4	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L3
CO5	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2

PROFESSIONAL ELECTIVES (GROUP 1)

ANGULAR AND REACTJS (Effective from the academic year 2023 -2024)			
Course Code	21AME011	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Objectives:
The students will be able to understand
1) Design static web pages using HTML5 and Cascading Style Sheets (CSS).
2. Develop client side validations using JavaScript.
3. Understand the basics of AngularJS
4. Develop interactive AngularJS script at the clientside.
5. Understand the basics of ReactJS.

Unit I	**Contact Hours**
HTML5: Overview of HTML5, New features in HTML5, Removed elements from HTML, HTML5 Semantic elements, HTML5 input types, HTML5 new form elements and attributes, HTML5 Video and Audio. **THE BASICS OF JAVASCRIPT:** Overview, Object orientation and JavaScript, General syntactic characteristics, Primitives, Operations, and Expressions, Screen output and keyboard input, control statements, Object creation and modification, Arrays, Functions, Constructors, Patterns matching using Regular Expressions, Errors in Scripts. **JAVASCRIPT AND XHTML DOCUMENTS:** The JavaScript Execution Environment, The Document object model, Element access in JavaScript, Events and Event handling, Handling events from Body elements, Handling events from Button elements, Handling events from Text Box and Password elements, The DOM 2 Event Model, The navigatorObject.	15
UNIT II	

Introduction To Angularjs: Angularjs Overview, Angularjs Mvc Architecture, Angularjs Expressions, Numbers, Strings, Objects, Arrays, Angularjs Modules, Angularjs Directives, Angularjs Model, Data Binding, Angularjs Controllers, Repeating Html Elements, Angularjs Scope, Angularjs Filters, Angularjs Services	15
Unit III	
Introduction To Reactjs: Introduction To Reactjs ,Reactjs Vs Angularjs, Pros And Cons Of Reactjs, React Components, React Class, React State, React Props, React Constructor, React Forms, React Events, React List, React Keys, React Fragments.	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Design static web pages using HTML5 and Cascading Style Sheets (CSS).
2. Develop client side validations using JavaScript.
3. Understand the basics of AngularJS
4. Develop interactive AngularJS script at the clientside.
5. Understand the basics of ReactJS

Textbooks:

1. Robert W. Sebesta, ―Programming the World Wide Web‖, Fourth Edition, Pearson,2014.
2. JakeSpurlock,―Bootstrap-ResponsiveWebDevelopment‖,O'Reilly publications,2013.

Reference Books:

1. Ari Lerner, Ng-book, ―The complete book on Angular JS‖,2013.

E Books / MOOCs/ NPTEL

- https://www.coursera.org/learn/angular

- https://nptel.ac.in/courses/106105084

Table 1: Mapping Levels of COs to POs														
COs	**Program Objectives (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3		3	2								3	
CO2	3	2		2	2								2	
CO3	3	2		2	2								3	
CO4	3	2		2	2								3	
CO5	3	2		2	2								3	

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	1,2,4,5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	1,2,4,5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L2
CO3	1,2,4,5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L2
CO4	1,2,4,5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L2
CO5	1,2,4,5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L2

ARTIFICIAL INTELLIGENCE AND MEACHINE LEARNING IN HEALTHCARE (Effective from the academic year 2023 -2024)			
Course Code	21AME012	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Objectives:

This Course will enable students to:

1) Outline how AI is transforming the practice of medicine.
2) Understand different evaluation models
3) Understand image classification technique
4) Analyse the use knowledge-based techniques in AI
5) Apply Fuzzy Logic and Genetic Algorithm in disease prediction.

Unit I	Contact Hours
AI and ML in Health care Introduction, History of AI, Clinical Application of AI, AI technologies used in healthcare, AI-based healthcare system vs. Traditional healthcare system, Advantage of AI in health care, Use of AI in Health care, Roles of AI in Health, Challenges for AI in Healthcare Associate features of machine learning for healthcare structure, Pillars of machine learning for healthcare. **Artificial Intelligence Disease Diagnosis** Framework for AI in disease detection modelling , Medical imaging for diseases diagnosis , Symptoms of diseases and challenges to diagnostics, diseases with their sign and indications for events , Medical imaging types , Healthcare applications and their purpose , Use of AI in Diagnosis of Alzheimer's disease , Use of AI in Diabetes detection , Use of AI in Heart disease diagnosis , Use of AI in Hypertension disease detection , Use of AI in Cancer disease detection Cross Validation , The train , test and validation split , Evidence-Based Medicine, Automated Machine Learning for Health care. **Clinical information System**	15

Introduction to clinical information systems, contemporary issues in healthcare, workflow and related tools for workflow design, electronic health records databases, Healthcare IT & portable technology **Evaluating models** Sensitivity, Specificity, and Evaluation Metrics, Accuracy in terms of conditional probability, Confusion matrix, ROC and AUC curve and Threshold.	
UNIT II	
Image Classification: What Is Image Classification? Image Processing, Purpose of Image processing, Phases of image processing, Steps in Image Classification, Image Classification Techniques, Maximum likelihood, Minimum-distance, Principal components, so cluster, Parallel piped, Mahala Nobis Distance, Application of Image Processing, Resolving Class imbalance Problem, SNOMED-CT : Classification of Conditions , The CAESAR-ALE Framework , Generating Perceptual-Gestural Sequences : Traces Merging and Somatization , Traces Enrichment , **Image segmentation on MRI images** Introduction, segmentation methods: Region Based Segmentation, Thresholding, Region growing, Region growing, Classification methods, boundary-based methods, Parametric deformable model, non-Parametric deformable model Medical, Hybrid methods, Level set methods, Graph cut method. Model Development and Workflow, Parameters and Hyperparameters, Hyper parameter Tuning, Multivariate Testing. **Knowledge Represent** Knowledge-Based Agent in Artificial intelligence , The architecture of knowledge-based agent , Inference system , Operations Performed by KBA , A generic knowledge-based agent , Various levels of knowledge-based agent , Approaches to designing a knowledge-based agent , What is knowledge representation , What to Represent , Types of knowledge , The relation between knowledge and intelligence , AI knowledge cycle , Approaches to knowledge representation , Requirements for knowledge Representation system , Techniques of knowledge representation, Bayesian Belief Network in artificial intelligence.	15
Unit III	

Use of Fuzzy System in AI Introduction, Fuzzy System history**,** Fuzzification, Defuzzification, Architecture of Fuzzy System, Member function, Advantages and Disadvantages of fuzzy logics. **Introduction to Genetic Algorithm** Introduction, Advantages of Gas, Limitations of Gas, Basic Terminology, Basic Structure, Algorithm of Genetic Algorithm, Classes of Search Techniques, Working Mechanism of Genetic Algorithms, The Genetic Algorithm Cycle of Reproduction, Two Armed and K – Armed Bandit Problem, Case study of Predicting Heart disease and kidney disease using Genetic Algorithm.	9

Course Outcomes:
Students should be able to do
1)Understand how AI can be applied to diagnosis of diseases.
2) Describe different evaluation models
3) Outline different Image Processing Technique
4) Analyse how to apply knowledge-based techniques to AI
5) Demonstrate the use of Genetic and Fuzzy logic in AI.

Textbooks:

1. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Eric Topol, Basic Books, 1st edition 2019.
2. Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Arjun Panesar, Apress, 1st ed. Edition, 2019.

Reference Books:

1. “Healthcare and Artificial Intelligence”, Springer, 2020

E Books / MOOCs/ NPTEL

1. https://www.coursera.org/learn/ai-for-medical-diagnosis
2. https://www.coursera.org/learn/ai-for-medical-prognosis#syllabus
3. https://www.coursera.org/learn/ai-for-medical-treatment#syllabus

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)	PSOs

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		1								2	
CO2	3	3	3	2	3								3	
CO3	3	3	2	2	3								3	
CO4	3	3	2		1								2	
CO5	3	3	3	2	3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO2	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO3	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO4	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO5	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2

ARTIFICIAL INTELLIGENCE IN AGRICULTURE
(Effective from the academic year 2023 -2024)

Course Code	21AME013	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives :

1. Define the need of AI for Agriculture
2. Illustrate the use of Computer vision in Agriculture
3. Demonstrate the various applications which require AI
4. Analysis the impact od weather changes in crops
5. Illustrate the use of computer vision in crop analysis.

Unit I	**Contact Hours**
Why we need AI in Agriculture, Opportunities and key Challenges of AI in Agriculture. Predictive analytics: Machine Learning models to track and predict impacts of weather changes, Machine Learning models for crop sustainability. Machine learning algorithms for diagnosing soil defects.	15
Unit II	
Computer vision for crop analysis, disease prediction, crop and soil health monitoring, controlling pests.	15
Unit III	
Agricultural Robotics Weed control , Crop Harvesting , Autonomous Tractors, Drones for efficient agriculture practices	09

Course Outcomes:
Students should be able to do

1. Understand need of AI for Agriculture
2. Understand the use of Computer vision in Agriculture

3. Understand the various applications which require AI
4. Describe the impact od weather changes in crops
5. Illustrate the use of computer vision in crop analysis.

Textbooks:

1. "IoT and Analytics for Agriculture", springer, 2020
2. "Artificial Intelligence for Biology and Agriculture", Springer, 1998

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3

CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3	

AUGMENTED AND VIRTUAL REALITY (Effective from the academic year 2023 -2024)			
Course Code	21AME014	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Objectives:
1) Outline the concept of virtual reality and its environment
2) Understand geometric modelling and its types
3) Describe virtual environment with linear interpolation and non-linear interpolation
4) Describe physical simulation and elastic collisions
5) Understand virtual reality applications

Unit I	**Contact Hours**
Introduction to Virtual Reality: Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics –Flight Simulation– Virtualenvironments–requirement–benefitsofvirtualreality- Historical development of VR : Introduction – Scientific Landmark -3D Computer Graphics :Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Color theory – Simple 3D modeling Illumination models – Reflection models – Shading algorithms- Radio city– Hidden Surface Removal – Realism-Stereographic image. **Geometric Modeling:** Introduction–From2Dto3D–3Dspacecurves–3Dboundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction– The virtual environment – the Computer environment – VR Technology – Model of interaction.	15
Unit II	
Virtual Environment:	15

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non- linear translation - shape & object in betweening – free from deformation – particle system **Physical Simulation:** Introduction – Objects falling in a gravitational field –Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft. **VR Hardwares:** Human factors : Introduction – the eye - the ear-the somatic senses –VR Hardware: Introduction–sensor hardware– Head-coupled displays –Acoustic hardware – Integrated VR systems	
Unit III	
VR Software: Introduction –Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML. **VR Application:** Virtual Reality Applications: Introduction – Engineering – Entertainment – Science – Training – The Future: Introduction – Virtual environments – modes of interaction.	9

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand concepts of Virtual Reality & geometric modelling
2. Build Animations and simulations for Virtual environment
3. Describe virtual environment with linear interpolation and non-linear interpolation
4. Describe physical simulation and elastic collisions
5. Develop Virtual Reality Hard ware's &Soft wares and Virtual Reality applications

Textbooks:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

Reference Books:

1. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill,2000.
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, 2nd Edition,2006.
3. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application, and Design", Morgan Kaufmann,2008

E Books / MOOCs/ NPTEL:

1) https://www.udemy.com/topic/virtual-reality/ -Virtual reality
2) https://www.udemy.com/course/augmented_reality_with_unity/ Augmented reality

Table 1: Mapping Levels of COs to POs														
COs	**Program Objectives (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3

AUTONOMOUS SYSTEMS
(Effective from the academic year 2023-2024)

Course Code	21AME015	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:

At the completion of syllabus students will be able to :

1. Illustrate the fundamentals of autonomous systems versus robots.
2. Illustrate the fundamentals of robotics and its applications.
3. Analyze operation of industrial robots.
4. Understand the programming and design of an autonomous robot.
5. Learn the required components to implement an autonomous drone.

Unit I	**Contact Hours**
Introduction What are autonomous systems?, Examples of autonomous systems, Sensors and fusion, Autonomous system software architecture, Software foundation for safe systems, AI in autonomous systems, Autonomous systems vs robots. **Introduction to robots** Introduction, Definition, Types of robots, Automation and robotics, Advantages and disadvantages, The grand challenges in robotics, Overview of robots, The characteristics and application of the present robots (industrial), Advanced technological features of the modern robots, Needs for robots, The characteristics and applications of future Industrial robot.	15
Unit II	
Structure of robotic system Anatomy of a robot, classification of robots, robot configurations-Advantages, robotic system, joints in robots, robot specifications, robot drive system (actuators) in brief.	15

Sensors in robots Terminology, Sensors that measure the robot's joint configuration, What is Robot Sensor: Working & Its Applications. **Operation, programming and path planning of robots** Types of industrial robot and their methods of operation- Pick and place manipulators, Point to point robots, Continuous path robots, Path planning in robots: Algorithms used in robotics and industrial automation, Path planning, Overview of path planning algorithms used by robots, Programming languages for Robots.	
Unit III	
Introduction to Drones Unmanned Aerial Vehicles, Classification of UAVs, Physical structure of a drone, Advantages and disadvantages, Applications of drones. **Flight Mechanics** Forces acting on a drone, Flight mechanism, Degrees of a freedom of a quadcopter **Drone Electronics** Frame, Motor, Propeller, Electronic speed controller, Flight controller, GPS module, Battery, Radio transmitter, Radio receiver, Communication protocols-PWM,PPM	9
Course Outcomes: Upon completion of this course, students will be able to: 1. Complete understanding fundamentals of autonomous systems versus robots. 2. Understanding the fundamentals of robotics and its applications. 3. Analyze operation and control of industrial robots. 4. Understand the programming and design of an autonomous robot. 5. Understand design, and implement an autonomous drone.	
Textbooks: 1. Industrial Robotics: by Ganesh S. Hegde, 2nd edition, Laxmi publications,2015. 2. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms by Nikolaus Correll, Bradley Hayes, Christoffer Heckman, and Alessandro Roncone, 2021 3. Syed Omar Faruk Towaha, "Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266" Packt Publishing, 2018.	

Reference Books:

1. Intelligent Autonomous Systems Foundations and Applications by Pratihar, Dilip Kumar, Springer, 2010.
2. Fundamentals of Robot Technology: An Introduction to Industrial Robots, Teleoperators and Robot Vehicles by D J Todd, Springer, 2012.
3. Neeraj Kumar Singh, Porselvan Muthukrishnan, Satyanarayana Sanpini, "Industrial System Engineering for Drones: A Guide with Best Practices for Designing", Apress, 2019.
4. Aron Asadi, "Drones The Complete Manual. The essential handbook for drone enthusiasts", Imagine Publishing Limited, 2016.

E Books / MOOCs/ NPTEL

1. http://polypedal.berkeley.edu/wp-content/uploads/eaar7650.full_.pdf
2. https://cfdflowengineering.com/working-principle-and-components-of-drone/
3. https://www.dummies.com/article/technology/electronics/circuitry/radio-electronics-transmitters-and-receivers-179838/

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2		1								2	
CO2	3	2	2	2	1								2	
CO3	3	3	3	2	3								2	
CO4	3	3	3	3	3								3	
CO5	3	3	3	3	3								3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1	L2

CO2	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO3	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO4	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L3
CO5	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L3

BIG DATA ANALYTICS (Effective from the academic year 2023 -2024)			
Course Code	21AME016	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Objectives:
The students should be able to
1. Understand basic terminologies used in data analytics.
2. understand and apply big data flow to actual projects
3. apply data analytics life cycle to big data projects.
4. identify and successfully apply appropriate techniques
5. tools to solve big data problems.

Unit I	Contact Hours
Overview of Big Data: Big data, Defining big data, Growth of and digitization of Global Information Storage Capacity, Big data types, Analytics, Industry Examples of Big data, Big data technologies, The evolution of big data architecture, Selecting big data technology, The Benefits of big data(Text Book 1). **Basics of Hadoop:** Big data and Hadoop, Architecture of Hadoop, Main components of Hadoop framework, Analysing big data with Hadoop, Distributed application concept: Comparison between Hadoop and RDBMS, Hadoop clustering, YARN, The Map Reducer's Engine, Advantages of Hadoop, Hadoop security concerns, Hadoop Streaming: Basics. (Text Book 1). **Hadoop Distributed File System:** HDFS**,** Architecture of Apache, Other file systems, HDFS File Blocks, HDFS File commands: cat, chgrp, chmod, chown, count, cp, ls, rm, mkdir (Text Book 1).	15
UNIT II	

NO SQL Data management and MONGODB: NO SQL Data Management, Types of NO SQL databases, Benefits of No SQL(Text book 1) MongoDB: What, Why- Replication, Sharding, Terms used in RDBMS and MongoDB, Data types in MongoDB (Text Book 2), Advantages of MongoDB over RDBMS (Text book 1) **HBASE and CASSANDRA:** Introduction to HBase, Row-oriented vs column oriented data stores, HDFS vs HBase, HBase architecture, HBase Performance, Understanding HBase model (Text book 1) **Cassandra**: Introduction, Features of Cassandra, Data replication in Cassandra, Components of Cassandra ,Cassandra Data model, Data models of Cassandra and RDBMS (Text book 1), CQL Data types, CQLSH, Keyspaces (Text book 2) **MAP REDUCE:** Introduction to Map Reduce-5 steps, How Map reduce works, What is map operations, What is reduce operations, Submitting a map reduce job.(Text book 1)	15
Unit III	
Introduction to Hive-Define, features, architecture, Hive data models, Hive building blocks, Hive data file formats (Text Book 1). Hive data types, Basics of HQL(Text Book 2) **PIG: The higher level programming environment:** Introduction to pig, Components of Pig, Pig program execution modes, Data formats and models, Other capabilities, pig v/s map reduce, Difference between hive and pig(Text Book 1).	9
Course Outcomes: At the end of the course student will be able to: 1.Understand and apply big data flow to actual projects as well as apply data analytics life cycle to big data projects. 2. Apply appropriate techniques and tools to solve big data problems 3. Understand various clustering techniques used for unsupervised data modelling. 4. Describe big data and use cases from selected business domains 5. Explain NoSQL big data management and understand the usage of Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics	

Textbooks:

1. V.K. Jain, Big Data & Hadoop, Khanna Book Publishing Co., Delhi. (ISBN 978-93-82609-131),2017
2. Seema Acharya, Subhashini Chellappan, "Big Data Analytics", Wiley Publications, 2nd Edition, 2019.

Reference Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to data Science and its applications", Wiley publications, 2014.
2. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2003.
3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2020.
4. Jeeva Jose, Beginner's Guide for Data Analysis using R Programming, Khanna Book Publishing House, 2019.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley, 2012.

E Books / MOOCs/ NPTEL

1. ftp://public.dhe.ibm.com/software/pdf/at/SWP10/Big_Data_Analytics.pdf
2. https://www.wileyindia.com/big-data-analytics-2ed.html
3. https://www.coursera.org/specializations/big-data
4. nptel.ac.in/courses/106104135/48

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		1								2	
CO2	3	3	3	2	3								3	
CO3	3	3	2	2	3								3	
CO4	3	3	2		1								2	
CO5	3	3	3	2	3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level

CO1	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO2	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO3	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO4	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO5	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2

BIO INFORMATICS

(Effective from the academic year 2023 -2024)

Course Code	21AME017	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives

1. Understand the concepts of bioinformatics
2. Identify different types of biological sequence
3. Analyse multiple sequences and find conserved regions
4. Understand RNA and Protein folding
5. Learn the algorithm for protein folding.

Unit I	**Contact Hours**

Bioinformatics and Computational Biology, Nature & Scope of Bioinformatics. The central dogma of molecular biology and bio-sequences associated with it, RNA classification –coding and non coding RNA- mRNA, tRNA, miRNA and sRNA, RNAi. DNA and RNA structure – Nucleic Acid structure and function, Genetic Code, Genes and Evolution Importance of databases - Biological databases-primary sequence databases, Composite sequence databases- Secondary databases- nucleic acid sequence databases - Protein sequence data bases - structure databases, Types of databases, Data retrieval tools - Entrez	15
Unit II	
Sequence alignment – local/global, pairwise sequence alignment, scoring methods. Needleman and Wunsch algorithm, global and local alignments. Multiple sequence alignment. Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. Differences between distance & similarity matrix. Introduction, Advantages, Phylogenetic Trees, Tree topologies, Methods for phylogenetic analysis- Distance Matrix methods, Character based methods. HMM (Hidden Markov Model): Introduction to HMM, Forward algorithm, Viterbi algorithm, applications in Bioinformatics	15
Unit III	
General introduction to Gene expression in prokaryotes and eukaryotes Protein and RNA structure Prediction: Predicting RNA secondary structure - Nussinov Algorithm, Energy minimisation methods - Zuker Algorithm. Amino Acids, Polypeptide Composition, Protein Structures, Algorithm for protein folding, Structure prediction **Course Outcomes:** **Upon completion of this course, students will be able to:** **6.** Understand the concepts of bioinformatics **7.** Identify different types of biological sequence **8.** Analyse multiple sequences and find conserved regions **9.** Understand RNA and Protein folding **10.** Learn the algorithm for protein folding.	09
Textbooks: 1. S C Rastogi, N Mendiratta and P Rastogi, " Bioinformatics: Methods and Applications" ,New Delhi,2015. 2. D E Krane and M L Raymer, Fundamental Concepts of Bioinformatics, 2006.	

Reference Book:

1.Andreas D.Baxevanis, B F Francis Ouellette, "Bioinformatics - A Practical Guide to theAnalysis of Genes and Proteins", Third Edition,

2. Neil C Jones and Pavel A Pevzner, An Introduction to Bioinformatics Algorithms, MITpress, 2004.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		1								2	
CO2	3	3	3	2	3								3	
CO3	3	3	2	2	3								3	
CO4	3	3	2		1								2	
CO5	3	3	3	2	3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO2	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO3	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,	L2

		2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2		
CO4	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3	
CO5	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2	

BLOCKCHAIN TECHNOLOGY (Effective from the academic year 2023 -2024)			
Course Code	21AME018	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1) Understand the basic concepts of block chain technology
2) Outline the concept of block chain currency
3) Learn about decentralization in block chain technology
4) Outline the concept of smart contract
5) Learn about Hyperledger

Unit I	**Contact Hours**
Introduction: What Is the Blockchain? What is Bitcoin? The Connected World and Blockchain: The Fifth Disruptive Computing Paradigm, Tiers of blockchain technology, Features of a blockchain, Types of blockchain. Benefits and limitations of blockchain: Technical Challenges, Business Model Challenges, Scandals and Public Perception, Government Regulation Overall: Decentralization Trends Likely to Persist. **Blockchain Currency:** Technology Stack: Blockchain, Protocol, Currency, The Double-Spend and Byzantine Generals' Computing Problems, how a Cryptocurrency Works, how blockchain works? How blockchain accumulates blocks? **Consensus:** Consensus mechanism, Types of consensus mechanisms, Consensus in blockchain, CAP theorem and blockchain	15

(Test Book 1 : Chapter 1,6 Textbook 2 : Chapter)	
Unit II	
Decentralization: Decentralization using blockchain, Methods of decentralization, How to decentralize, Computing power and decentralization, DO, DAO,DAC,DAS,Dapps, **Ethereum and Smart Contracts:** Definition, Ricardian contracts, Deploying smart contracts on a blockchain, Ethereum Blockchain, Ethereum Network, Components of the Ethereum, ecosystem, Ether cryptocurrency, Introducing Solidity, Global Variables and Functions, Expressions and Control Structures, Writing Smart Contracts, Truffle Basics and Unit Testing, Debugging Contracts Remix IDE: Programs execution. ***(Textbook 2: Chapter 1,2,9,10 Textbook 3: Chapter 3,4,5,6,9,10)***	15
Unit III	
Hyperlegder: Fabric, The reference architecture, Requirements and design goals of Hyperledger Fabric, Membership services, Blockchain services, Components of the fabric, Chain code implementation, The application model, Consensus in Hyperledger Fabric, The transaction life cycle in Hyperledger Fabric ***(Textbook 2: Chapter 15)***	9
Course Outcomes: Upon completion of this course, students will be able to: 1. Understand the basic concepts of block chain and bit coin technology 2. Describe crypto currency and its usage 3. Describe about decentralization in block chain technology 4. Analyse the concept of smart contract 5. Analyse block chain services, applicational models	

Textbooks:

1) Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017

Reference Books:

1. Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016
2. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017
3. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

MOOC/NPTEL

1. https://onlinecourses.nptel.ac.in/noc22_cs44/preview - Blockchain and its application-

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1										2	
CO2	2	2	1										2	
CO3	2	2	1										2	
CO4	2	2	1										2	
CO5	2	2	1										2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3	1.1.1, 1.2.1, 1.2.3, 2.2.1, 3.1.1	L2
CO2	PO1, PO2, PO3	1.1.1, 1.2.1, 1.2.3, 2.2.1, 3.1.1	L2

CO3	PO1, PO2, PO3	1.1.1, 1.2.1, 1.2.3, 2.2.1, 3.1.1	L2
CO4	PO1, PO2, PO3	1.1.1, 1.2.1, 1.2.3, 2.2.1, 3.1.1	L2
CO5	PO1, PO2, PO3	1.1.1, 1.2.1, 1.2.3, 2.2.1, 3.1.1	L2

BUSINESS INTELLIGENCE

(Effective from the academic year 2023 -2024)

Course Code	21AME019	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives

1. Identify the source and distinguish the data based on its type for a business application.
2. Identify various roles In a BI application and Design the ETL process for handling the data from a given application.
3. Apply the data warehousing concepts for a business application and Design a star / snowflake schema for a multi dimensional data of a given problem.
4. Illustrate the data mining concepts and association rules with suitable examples.
5. Apply classification, prediction and clustering concepts to various applications.

Unit I	**Contact Hours**
INTRODUCTION TO BUSINESS INTELLIGENCE: Types of digital data; Introduction to OLTP, OLAP and Data Mining; BI Definitions & Concepts; Business Applications of BI; BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles &Responsibilities. Basics of Data Integration (Extraction Transformation Loading); Concepts of data integration; Need and advantages of using data integration; Introduction to common data integration approaches;	15

Introduction to data quality, data profiling concepts and applications, Data Warehouse and OLAP Technology – Definition, A Multidimensional Data Model, Concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema; **Unit II**	
Data Warehouse Architecture. Introduction to data and dimension modelling, multidimensional data model, ER Modelling vs. multi dimensional modelling; Introduction to business metrics and KPIs; Introduction to enterprise reporting; Concepts of dashboards, balanced scorecards; Applications of Data mining and Case studies of BI. Data Mining — On What Kind of Data? Data Mining Functionalities - What Kinds of Patterns Can Be Mined? Mining Association rules: Basic concepts, frequent item set mining methods. Definitions of classification, prediction and clustering; **Unit III**	16
Classification and Prediction - Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Prediction, Cluster Analysis - Types of Data in Cluster Analysis, Hierarchical Methods.	08
Course Outcomes: Upon completion of this course, students will be able to: 6. Identify the source and distinguish the data based on its type for a business application. 7. Identify various roles In a BI application and Design the ETL process for handling the data from a given application. 8. Apply the data warehousing concepts for a business application and Design a star / snowflake schema for a multi dimensional data of a given problem. 9. Illustrate the data mining concepts and association rules with suitable examples. 10. Apply classification, prediction and clustering concepts to various applications. **Textbooks:** 1. R N Prasad and Seema Acharya, “Fundamentals of Business Analytics”, Wiley-India,2011 2. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, 3. Morgan Kaufmann Publishers, (ISBN: 1-55860-489-8), 2000. 4. David Loshin, “Business Intelligence -The Savvy Manager's Guide”, Morgan Kaufmann Publishers,2003.	
Reference Books: 1. Carlo Vercellis“Business Intelligence Datamining and Optimization for DecisionMaking”,Wiley,2009 2. Uddagiri Chandrasekhar, S. K. Shinde,”Data Mining and Business Intelligence”, DreamtechPress,2015.	

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

CLOUD COMPUTING
(Effective from the academic year 2023 -2024)

Course Code	21AME020	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Unit I	Contact Hours
Erasofcomputing,Parallelvs.DistributedComputing,ElementsofParallel Computing-(Whatisparallelcomputing,hardwarearchitectureforParallel processing, approaches to parallel programming, levels of parallelism, Laws of caution). Elements of Distributed Computing- (General concepts anddefinitions,componentsofadistributedsystem,Architecturalstylesfor distributed computing, models for inter-process communication, Technologies for distributed computing-Remote procedure call, Service oriented computing). Classic data center, its elements, challenges and benefits. Data center managementStepsintransitioningtocloud-consolidation,automation,IT as a service. Cloud computing Architecture: - Introduction, Cloud reference models- (Architecture, Infrastructure/Hardware as a service, Platform as a service, Software as a service), Types of cloud – (Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds),Economics of cloud ,Open challenges.	15
Unit II	
Virtualization: – Introduction, characteristics of virtualized environments, taxonomy of virtualization technique- (execution of virtualization, other types of virtualization-Compute, Storage, Network, Desktop, Application). Virtualization and cloud computing, Pros and Cons of virtualization, Technology examples- XEN, VMware, Microsoft Hyper-V. Security Concerns, Risk Issues:- Cloud Computing- Security Concerns. A Closer Examination: Virtualization, A Closer Examination: Provisioning. Securing the Cloud: Key Strategies and Best Practices: - Overall Strategy: Effectively Managing Risk-Risk Management: Stages and Activities. Overview of Security Controls, Cloud Security Controls Must Meet Your Needs, NIST Definitions for Security Controls, Unclassified Models, Classified Model The Cloud Security Alliance Approach. The Limits of Security Controls - Security Exposure Will Vary over Time, Exploits Don’t Play Fair. Best Practices: Best Practices for Cloud	15

Computing- First Principals, Best Practices across the Cloud Community .Other Best Practices for Cloud Computing- Cloud Service Consumers, Cloud Service Providers. Security Monitoring.

Unit III

The Purpose of Security Monitoring, Transforming an Event Stream, The Need for C.I.A. in Security Monitoring, the Opportunity for MaaS. 09

Case studies: Public cloud- AWS, Windows Azure, Google App Engine. Private Cloud- Open stack, Eucalyptus.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Define the concept of cloud computing business need and various networkingmethods.
2. Express the infrastructure management for cloudenvironment.
3. Practice the Virtualization at all levels using technology XEN, Vmware, MicrosoftHyper-v.
4. Explain the security concepts in cloud computing and securing the cloud.
5. Practice the case studies of public cloud such as AWS, GoogleApp Engine and private cloud such as OpenStack.

Textbooks:

1. Buyya, Rajkumar, Christian Vecchiola and ThamaraiSelvi, "Mastering Cloud Computing Fundamentals and Applications Programming", McGraw Hill,2013.
2. G, Somasundarm and Alok Srivatsa, "Information Storage and Managemnt.", EMC Education Services, Wiley Publishing Inc., 2009.
3. Sitaram, Dinakar and Geetha Manjunath,"Moving to the Cloud - DevelopingAppsintheWorldofCloudComputing",Elsevier,2012.
4. Sosinsky, Barrie,"Cloud Computing Bible.", Wiley India Pvt.Ltd , 2013.
5. Winkler, Vic(J.R), "Securing the Cloud - Cloud Computer Security Techniques and Tactics.",ElsevierInc,2012.

Reference Books:

1. Hurwitz, Judith, "Cloud computing for dummies." ,Wiley India Pvt Ltd,2011.
2. Rittinghouse, John, "Cloud computing – implementation, management and security", CRC Press, First edition,2009.
3. Velte, Toby, AnthonyVelteand Robert Elsenpete "Cloud Computing, APracticalApproach.", Tata McGraw-Hill Authors, 2010.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

COMPILER DESIGN (Effective from the academic year 2023 -2024)			
Course Code	21AME021	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

This Course will enable students to

1. Outline lexical analysis, use of regular expressions, transition diagrams, scanner- generator tools and context free grammars.
2. Get the idea of major parsing techniques top-down (recursive-descent, LL(1)) and Bottom up parsers.
3. Discuss LR parsers using items sets and parsing tables.
4. Make use of the principal ideas in syntax-directed definitions, syntax-directed translations and intermediate code representations for assignment statements and boolean expressions.
5. Describe how to construct the basic blocks from intermediate code, code optimization techniques and code generation algorithm.

Unit I	Contact Hours
INTRODUCTION: A Simple Compiler, The Phases of a Compiler. **LEXICAL ANALYSIS:** Lexical Analysis, Input Buffering, Specifications of Tokens, Recognition of Tokens, A Language for Specifying Lexical Analyzer, LEX programming. **SYNTAX ANALYSIS:** Context-free Grammars, ambiguity **SYNTAX ANALYSIS:** The Role of the Parser, Top-down Parsing: No recursive Predictive parsing, LL (1) grammars, Bottom-up Parsing: shift reduce conflicts.	15
Unit II	

SYNTAX ANALYSIS: Introduction to LR Parsers –Simple LR (SLR), LR (0) item set, LR (1) item set, Canonical LR (CLR), Look Ahead LR (LALR) Parsers, YACC programming. **SYNTAX-DIRECTED DEFINITIONS** Constructions of Syntax Trees, Bottom-up Evaluation of S-attributed definitions, L-attributed definitions. **INTERMEDIATE CODE GENERATION:** Intermediate Languages, Assignments, Boolean Expressions	15
Unit III	
Target Machine, Basic blocks and Flow graphs, Next-use information, A Simple Code Generator, Register Allocation and Assignment, The DAG representation of Basic Blocks Introduction, The Principle of Optimization, Optimization of Basic Blocks, Loops in flow graphs.	09
Course Outcomes: Upon completion of this course, students will be able to: **1. Explain** the various phases of compiler **Build** the regular expressions and transition diagrams by applying the knowledge of finite automata. **Develop and Implement** tokenizer using high level programming language and LEX Tool **2. Develop** top down parsers by applying the knowledge of context free grammar and parsing algorithms. **3. Construct** LR item sets by applying the knowledge of Closure and Go to functions. **Make use of** SLR, CLR and LALR parsing tables to parse the language constructs. **Design and Implement** parser using high level programming language and YACC Tool. **4.** Illustrate Syntax-Directed translation scheme for engineering problems. Apply three address code representations to **generate** an intermediate code for assignment statement and Boolean expressions. **5. Build** a code generator for the intermediate code by applying the knowledge of Basic blocks, address, register descriptors and next use information. **Apply** code optimization techniques to optimize the target code.	
TEXT BOOKS: 1. Alfred W Aho, Monica S. Lam,Ravi Sethi, Jeffrey D Ullman, “Compilers- Principles, Techniques and Tools”, Addison-Wesley, Second edition, 2007.	

REFERENCE BOOKS:

1. Andrew W Apple, "Modern Compiler Implementation in C", Cambridge University Press, 1997.
2. Kenneth C Louden, "Compiler Construction Principles & Practice", Thomson Education, 1997.
3. John R. Levine, Tony Mason, Doug Brown, "LEX and YACC", O'Reilly Publication,1999.

E-Books / Online Resources:

1. https://www.tutorialspoint.com/compiler_design/index.htm
2. http://hjemmesider.diku.dk/~torbenm/Basics/basics_lulu2.pdf
3. http://cnp3book.info.ucl.ac.be/2nd/cnp3bis.pdf

MOOCs:

1. http://www.nptelvideos.in/2012/11/compiler-design.html

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		2				2	2			2	
CO2	3	2	2		2				2	2			2	
CO3	3	2	2		2				2	2			2	
CO4	3	2	2		2				2	2			2	
CO5	3	2											2	

Table 2: Mapping of Cos to PIs, Pos and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level

CO1	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 3.2.1,5.1.1, 9.1.1, 10.1.1	L2, L3
CO2	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 3.2.1,5.1.1, 9.1.1, 10.1.1	L2, L3
CO3	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3,5.1.1, 9.1.1, 10.1.1	L2, L3
CO4	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 5.1.2, 9.1.1, 10.1.1	L2, L3
CO5	1, 2	1.3.1,1.4.1, 2.1.3	L2

COMPUTER VISION WITH EMBEDDED MACHINE LEARNING (Effective from the academic year 2023 -2024)			
Course Code	21AME022	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1. To help students understand advanced deep learning models for handling images. This course also helps students to generate synthetic dataset with the help of GANs.

Unit I	Contact Hours
Introduction and Overview Introduction to Image Formation, Capture and Representation; Linear Filtering, Correlation, Convolution **Visual Features and Representations** Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc. **Visual Matching** Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow **Convolutional Neural Networks (CNNs)** Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets **Visualization and Understanding CNNs** Visualization of Kernels; Backprop-to-image/Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM,Grad-CAM, Grad-CAM++; Recent Methods (IG, Segment-IG, SmoothGrad)	15
Unit II	
CNNs for Recognition, Verification, Detection, Segmentation CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN **Recurrent Neural Networks (RNNs)** Review of RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition **Attention Models** Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers Transformer Networks **Deep Generative Models** Review of (Popular) Deep Generative Models: GANs, VAEs; Other Generative Models: Pixel RNNs, NADE, Normalizing Flows, etc	15
Unit III	
Variants and Applications of Generative Models in Vision Applications: Image Editing, Inpainting, Super resolution, 3D Object Generation, Security; Variants: Cycle GANs, Progressive GANs, Stack GANs, Pix2Pix, etc **Recent Trends**	9

Zero-shot, One-shot, Few-shot Learning; Self-supervised Learning; Reinforcement Learning in Vision; Other Recent Topics and Applications	

Course Outcomes:

Upon completion of this course, students will be able to:

6. Understand basic Computer Vision concepts.
7. Apply complex deep learning models to real-life problems and datasets
8. Create synthetic datasets with the help of GANs.
9. Use of transfer learning for image classification.
10. Use of LSTM for image captioning.

Textbooks:

1. Programming Computer Vision with Python: Techniques and Libraries for Imaging and Retrieving Information by Jan Erik Solem, O'Reilly, 2012
2. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi.

Reference Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
2. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
3. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016
5. Michael Nielsen, Neural Networks and Deep Learning, 2016
6. Yoshua Bengio, Learning Deep Architectures for AI, 2009
7. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
8. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
9. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
10. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
11. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2

CO1	3	2	2		1								2	
CO2	3	2	2	2	1								2	
CO3	3	3	3	2	3								2	
CO4	3	3	3	3	3								3	
CO5	3	3	3	3	3								3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1	L2
CO2	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO3	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO4	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L3
CO5	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L3

CRYPTOGRAPHY AND CYBER SECURITY (Effective from the academic year 2023 -2024)			
Course Code	21AME023	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 4			

Course Learning Objectives:
This Course will enable students to:

1. Analyze the principles and underlying mathematical theory of cryptography and classical encryption techniques.
2. Select appropriate data encryption techniques and apply them to solve a given problem.
3. Get the idea of various public key cryptosystems.
4. Analyze the fundamentals of cyber security and its essentials.
5. Describe various actions and motivations of attackers, involved in the cyber threat.

Unit I	**Contact Hours**
Classical Encryption Techniques: Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad. **Block Ciphers and The Data Encryption Standard:** Traditional block Cipher structure, stream Ciphers and block Ciphers, DES, Block cipher design principles, number of rounds, Design of function F, key schedule algorithm, AES algorithm introduction. **Public-Key Cryptography and RSA:** Principles of Public-key cryptosystems. Public-key cryptosystems. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA.	15
Unit II	

Other Public-Key Cryptosystems: Diffie-Hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, Elliptic curve cryptography, Analog of Diffie-Hellman key exchange, Elliptic curve encryption/decryption. **Cyber Security Fundamentals:** Information Assurance Fundamentals: Authentication, Authorization, Nonrepudiation, Confidentiality, Integrity, Availability; Basic Cryptography; Symmetric Encryption: Example ofSimple Symmetric Encryption with Exclusive OR (XOR) and Improving upon Stream Ciphers withBlock Ciphers; Public Key Encryption; The Domain Name System (DNS) : Security and the DNS; Firewalls: History Lesson, What's in a Name? Packet-Filtering Firewalls, Stateful Firewalls,Application Gateway Firewalls	15
Unit III	
Attacker Techniques And Motivations: How Hackers Cover Their Tracks (Antiforensics): How and Why Attackers Use Proxies, Types of Proxies, Detecting the Use of Proxies, Tunneling Techniques - HTTP, DNS, ICMP, Intermediaries, Steganography, and Other Concepts, Detection and Prevention; Fraud Techniques : Phishing, Smishing, Vishing, and Mobile Malicious Code - Mobile Malicious Code, Phishing against Mobile Devices; Rogue Antivirus - Following the Money: Payments; Click Fraud - Pay-per-Click, Click Fraud Motivations, Click Fraud Tactics and Detection. Threat Infrastructure: Botnets, Fast-Flux, Advanced Fast-Flux.	9
Course Outcomes: Upon completion of this course, students will be able to: 1. Comprehend the cryptography techniques. 2. Apply the Knowledge of number theory in public key crypto systems. 3. Analyze and determine various public key cryptosystems. 4. Explain the requirements of the cyber security and various methods to provide the security to the computer networks. 5. Determine the various actions and motivations of attackers, involved in the cyber threat.	
Textbooks: 1. William Stallings: Cryptography and Network Security, Pearson 6th Edition, 2013. 2. Cyber security essentials --Edited by James Graham, Richard Howard, Ryan Olson, publication: CRC press, Taylor and Francis group, 2011.	
Reference Books: 1. V K Pachghare: Cryptography and Information Security, PHE, 2013.	

2. Yuri Diogenes, Erdal Ozkaya, “Cybersecurity - Attack and Defense Strategies: Infrastructure security with Red Team and Blue Team tactics (Kindle Edition)”.
3. Joseph carson, “Cybersecurity for Dummies”, CISSP
4. Scott Augenbaum, “The Secret to Cybersecurity A Simple Plan to Protect Your Family and Business from Cybercrime”.
5. Cyber Security –Nina godbole, Sunit Belapure, Publication: John Wiley, 2012.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	3	1								2	
CO2	3	3	2	3	1								2	
CO3	3	3	2	2	1								2	
CO4	3	2	1		1								2	
CO5	3	3	1		1								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom’s Taxonomy Level
CO1	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L3
CO3	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L2
CO4	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2	L2

		5.1.1,5.2.1,5.2.2,5.3.1		
CO5	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2	

CYBER FORENSICS

(Effective from the academic year 2023 -2024)

Course Code:	**21AME024**	**Course Type**	**PCC**
Teaching Hours/Week (L: T: P)	**3:0:0**	**Credits**	**03**
Total Teaching Hours	**39+0+0**	**CIE + SEE Marks**	**50+50**

Teaching Department: Computer Science and Engineering

Course Objectives:

1. To understand the basics of Cyber Forensics.
2. To understand and analyze forensic data.
3. To analyze network logs.
4. To study cyber laws.
5. To apply cyber forensic skills to find out malicious users.

UNIT-I — **15 Hours**

Digital forensic evidence collection and processing Framework, Fundamentals of end point forensics for Microsoft windows - Kernel and device driver architecture, Registry, Auditing and security architecture. File system handling - Reconstruction of files and directory structures on the FAT and NTFS.

Fundamentals of host forensics for Unix derivatives - Linux operating system, Kernel and device drives architecture, Security and audit mechanisms, File system and pseudo file systems, Reconstruction of file and directory structures using UFS and EXT2/3/4 file systems as exemplars.

UNIT-II — **15 Hours**

Forensic analysis of database systems, Database tampering, Forensic analysis of database components, Table storage, Transaction logs, indexes, Forensic recovery for table storage.

Network device forensics, investigating logs, Network traffic and web attacks.

UNIT-III — **09 Hours**

Investigation of Mobile device, Social media and wireless forensics, Steganography and image file forensics, Email investigation. Cyber laws in India, Case studies and tools.

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

1. Understand how to perform cyber forensic on Windows devices.
2. Understand how to perform cyber forensic on Linux devices.
3. Demonstrate how to capture and analyze network traffic.
4. Demonstrate how to create a forensic report.
5. Understand Cyber Laws and latest Cyber Forensic use cases.

Course Outcomes Mapping with Program Outcomes & PSO

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	3	1								2	
CO2	3	3	2	3	1								2	
CO3	3	3	2	2	1								2	
CO4	3	2	1		1								2	
CO5	3	3	1		1								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L3
CO3	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,5.1.1,5.2.1,5.2.2,5.3.1	L2
CO4	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO5	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2

TEXT BOOKS:

1.	Digital Forensics and Incident Response: Incident response techniques and procedures to respond to modern cyber threats, 2nd Edition by Gerard Johansen
2.	Brian Carrier, File System Forensic Analysis, Pearson, 2006.
3.	E. Casey, Handbook of Digital Forensics and Investigation, Academic Press, 2010

REFERENCE BOOKS:

1.	Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations by Niranjan Reddy

DATA AND VISUAL ANALYTICS IN AI (Effective from the academic year 2023 -2024)			
Course Code	21AME025	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 4			

Course Learning Objectives:-
The student will be able to understand techniques and algorithms for creating effective visualizations based on principles from graphic design. They will also be introduced to several industry-standard software tools to create a compelling and interactive visualization of various types of data.

Unit I	**Contact Hours**
Introduction: Data for Graphics, Design principles, Value for visualization, Categorical, time series, and statistical data graphics, Introduction to Visualization Tools. **Graphics Pipeline and Aesthetics and Perception:** Introduction, Primitives: vertices, edges, triangles, Model transforms: translations, rotations, scaling, View transform, Perspective transform, window transform, Graphical Perception Theory, Experimentation, and the Application, Graphical Integrity, Layering and Separation, Color and Information, Using Space.	15
Unit II	
Visualization Design: Visual Display of Quantitative Information, Data-Ink Maximization, Graphical Design, Exploratory Data Analysis, Heat Map. **Multidimensional Data and Interaction:**	15

Query, Analysis and Visualization of Multi-Dimensional Relational Databases, Interactive Exploration, tSNE, Interactive Dynamics for Visual Analysis, Visual Queries, Finding Patterns in Time Series Data, Trend visualization, Animation, Dashboard, Visual Storytelling	
Unit III	
Collaboration: Graph Visualization and Navigation, Online Social Networks, Social Data Analysis, Collaborative Visual Analytics, Text, Map, Geospatial data	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the key techniques used for visualization of categorical, time series and statistical data.
2. Understand the theory used in visualization, including data models, graphical perception, and techniques for visual encoding and interaction.
3. Apply knowledge to a number of common data domains and corresponding analysis tasks, including multivariate data, networks, text, and cartography.
4. Describe big data and use cases from selected business domains.
5. Explain NoSQL big data management and other technologies such as Hadoop and HDFS

Textbooks:

1. The Visual Display of Quantitative Information by E. Tufte, Graphics Press, 2nd Edition, 2001
2. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Publishing 2019.

Reference Books:

1. Data Visualization Handbook by J. Koponen, J. Hildén, CRC Press, 2019
2. The Book of Trees: Visualizing Branches of Knowledge by M. Lima, Princeton Architectural Press, 2014
3. Handbook of Graph Drawing and Visualization by R. Tamassia, CRC Press, 2013
4. Interactive Data Visualization for the Web by S. Murray O'Reilly Press, 2nd Edition, 2017

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	2	2									
CO2	3	3	1											
CO3	3	3	3	2	2									
CO4	3	3	3	2	2									
CO5	3	2	3	2	3									

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO3, PO4, PO5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO2	PO1, PO2, PO3	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2	L2
CO3	PO1,PO2,PO3,PO4, PO5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO4	PO1.PO2.PO3.PO4.PO5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO5	PO1.PO2.PO3.PO4.PO5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2

DATA MINING AND DATA WAREHOUSING (Effective from the academic year 2023 -2024)			
Course Code	21AME026	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

Demonstrate Storing voluminous data for online processing, Preprocess the data for mining applications
2. Apply the association rules for mining the data
3. Design and deploy appropriate classification techniques
4. Cluster the high dimensional data for better organization of the data
5. Discover the knowledge imbibed in the high dimensional system

Unit I	**Contact Hours**
Introduction and Data Preprocessing: Why data mining, What is data mining, What kinds of data can be mined, What kinds of patterns can be mined. Data Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization. Data warehousing and online analytical processing: Data warehousing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data warehouse design and usage, Data warehouse implementation,	15
Unit II	
Classification: Basic Concepts: Basic Concepts, Decision tree induction, Bays Classification Methods, Rule-Based classification, Model evaluation and selection, Techniques to improve classification accuracy Cluster Analysis: Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods,	16
Unit III	

Data mining trends and research frontiers: Mining complex data types, other methodologies of data mining, Data mining applications, Data Mining and society.	08

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate Storing voluminous data for online processing, Preprocess the data for mining applications
2. Apply the association rules for mining the data
3. Design and deploy appropriate classification techniques
4. Cluster the high dimensional data for better organization of the data
5. Discover the knowledge imbibed in the high dimensional system

Textbooks:

1. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining Concepts and Techniques, ELSEVIER(MK) 3rd edition 2012

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3

CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

DISTRIBUTED SYSTEMS

(Effective from the academic year 2023 -2024)

Course Code	21AME027	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:

This Course will enable students to:

1. Identify the issues involved in designing distributed systems.
2. Describe various synchronization methods of distributed methods.
3. Analyze process migration approach and distributed deadlock management.
4. Describe features distributed shared memory and file system.
5. List and describe load balancing mechanisms in distributed systems.

Unit I	Contact Hours
Introduction to distributed systems: Fundamentals: -What is Distributed Computing Systems? Distributed Computing System Models, what is DOS? Issues in designing a DOS. Remote Procedure Calls: The RPC model, Transparency of RPC, Implementing RPC mechanism, Stub generation, RPC messages, Marshaling Arguments and results. Server management, Parameter passing semantics, call semantics, communication protocols RPC's. Complicated RPCs,Client –server binding, Exception handling, Security. Synchronization in distributed Systems: Clock synchronization – logical clocks – physical clocks – clock synchronization algorithms, Mutual exclusion – A centralized algorithm – A distributed algorithm – a token ring algorithm, Comparison of the three algorithms, Election algorithms – the Bully algorithm – ring algorithm.	15
Unit II	
Synchronization in distributed Systems: Dead locks in distributed systems – distributed deadlock avoidance algorithms – distributed deadlock prevention algorithms, distributed deadlock detection algorithms: Centralized approach, Hierarchical approach and Fully distributed approach.	15

Process Migration: Desirable Features of a Good Migration Mechanism, Process Migration Mechanisms, Threads: Introduction, Motivation for using Threads, Models for Organizing Threads, Issues in Designing Threads Package, Implementing Thread Package. Distributed Shared Memory: General structure, Design and implementation issues of DSM, Granularity, Structure of shared memory space, Consistency Models, Replacement Strategy, Thrashing.	
Unit III Distributed File Systems: Desirable features of a good distributed file system, file models, file accessing models, file sharing semantics, file Replication. Resource Management: Desirable features, task management approach, load balancing approach, load sharing approach. Naming: Introduction, Desirable Features of Good Naming System, System-Oriented Names, Object-Location Mechanism, Human Oriented Names, Name Cache.	09
Course Outcomes: Upon completion of this course, students will be able to: 1. Determine the benefits and issues involved in designing distributed systems. 2. Explain various synchronization methods of distributed methods. 3. Compare various process migration approaches and distributed deadlock management approaches. 4. Apply features of distributed shared memory and file system. 5. Describe load balancing mechanisms in distributed systems.	
Textbooks: 1. Pradeep K Sinha," Distributed Operating Systems, Concepts & Design", PHI,2009.	
Reference Books: 1. Lampson (Ed), Distributed Systems, Singer – Verlay NY 1981. 2. Mukesh Singhal, Niranjan G,"Advanced Concepts in Operating Systems", Tata McGraw-Hill Education, 2001. **E-Books / Online Resources:** 1. http://www.gecg.in/papers/ds5thedn.pdf 2. http://cs-www.cs.yale.edu/homes/aspnes/classes/465/notes.pdf **MOOCs:** 1. nptel.ac.in/courses/117102060/ 2. https://www.coursera.org/learn/distributedsystem.	

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1		1								2	
CO2	3	3	1		1								2	
CO3	3	2	1		1								2	
CO4	3	2	1		1								3	
CO5	3	2	2		1								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO3	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO4	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO5	P1, P2,P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2

FULL STACK DEVELOPMENT (Effective from the academic year 2023 -2024)			
Course Code	21AME028	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1. Design static and modern web pages using HTML5, Cascading Style Sheets (CSS) and Bootstrap.
2. Develop client-side validations using JavaScript.
3. Develop the server-side script using PHP.
4. Design the server-side database using MySQL
5. Develop the interactive web application using NodeJS framework and MongoDB.

Unit I	**Contact Hours**
Basics of Html5, Css and Javascript: Overview of HTML5, HTML5 elements, Introduction to CSS, Levels of style sheets, The Box Model, The basics of Javascript, General syntactic characteristics, Event Handling. **Bootstrap** What is Bootstrap? Why use Bootstrap? Where to get Bootstrap? Bootstrap CDN, First Web Page with Bootstrap, Bootstrap Grid system, Contextual Colors and Backgrounds, Bootstrap Tables, Bootstrap Images, Bootstrap Jumbotron and Page Header, Bootstrap Wells, Bootstrap Alerts, Bootstrap Buttons, Bootstrap Badges and Labels, Bootstrap Progress Bars, Bootstrap List Groups, List Group with Badges, Tabs, Tabs with Dropdown Menu, Pills, Bootstrap Navigation Bar, Bootstrap Forms, Bootstrap Form Inputs, Bootstrap Media Objects, Bootstrap Carousel Plugin.	15
Unit II	
Introduction to Php:	15

Origins and uses of PHP, Overview of PHP, General syntactic characteristics, Primitives, Operations and Expressions, Output, Control statements, Arrays, Functions, Pattern Matching, Form handling, Files, Cookies, Session tracking, Database access with PHP and MySQL.	
Unit III	
NodeJS: Introduction to Node.js- Installing Node.js - Node.js Modules, Node.js File System, Node.js URL Module, Node.js NPM, Node.js Events, Node.js Upload Files, Node.js Email. **NodeJS MySQL**- Create Database, Create Table, Insert into, select from, Where, Order by, Delete, Drop Table, Update, Limit, Join. **Introduction to Mongo DB**- Node.js MongoDB, Create Database, Create Collection, Insert, Find, Query, Sort, Delete, Drop Collection, Update, Limit, Join	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Describe the fundamental features of HTML5, CSS and Bootstrap and Design static web pages.
2. Design and Implement the client-side validations using JavaScript.
3. Illustrate the concept of PHP and Develop the server-side script using PHP.
4. Design the server-side database using MySQL
5. Develop the interactive web application using NodeJS framework and MongoDB.

Textbooks:

1. Robert W. Sebesta, “Programming the World Wide Web”, Fourth Edition, Pearson, 2014.
2. Jake Spurlock, “Bootstrap-Responsive Web Development”, O’Reilly publications, 2013.
3. Ari Lerner, Ng-book, “The complete book on Angular JS”, 2013.
4. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer Paperback – Import, 20 November 2018.
5. David Herron, Node.js Web Development: Server-side web development made easy with Node 14 using practical examples, 5th Editio, 2020

Reference Books:

1. M. Deitel, P.J. Deitel, A. B. Goldberg," Internet & World Wide Web: How to Program, 4e Paperback – 1 January 2009.
2. Chris Bates,"Web Programming Building Internet Applications", Third Edition, Wiley India, 2006.

E Books / MOOCs/ NPTEL:

1. https://www.cs.uct.ac.za/mit_notes/web_programming.html
2. http://www.multitech.ac.ug/uploads/IntroductiontoWebProgramming.pdf
3. https://www.w3schools.com/php/
4. https://www.w3schools.com/bootstrap/

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1		1								2	
CO2	3	3	1		1								2	
CO3	3	2	1		1								2	
CO4	3	2	1		1								3	
CO5	3	2	2		1								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO3	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO4	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO5	P1, P2,P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2

FUNDAMENTALS OF IMAGE PROCESSING (Effective from the academic year 2023 -2024)			
Course Code	21AME029	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:
The students will be

1. Understand the basic terminologies of Image Processing
2. able to work with images and videos in several ways.
3. pre-processing steps for complex models. Students will
4. understand the basic image processing operations that
5. enables them to develop various vision based models.

Unit I	**Contact Hours**
Image representation and analysis Introduction to computer Vision, Numerical representation of images, Image augmentation, enhancement, processing, color transforms, geometric transforms, feature recognition and extraction. **Image Segmentation** Object detection, breaking image into parts, finding contours and edges of various objects in image, Background subtraction for video.	15
Unit II	
Object Motion and tracking Tracking a single point over time, motion models to define object movement over time, analyze videos as sequences of individual image frames, methods to track a set of features over time, matching features from image frame to other, tracking a moving car using optical flow. **Robotic localization**	15

Bayesian statistics to locate a robot in space, sensor measurements to safely navigate an environment, Gaussian uncertainty, histogram filter for robot localization in python.	
Unit III	
Image Restoration Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand images and videos representation in a detailed manner.
2. Understand basic image processing and image segmentation techniques
3. Understand and apply object tracking algorithms.
4. Understand the usage of computer vision in robotics
5. Apply various image restoration techniques and algorithms

Textbooks:

1. Audio Video Systems, Bali & Bali, Khanna Book Publishing, 2020.
2. Computer vision a modern approach, Forsyth and Ponce, 2011.

Reference Books:

1. Handbook of Image and Video Processing by Alan C. Bovik, Academic Press, 2000.
2. Python 3 Image Processing, Ashwin Pajankar, BPB Publication, 2019

https://www.coursera.org/learn/image-processing

E Books / MOOCs/ NPTEL:

1. https://onlinecourses.nptel.ac.in/noc19_cs58/
2. https://www.coursera.org/learn/introduction-computer-vision-watson-opencv

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		1								2	

CO2	3	3	3	2	3								3	
CO3	3	3	2	2	3								3	
CO4	3	3	2		1								2	
CO5	3	3	3	2	3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO2	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO3	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO4	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO5	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2

GAME THEORY AND APPLICATIONS

(Effective from the academic year 2023 -2024)

Course Code	21AME030	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:

This Course will enable students to:

1. Learn the Architecture of Games Understand the association of functions, relations, partial ordered set and lattices with problems related to theoretical computer science and network models.
2. Describe the Architecture of Game Playing, Apply the use of Equilibrium in Games.
3. Study the Concepts of extensive games
4. Illustrate the mixed strictly competitive games and rationzability.
5. Explain the application of Game theory.

Unit I	Contact Hours
INTRODUCTION; STRATEGIC GAMES What is game theory? Four elements, Classification of games, The theory of rational choice; Interacting decision makers, Strategic games; Example: The prisoner's dilemma; Nash equilibrium; Examples of Nash equilibrium; Best- response functions; Dominated actions; Equilibrium in a single population: symmetric games and symmetric equilibria, Interpretation of Nash Equilibrium **Games Theory.** Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games. **MIXED STRATEGY EQUILIBRIUM** Introduction; Strategic games in which players may randomize; Mixed strategy Nash equilibrium; Finding mixed strategy by graphical method; Finding mixed strategy by analysing subset of all actions; Dominated actions; Pure equilibria when randomization is allowed, examples; The formation of players beliefs; Eliminating dominated actions, Median Voter theorem.	15

Unit II	
EXTENSIVE GAMES Extensive games with perfect information; Strategies and outcomes; Nash equilibrium; Subgame perfect equilibrium; Finding subgame perfect equilibria of finite horizon games. **EXTENSIONS** Allowing for simultaneous moves, examples, Discussion: subgame perfect equilibrium and backward induction. **STRICTLY COMPETITIVE GAMES AND MAXIMIZATION** Maximization and Nash equilibrium; Strictly Competitive Games; Maximization and Nash equilibrium in strictly competitive games **RATIONALIZABILITY** Iterated elimination of strictly dominated actions; Iterated elimination of weakly dominated actions; Dominance solvability.	16
Unit III	
APPLICATIONS OF GAME THEORY Assumptions and issues in Game theory, Mechanism design problem and examplesgametheoryandcryptography,gametheoryandwirelessAdhocnetworks,gametheoryandnetworksecurity,Paretooptimal,Selfish routing, Correlatedequilibrium **Game Theory and Adversarial Machine Learning and Its applications** Adversarial learning and its connection to game theory, Game-theoretic models for security and robustness in machine learning, Strategies for defending against adversarial attacks **Game Theory in Recommender Systems** Modelling user-item interactions as strategic games, Collaborative filtering and matrix factorization techniques, Game-theoretic approaches to recommendation generation and personalization. **Game Theory in Online Advertising** Auction mechanisms for online advertising, Sponsored search auctions and bidding strategies, Revenue optimization and game-theoretic analysis in ad platforms	08
Course Outcomes: Upon completion of this course, students will be able to: 1. Understand the Architecture ofGames 2. Analyse the Architecture of Game Playing, Apply the use of Equilibrium inGames 3. Apply the Concepts of extensive games 4. Apply the mixed strictly competitive games and rationzability. 5. Understand the application of Game theory.	
Textbooks:	

1. Martin Osborne: An introduction to game theory, Oxford University Press, Indian Edition,2004.
2. An Introduction to Game Theory: Strategy, Joel Watson, W WNorton andCompany.
3. Algorithmic Game Theory, Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V Vazirani, Cambridge UniversityPress.

Reference Book:

1. Roger B Myerson: Game theory: Analysis of Conflict, Harvard University Press, 1997.

Table 1: Mapping Levels of COs to POs
1: Low, 2: Medium, 3: High

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	3			3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2	1.1.1,1.3.1, 1.4.1, 2.1.3	L3
CO2	1,2,4	1.1.1,1.3.1,1.4.1, 2.1.3, 2.3.1, 2.4.1, 4.3.1,4.3.3,4.3.4	L4
CO3	1,2,4	1.1.1,1.3.1,1.4.1, 2.1.3, 2.3.1, 2.4.1, 4.3.1,4.3.3,4.3.4	L4
CO4	1,2,5	1.3.1, 1.4.1, 2.1.3, 5.1.1	L2
CO5	1,2,4,5	1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.4.1, 2.3.1, 2.4.1, 4.3.1, 4.3.3, 4.3.4, 5.1.1	L4

GRAPHICS AND ANIMATION (Effective from the academic year 2023 -2024)			
Course Code	21AME031	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives

1. Design and implement algorithms for 2D graphics algorithms
2. Illustrate Geometric transformations on 2Dobjects.
3. Understand the basics of computer animation
4. Analyse the different techniques in graphics
5. Demonstrate different animation technique

Unit I	Contact Hours
Introduction to Computer Graphics: Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan), Video Basics. **Scan conversion**: Digital Differential Analyzer (DDA) algorithm, Bresenhams' Line drawing algorithm. Bresenhams' method of Circle drawing, Midpoint Circle Algorithm, Midpoint Ellipse Algorithm, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Clipping Lines algorithms– Cyrus-Beck, Cohen- Sutherland and Liang-Barsky, Clipping Polygons, problem with multiple components. **Two-Dimensional Transformations**: Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, TranslationsandHomogeneousCoordinates,Rotation,Reflection,Scaling, CombinedTransformation,TransformationofPoints,TransformationofThe UnitSquare,SolidBodyTransformations,RotationAboutanArbitraryPoint, Reflection through an Arbitrary Line, A Geometric Interpretation of Homogeneous Coordinates, The Window-to-ViewportTransformations.	16

Unit II	
Visible-Surface Determination: Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison ofthemethods. **Plane Curves and Surfaces:** Curve Representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation of a Parabola, Parametric Representation of a Hyperbola, Representation of Space Curves, Cubic Splines, Bezier Curves, B-spline Curves, Bezier Surfaces.	15
Unit III	
Computer Animation: Principles of Animation, Key framing, Deformations, Character Animation, Phsics-Based Animation, Procedural Techniques, Groups of Objects. **Image Manipulation and Storage:** What is an Image? Digital image file formats, Image compression standard – JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization, smoothing and median Filtering.	08
Course Outcomes: Upon completion of this course, students will be able to: 1. Design and implement algorithms for 2D graphics algorithms 2. Illustrate Geometric transformations on 2Dobjects. 3. Understand the basics of computer animation 4. Analyse the different techniques in graphics 5. Demonstrate different animation technique	
Textbooks: 1. Donald D. Hearn, Warren Carithers, M. Pauline Baker. Computer Graphics with OpenGL (4e), Pearson, Education,2014. 2. Steve Marschner, Peter Shirley, Fundamentals of Computer Graphics, CRC Press, 4th Edition,2016.	
Reference Books: 1. Zhigang Xiang, Computer Graphics: Theory and Practice with OpenGL (3e), Pearson Education,2016. 2. Edward Angel, Interactive Computer Graphics- A top down approach using OpenGL (5e), Pearson Education,2012. 3. Foley J. D., Van Dam A., Feiner S. K., Hughes J. F., Computer Graphics, Principles and Practice (3e), Addision-Wesley,2014. **Table 1: Mapping Levels of COs to POs**	

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

HIGH PERFORMANCE COMPUTING
(Effective from the academic year 2023 -2024)

Course Code	21AME032	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:

1. Define the need of graphical processing unit
2. Learn the simple CUDA programs
3. Show the memory model and GPU interaction with CPU
4. Describe the use of Memory hierarchy
5. Understand the usage of tools and programming.

Unit I	**Contact Hours**
Introduction to GPU computing: Why GPU, evolution of GPU pipeline and general purpose computation on GPU, GPU architecture case studies: NVIDIAG80,GT200,Fermi,AMD Radeon, AMD Fusion APU etc. Execution Model: Features of CUDA and OpenCL, Comparison of CUDA andOpenCL,Threadorganization,Kernel,errorhandling,andexecutionin CUDA and OpenCL	15
Unit II	
Programming Model: CUDA Introduction, basics of CUDA C, Complete CUDA structure, basic details of API and libraries, OpenCL overview, OpenCL basic specification, OpenCL C language, Vectorization. **Memory Model**: Introduction to memory model and GPU interaction with CPU, Memory model of CUDA and OpenCL, Memory hierarchy (local/register, shared and global) and optimizations.	15
Unit III	
Tools and programming: Introduction to installation and compilation process, usage of tools, profilers and debuggers. CUDA by Examples and OpenCL by Examples, Future Directions.	08
Course Outcomes:	

Upon completion of this course, students will be able to:

6. Understand the need of graphical processing unit
7. Write simple CUDA programs
8. Analyse the memory model and GPU interaction with CPU
9. Describe the use of Memory hierarchy
10. Understand the usage of tools and programming.

Textbooks:

1. David B Kirk and Wen-Mei W.Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 2010.
2. Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming,2010.

Reference Books:

1. T.Mattson, etal. Patterns of Paralle lProgramming, Addison Wesley, 2005
2. NVIDIA CUDA Programming Guide V3.0,NVIDIA
3. Benedict R. Gaster, Timothy G. Mattson and James Fung, OpenCL Programming Guide by Aaftab Munshi,2011.
4. Benedict Gaster, David R. Kaeli, Lee Howes and Perhaad Mistry, Heterogeneous Computing with OpenCL,2011.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1		1								2	
CO2	3	3	1		1								2	
CO3	3	2	1		1								2	
CO4	3	2	1		1								3	
CO5	3	2	2		1								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO3	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO4	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO5	P1, P2,P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2

HUMAN COMPUTER INTERACTION (Effective from the academic year 2023 -2024)			
Course Code	21AME033	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1. Learn basics of HCI and different HCI models.
2. Understand the research methods and the guidelines to be followed in designing HCI.
3. Learn to design HCI systems.
4. Design task modelling
5. Use different techniques for cognitive architecture,

Unit I	Contact Hours
INTRODUCTION: Course Learning Objectives and overview, Historical evolution of the field. **INTERACTIVE SYSTEM DESIGN**: concept of usability -definition and elaboration, HCI and software engineering, GUI design and aesthetics, prototyping techniques. **MODEL-BASED DESIGN AND EVALUATION:** Introduction to different typesofmodels,GOMSfamilyofmodels(KLMandCMN-GOMS),Fitt'slaw and Hick-Hyman's law,Model based design case studies.	15
Unit II	
Guidelines in HCI: Shneiderman's eight golden rules, Norman's seven principles, Norman's model of interaction, Nielsen's ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry, Cognitive walk-through. **Empirical research methods in HCI**: Introduction (motivation, issues, research question formulation techniques) ,Experiment design and data analysis(with explanation of one-way ANOVA).	16

Task modeling and analysis: Introduction to formalism in dialog design, design using FSM (finite state machines),State charts and(classical) Petri Nets in dialog design.	
Unit III	
Cognitive architecture: Introduction to CA, CA types, relevance of CA in IS design ,Model Human Processor (MHP). **Design - Case Studies:** Case Study 1- Multi- Key press Hindi Text Input MethodonaMobilePhone,CaseStudy2-GUIdesignforamobilephone based Matrimonial application. Case Study 3 - Employment Information System for unorganised construction workers on a MobilePhone.	08
Course Outcomes: Upon completion of this course, students will be able to: 6. Learn basics of HCI and different HCI models. 7. Understand the research methods and the guidelines to be followed in designing HCI. 8. Learn to design HCI systems. 9. Design task modeling 1. Use different techniques for cognitive architecture,	
Textbooks: 1. Jennifer Preece, Helen Sharp and Yvonne Rogers, Interaction design: Beyond Human-Computer Interaction, 4th edition Helen Sharp, John Wiley and Sons, 2015, ISBN:978-1-119-02075-2 2. Ben Shneiderman and Catherine Plaisant, Designing the User Interface:StrategiesforEffectiveHuman-ComputerInteraction,6th Edition, Pearson,2017	

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	

CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

INTRODUCTION TO DATA SCIENCE (Effective from the academic year 2023 -2024)			
Course Code	21AME034	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Objectives:

This course will enable students to:

1. Get the idea of lookup functions and Pivot Tables
2. Illustrate the use of Data validation and Data Visualization
3. Describe the basic concepts of R programming
4. Apply the Data visualization concepts using R programs
5. Explain the concepts of data mining and types of Analytics.

Unit I	**Contact Hours**
Introduction to Data Analysis using Excel: Introduction to Data Mining, Business Intelligence, Statistical Analysis, Predictive Analytics, Text Analytics, **Data Analysis Process:** Excel Formulas and Functions — Learn with Basic Examples, Logical Functions in Excel — IF, AND, OR, Nested IF and NOT. Conditional Formatting, Sorting and Filtering, Subtotals with Ranges. **Data Quick Analysis:** Understanding Lookup Functions, PivotTables, Data Visualization, Data Validation. What-If Analysis, Importing Data into Excel, Data Model, Exploring Data with PivotTable	15
Unit II	
R Programming Basics: Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions. **Data Visualization using R:** Reading and getting data into R (External Data): Using CSV files, Excel files. **Working with R Charts and Graphs:** Histograms, Box plots, Bar Charts, Line Graphs, Scatter plots, Pie Charts.	15
Unit III	
Introduction to Data Science: Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields	9

Introduction to Data Mining: What is data mining, Challenges, Data Mining Tasks Textbook 3: Ch.1.1,1.2,1.4, 2.1 to 2.4 **Classification:** Decision Trees Induction, Rule Based Classifiers, Nearest Neighbour Classifiers, Bayesian Classifiers. K-Means., Regression Model Textbook 3: Ch 4.3,4.6,5.1,5.2,5.3	
Course Outcomes: Upon completion of this course, students will be able to: **1.** Acquire the knowledge of data analysis and carry out the data analysis process. **2.** Practice out quick data analysis, extracting data values from text. **3.** Demonstrate the export of data to excel, PivotTable **4.** Describe R basics, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, and analysis the data using different R graphs and Charts. **5.** Apply the concepts of Data science and study different data mining algorithms.	
Textbooks: **1.** Microsoft Excel 2019 Data Analysis and Business Modelling (Business Skills), 6th Edition, Wayne L Winston, ISBN-13: 978-1509305889, ISBN-10: 1509305882. **2.** Tilman M. Davies, "The Book of R: A First Course in Programming and Statistics", No Starch Press; 1st edition,2016. **3.** Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression,2014	
Reference Books: **1.** Paul Mc Fedries. Microsoft Excel 2019 Formulas and Functions (Business Skills), 1st Edition, ISBN-13: 978-1509306190, ISBN-10: 1509306196. **2.** Gil Raviv, Collect, Combine, and Transform Data Using Power Query in Excel and Power BI (Business Skills) 1st Edition, ISBN-13: 978-1509307951, ISBN-10: 1509307958. **3.** Devin Knight, Mitchell Pearson, Bradley Schacht, Erin Ostrowsky, Microsoft Power BI Quick Start Guide: Bring your data to life through data modelling, visualization, digital storytelling, and more, 2nd Edition, ISBN-13: 978-1800561571, ISBN-10: 1800561571 **4.** Andrie de Vries and Joris Meys, R for Dummies, 2nd Edition, John Wiley & Sons' 2nd edition, 2015. **5.** Hadley Wickham, Garrett Grolemund, R for data Science: Import, Tidy, Transform, Visualize, And Model Data, O'Reilly; 1st edition, 2017. **6.** Andrew Oleksy, Data Science with R: A Step by Step Guide With Visual Illustrations & Examples,	
1. Excel Skills for Data Analytics and Visualization Specialization	

https://www.coursera.org/specializations/excel-data-analytics-visualization

2. IBM Data Analytics with Excel and R Professional Certificate
   https://www.coursera.org/professional-certificates/ibm-data-analyst-r-excel
3. Introduction to Data Analysis Using Excel
   https://www.coursera.org/learn/excel-data-analysis

Table 1: Mapping Levels of COs to POs														
COs	**Program Objectives (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1										3	
CO2	3	3	1										3	
CO3	3	3	1										3	
CO4	3	3			1								3	
CO5	3	3	1		1								3	

Table 1: Mapping Levels of COs to POs														
COs	**Program Objectives (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1										3	
CO2	3	3	1										3	
CO3	3	3	1										3	
CO4	3	3			1								3	
CO5	3	3	1		1								3	

INTRODUCTION TO DRONES
(Effective from the academic year 2023 -2024)

Course Code	21AME035	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives

1. understand drone concepts and terminology
2. describe the steps for drone design;
3. Understand the technical characteristics
4. describe the process for drone fabrication
5. describe the algorithm for drone programming

Unit I	**Contact Hours**
Overview and background. Definitions. History of UAVsc. Classifications of UAVsi. Scale lift generation method contemporary applications, military. Government. civil societal impact and future outlook. Operational considerations. Liability / legal issues. Insurance. Ethical implications. human factors	14
Unit II	
Introduction to Drone Technology, Drone design and fabrication , Drone programming, Drone flying and operation, Drone accessories, Drone maintenance, Safety and Regulations, Drone commercial applications	16
Unit III	
Case studies in the drone industry to show the potential for boosting entrepreneurial spirit, Drone technology and entrepreneurship, Drone Technology as a tool for social inclusion, Future of drones	09

Course Outcomes:
Upon completion of the course students should be able to

6. understand drone concepts and terminology

7. describe the steps for drone design;
8. Understand the technical characteristics
9. describe the process for drone fabrication
10. describe the algorithm for drone programming

Textbooks:

1. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha., 2016

Reference Book:

1. Handbook of Unmanned Aerial Vehicles- Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014

Table 1: Mapping Levels of COs to POs
1: Low, 2: Medium, 3: High

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	3			3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2	1.1.1,1.3.1, 1.4.1, 2.1.3	L3
CO2	1,2,4	1.1.1,1.3.1,1.4.1, 2.1.3, 2.3.1, 2.4.1, 4.3.1,4.3.3,4.3.4	L4
CO3	1,2,4	1.1.1,1.3.1,1.4.1, 2.1.3, 2.3.1, 2.4.1, 4.3.1,4.3.3,4.3.4	L4

CO4	1,2,5	1.3.1, 1.4.1, 2.1.3, 5.1.1	L2
CO5	1,2,4,5	1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.4.1, 2.3.1, 2.4.1, 4.3.1, 4.3.3, 4.3.4, 5.1.1	L4

MICROCONTROLLERS AND EMBEDDED SYSTEMS
(Effective from the academic year 2023 -2024)

Course Code	21AME036	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:

1. To gain a thorough understanding of the design and fundamentals of ARM-based systems.
2. To program an ARM controller with a variety of instruction sets.
3. To explore the fundamentals of the embedded system's structure and determine its applicability.
4. To learn about the fundamental hardware components and choose them based on the characteristics and attributes of an embedded device.
5. To make approaches for hardware/software co-design and firmware design.

Unit I	**Contact Hours**
ARM Embedded Systems, ARM Processor Fundamentals, ARM Instruction Set, and Programming Microprocessors versus Microcontrollers. **ARM Embedded Systems**[T1-Ch1]: The RISC design philosophy[T1-1.1], The ARM Design Philosophy[T1-1.2], Embedded System Hardware[T1-1.3], Embedded System Software[T1-1.4]. **ARM Processor Fundamentals**[T1-Ch2]: Registers[T1-2.1], Current Program Status Register[T1-2.2], Pipeline[T1-2.3], Exceptions, Interrupts, and the Vector Table[T1-2.4], Core Extensions[T1-2.5]. Instructions[T1-3.2], Load-Store Instructions[T1-3.3], Software Interrupt Instructions[T1-3.4], Program Status Register Instructions[T1-3.5], Coprocessor Instructions, Loading Constants[T1-3.6]. **Writing and Optimizing ARM Assembly Code**[T1-Ch6]: Writing Assembly Code[T1-6.1], Profiling and Cycle Counting [T1-6.2], Instruction Scheduling [T1-6.3]	15
Unit II	
Embedded System Components and Applications	15

Introduction to Embedded Systems[T2-Ch1]: Embedded vs General Computing System[T2-1.2], History of Embedded Systems[T2-1.3], Classification of Embedded Systems[T2-1.4], Major Application Areas of Embedded Systems[T2-1.5], Purpose of Embedded Systems[T2-1.6]. **Typical Embedded System**[T2-Ch2]: Core of the Embedded System[T2-2.1], Memory[T2-2.2], Sensors and Actuators[T2-2.3], Communication Interface[T2-2.4], Embedded Firmware[T2-2.5], Other System Components[T2-2.6]. **Characteristics and Quality Attributes of Embedded Systems**[T2-Ch3]: Characteristics of an Embedded System[T2-3.1], Quality Attributes of Embedded Systems[T2-3.2]. **Embedded Systems – Application- and Domain-Specific**[T2-Ch4]: Washing Machine – Application-Specific Embedded System[T2-4.1], Automotive-Domain Specific Examples of Embedded System[T2-4.2]. **(T2: Chapter 1: 1.2 to 1.6, T2: Chapter 2: 2.1 to 2.6, Chapter 3:3.1, 3.2, Chapter 4:4.1, 4.2)**	
Unit III	
Embedded System Design Components and IDE **Hardware Software Co-Design and Program Modelling**[T2-Ch7]: Fundamental Issues in Hardware Software Co-Design[T2-7.1], Computational Models in Embedded Design[T2-7.2]. **Embedded Firmware Design and Development**[T2-Ch9]: Embedded Firmware Design Approaches[T2-9.1], Embedded Firmware Development Languages[T2-9.2], 'C' vs 'Embedded C[T2-9.3.1], Compiler vs CrossComplier[T2-9.3.2]. **Integration and Testing of Embedded Hardware and Firmware**[T2-Ch12]: Integration of Hardware and Firmware[T2-12.1] **The Embedded System Development Environment**[T2-Ch13]: The Integrated Development Environment (IDE-Block Diagram Only) [T2-13.1], Disassembler/ Decomplier[T2-13.3], Simulators, Emulators, and Debugging[T2-13.4]. **(T2: Chapter 7: 7.1, 7.2, Chapter 9: 9.1, 9.2, 9.3.1, 9.3.2, Chapter 12: 12.1, Chapter 13: 13.1, 13.3, 13.4)**	9
Course Outcomes: Upon completion of this course, students will be able to: 1. Describe the ARM microcontroller's architectural features and instructions. 2. Apply the knowledge gained for Programming ARM to a variety of applications. 3. Interface external devices and I/O with ARM microcontroller. 4. Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system. 5. Develop the hardware /software co-design and firmware design approaches.	
Textbooks: 1. Andrew N Sloss, Dominic Symes, and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman Publishers, 2008. 2. Shibu K V, Introduction to Embedded	

3. Systems, Tata McGraw Hill Education Private Limited, 2nd Edition

Reference Books:

1. Raghunandan G. H., Microcontroller (ARM) and Embedded System, Cengage Learning Publication, 2019.
2. The Insider's Guide to the ARM7 based microcontrollers, Hitex Ltd., 1st edition, 2005.
3. Steve Furber, ARM System-On-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

E Books / MOOCs/ NPTEL:

1. https://www.coursera.org/learn/introduction-embedded-systems
2. https://onlinecourses.nptel.ac.in/noc20_ee98/

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2								1	1		1		
CO2	2	2	2						1	1		1		
CO3	2	2	2						1	1		1	2	
CO4	2	2	2						1	1		1	3	
CO5	2	2	2						1	1		1	2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1	1.3.1,1.4.1	**L1**
CO2	1,2,3	1.3.1,1.4.1,2.2.4, 3.2.1,3.2.2,	**L3**

CO3	1,2,3	1.3.1,1.4.1,2.2.4,3.2.1,3.2.2	**L3**
CO4	1,2,3	1.4.1,1.3.1,2.3.1, .2.1,3.2.2	**L3**
CO5	1,2,3	1.3.1,1.4.1,2.1.1,3.1.1,3.2.1,3.2.2	**L4**

MOBILE APPLICATION DEVELOPMENT WITH FLUTTER (Effective from the academic year 2023 -2024)			
Course Code	21AME037	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1. Learn about the features and installation of Flutter
2. Learn about the basic programming constructs of Dart
3. Develop simple mobile applications in Flutter using Dart language
4. Develop mobile applications using database Connections
5. Construct Flutter application using database

Unit I	**Contact Hours**
Introduction to Flutter Features of Flutter- Advantages of Flutter, Disadvantages of Flutter, Flutter Installation - Installation in Windows, Installation in Mac OS, Creating Simple Application in Android Studio, Architecture of Flutter Applications- Widgets, Gestures, Concept of State, Layers, Introduction to Dart Programming-Variables and Data types, Decision Making and Loops, Functions, Object Oriented Programming. Introduction to Widgets- Widget Build Visualization, Introduction to Layouts- Type of Layout Widgets, Single Child Widgets, Multiple Child Widgets, Advanced Layout Application, Introduction to Gestures, State Management in Flutter- Ephemeral State Management, Application State - scoped model	15
Unit II	
Animation on Flutter Navigation and Routing, Introduction to Animation Based Classes, Work flow of the Flutter Animation, Working Application, Android Specific Code on Flutter, Introduction to Package- Types of Packages, Using a Dart Package, Develop a Flutter Plugin Package, Accessing Rest API- Basic Concepts, Accessing Product service API	15
Unit III	
Database Concepts SQLite, Cloud Fire store, Internalization on Flutter- Using intl Package, Testing on Flutter- Types of Testing, Widget Testing, Steps Involved, Working Example, Deployment- Android Application, IOS Application, Flutter Development Tools- Widget Sets, Flutter Development with Visual Studio Code, Dart Dev Tools- Flutter SDK	9
Course Outcomes:	

Upon completion of this course, students will be able to:
CO1: Install Flutter in Android Studio
CO2: Build simple Flutter application using simple widgets and layouts
CO3: Build Animation on Flutter
CO4: Develop Flutter applications using Dart packages
CO5: Construct Flutter application using database

Textbooks:

1. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps 1st ed. Edition, Rap Payne, Apress publication.
2. Beginning Flutter: A Hands On Guide to App Development, Marco L. Napoli

Reference Books:

1. Flutter Application Development By Android ATC Team

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3

CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3

OPERATION RESEARCH
(Effective from the academic year 2023 -2024)

Course Code	21AME038	**CIE Marks**	
Number of Contact Hours/Week	3:0:0	**SEE Marks**	
Total Number of Contact Hours	39	**Exam Hours**	

Course Learning Objectives:

This Course will enable students to:

1. Describe the scope and limitations of OR methods and outline the role of OR techniques in supporting the decisions.
2. Explain the concept of Linear Programming Model (LPM) and formulate Linear Programming problems.
3. Describe the various methods like Simplex Method, revised simplex Method, Big M Method, Two Phase Method, Dual Simplex Method and duality theory and use it on Linear Programming Problems.
4. Describe the formulation of Transportation problems, different methods in Transportation problems like North West Corner Rule, Row minima method, Column minima method, Matrix minima method, Vogel's approximation method, U-V method and use those methods on the respective real-world problems.
5. Describe the formulation of Assignment problems, use Hungarian method in Assignment problems, CPM and PERT (project management techniques) and use it on the respective real-world problems

Unit 1	
INTRODUCTION Introduction to OR, nature and meaning, applications, modeling in OR, phases of OR study **LINEARPROGRAMMING** Introduction to Linear Programming through an example, graphical method, formulation of LP model from practical problems, assumptions and properties of linear programming, simplex method**,** Big M method, 2 phase method, Revised simplex method, Duality theory, Primal and dual relationship. ***(Text Book-1: Chapter 2,3,5,6,7,8)***	15
Unit II	
TRANSPORATION PROBLEMS Transportation problems, methods to find initial feasible solution and modification to obtain optimal solution (Degeneracy in transportation problems, unbalanced transportation problems	15

ASSIGNMENTPROBLEM Mathematical formulation of an assignment problem, unbalanced assignment problem, Travelling Salesman Problem (TSP), Hungarian method. ***(Text Book-1: Chapter 15,16)***	
Unit III	
CPM, PERT Representation of a project by a network, activities and events, starting times, finishing times, floats, slacks, CPM, Idea of crashing probabilistic times and PERT analysis ***(Text Book-1: Chapter 31)***	9
Course Outcomes: At the end of the course the student will be able to: **1.** **Describe** the basics of OR, modelling and applications of OR and the linear programming model. **2.** **Construct** linear programming problem and apply methods like Simplex method, revised simplex method, Big M method, 2 phase method and Dual simplex method **to solve** the different use cases of linear programming problem. **3.** Apply the North West Corner Rule, Row minima method, Column minima method, Matrix minima method, Vogel's approximation method and U-V method to **solve** the Transportation Problems. **4.** Apply the Hungarian method to solve the Assignment Problems and Travelling Salesman Problems. **5.** Apply the CPM and PERT project management techniques on the respective use cases to **solve** the problems related to the use cases.	
TEXTBOOK: 1. Operations Research, S. D. Sharma, 17th Revised edition,2014. **REFERENCE BOOKS:** 1. Operations Research,Er. Premkumar Gupta,Dr. D.S. Hira, 4th edition, 2015. 2. Introduction to Operations Research - A Computer Oriented Algorithmic Approach, Gillelt B G, McGraw Hill, 2008. 3. Operations Research – An introduction, Hamdy A Taha, PHI, 8th edition,2007. **E-Books / Online Resources:** 1. https://www.tutorialspoint.com/linear_programming/index.asp	

2. https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf
3. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html

MOOCs:

1. Fundamentals of Operations Research IIT Madras Course, Prof. G. Srinivasan:https://swayam.gov.in/

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

PATTERN RECOGNITION (Effective from the academic year 2023 -2024)			
Course Code	21AME039	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives

1. Recall the basics of pattern recognition systems and Bayesian Decision Theory.
2. Determine the maximum likelihood and Bayesian parameter estimation.
3. Express the nonparametric techniques such as density estimation and nearest neighbour estimation.
4. Examine linear discriminant functions, minimizing the perception criterion function and minimum squared-error procedure
5. Describe the various unsupervised learning and clustering methods.

Unit I	**Contact Hours**
Introduction: Machine Perception, Pattern Recognition systems, Design cycle, learning and adaptation Bayesian Decision Theory: Introduction, Bayesian Decision theory – continuous features, classifiers, discriminant functions, and decision surfaces ,normal density and discriminant functions, Bayes decision theory–discrete features. Maximum likelihood and Bayesian parameter estimation: Introduction, maximum likelihood estimation, Bayesian Estimation, Bayesian parameter estimation, problem of dimensionality, sufficient and exponential family, complex analysis & discriminants.	15
Unit II	
Nonparametric Techniques: Introduction, Density Estimation, Parzen Windows,kn-nearestneighbourestimation,nearestneighbourrule,metrics andnearest-neighbourclassification,fuzzyclassification,reducedcoulomb energy, approximations by series expansions. **Linear discriminant functions**: Introduction, linear discriminant functions, generalized linear discriminant functions, minimizing the Perceptron criterion function, relaxation procedures, non separable behaviours, minimum squared-error procedures, Ho-Kashyap procedures.	15
Unit III	

Unsupervised learning and clustering: Mixture densities and identifiability,maximum-likelihoodestimates,applicationtonormalmixtures, unsupervised Bayesian learning, data decryption and clustering, criterion functions and clustering, hierarchical clustering, on-line clustering. Component analysis, low-dimensional representations and multidimensional calling.	09

Course Outcomes:

Upon completion of this course, students will be able to:

6. Recall the basics of pattern recognition systems and Bayesian Decision Theory.
7. Determine the maximum likelihood and Bayesian parameter estimation.
8. Express the nonparametric techniques such as density estimation and nearest neighbour estimation.
9. Examine linear discriminant functions, minimizing the perception criterion function and minimum squared-error procedures
10. Describe the various unsupervised learning and clustering methods.

Textbooks:

1. Richard O. Duda, Peter E. Hart and David G Stork," Pattern Classification", John Wiley &Sons, Inc.2nd Ed.2001.
2. Robert Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley &Sons,Inc.1992.

Reference Books:

1. Christopher M. Bishop, "Pattern recognition and machine learning (information science and statistics).", Springer - Verlag New York Inc, 2006.
2. Anzai,Yuichiro,"Pattern recognition and machinelearning",Elsevier, 2012.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

PROMPT ENGINEERING (Effective from the academic year 2023 -2024)			
Course Code	21AME040	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

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

1. Understand the details on transformers and BERT models
2. Analyze how pretrained models work
3. Apply prompt engineering with GPT3 and optimizing LLMs
4. Illustrate the advanced prompt engineering
5. Learn about hugging face and hugging face library

Unit I	**Contact Hours**
Introduction to Transformers: Motivation behind transformers, Self-attention mechanism, Transformer architecture and components **Pretrained language models (PLMs):** Introduction to PLMs, Transformer based models: BERT, Fine tuning, and transfer learning with PLMs **Introduction to Large language models:** What are large language models, Popular modern LLMs, Domain specific LLMs, Applications of LLMs	15
Unit II	

Prompt Engineering with GPT3: Introduction, Prompt engineering, working with prompts across models, Building Q/A bot with GPT **Optimizing LLMs with Customized Fine Tuning:** Introduction, Transfer learning and fine tuning, OpenAI Fine tuning API, Amazon Review category classification **Advanced Prompt Engineering:** Introduction, Prompt engineering, Introduction, Prompt injection attacks, Input/Output Validation, Batch Prompting, Prompt Chaining, chain of thought prompting, Testing and Iterative prompt development.	15
Unit III	
Hugging Face: Introduction, Features of hugging face platform, Components of hugging face, Pipelines **Tasks using hugging face library:** Introduction to Gradio, Creating a space on hugging face, Hugging face tasks.	09
Course Outcomes: Upon completion of this course, students will be able to: 6. Learn details on transformers and BERT models 7. Illustrate how pretrained models work 8. Apply prompt engineering with GPT3 and optimizing LLMs 9. Describe advanced prompt engineering 10. Learn about hugging face and hugging face library	
Textbooks: 1. "Quick Start Guide to Large Language Models: Strategies and Best Practices for using ChatGPT and Other LLMs" by Sinan Ozdemir, O'reilly publications, October 2023 2. "Introduction to Transformers for NLP: With the Hugging Face Library and Models to Solve Problems" by Shashak mohan Jain, O'reilly publications, October 2022	

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		2				2	2			2	
CO2	3	2	2		2				2	2			2	

CO3	3	2	2		2				2	2			2	
CO4	3	2	2		2				2	2			2	
CO5	3	2											2	

Table 2: Mapping of Cos to PIs, Pos and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 3.2.1,5.1.1, 9.1.1, 10.1.1	L2, L3
CO2	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 3.2.1,5.1.1, 9.1.1, 10.1.1	L2, L3
CO3	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3,5.1.1, 9.1.1, 10.1.1	L2, L3
CO4	1, 2, 3, 5, 9, 10	1.3.1,1.4.1, 2.1.3, 5.1.2, 9.1.1, 10.1.1	L2, L3
CO5	1, 2	1.3.1,1.4.1, 2.1.3	L2

SEMANTIC WEB

(Effective from the academic year 2023 -2024)

Course Code	21AME041	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Unit I	**Contact Hours**
Web Intelligence: Thinking and Intelligent Web Applications, The Information Age,The World Wide Web, Limitations of Today's Web, The NextGenerationWeb,MachineIntelligence,ArtificialIntelligence,Ontology, Inference engines, Software Agents, Semantic Road Map, Logic on the semanticWeb. **KnowledgeRepresentationfortheSemanticWeb:**Ontologiesandtheir role in the semantic web, Ontologies Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XMLSchema.	16
Unit II	
Ontology Engineering: Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines. **Semantic Web Applications, Services and Technology:** Semantic Web applications and services, Semantic Search, e-learning,	15
Unit III	
Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods,	08

Course Outcomes:

Upon completion of this course, students will be able to:

1. To learn Web Intelligence
2. To learn Knowledge Representation for the Semantic Web
3. To learn Ontology Engineering
4. To learn Semantic Web Applications, Services and Technology

To learn Social Network Analysis and semantic web

Textbooks:

1. Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science,2008.
SocialNetworksandtheSemanticWeb,PeterMika,Springer,2007.

Reference Books:

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
2. Semantic Web and Semantic WebServices-Liyang LuChapman and Hall/CRC Publishers,(Taylor &FrancisGroup)
3. Information sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.
4. Programming the Semantic Web,T .Segaran ,C.Evans,J.Taylor, O'Reilly, SPD.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

SOCIAL AND WEB ANALYTICS (Effective from the academic year 2023 -2024)			
Course Code	21AME042	**CIE Marks**	50
Number of Contact Hours/Week	**3:0:0**	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 1			

Course Learning Objectives:

1. Understand social media, web and social media analytics, and their potential impact.
2. Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics
3. Use various data sources and collect data relating to the metrics and key performance indicators
4. Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators
5. Use ready-made web analytics tools (Google Analytics) and be able to understand a statistical programming language (R), also use its graphical development environment (Deduce) for data exploration and analysis.

Unit I	**Contact Hours**
Introduction to web and social analytics: Overview of web & social media (Web sites, web apps, mobile apps and social media), Impact of social media on business, Social media environment, how to leverage social media for better services, Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages. Need of using analytics, Web analytics technical requirements., current analytics platforms, Open Source vs licensed platform, choosing right specifications & optimal solution, Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes Relevant Data And its Collection using statistical Programming language R.:Data (Structured data, unstructured data, metadata, Big Data and Linked Data), Participating with people centric approach, Data analysis basics (types of data, metrics and data, descriptive statistics, comparing, Basic overview of R:R-Data Types, R-Decision Making, R-Loops, R-functions, R-Strings, Arrays, R-Lists, R-Data Frame, R-CSV Files, R-Pie Charts, R-Bar charts, R-Barplots. Basic Text Mining in R and word cloud.	15
Unit II	

Kpi/Metrics: Understand the discipline of social analytics, aligning social objectives with business goals, identify common social business objectives, developing KPIs; Standard vs Critical metrics. PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical Issues, HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behavior issues; Bounce rate, exit rate, conversion rate, engagement, strategically aligned KPIs, Measuring Macro & micro conversions, On-site web analytics, off-site web analytics, the goal-signal-metric process. Case study on Ready-made tools for Web and social media analytics (Key Google Analytics metrics, dashboard, social reports, Tableau Public and KNIME **Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More:** Why Is Twitter All the Rage?, Exploring Twitter's API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analyzing the 140 Character, Extracting Tweet Entities, Analyzing Tweets and Tweet Entities with Frequency Analysis, Computing the Lexical Diversity of Tweets, Examining Patterns in Retweets, Visualizing Frequency Data with Histograms.	15
Unit III	
Mining Facebook: Analyzing Fan Pages, Examining Friendships, and More: Overview, Exploring Facebook's Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analyzing Social Graph Connections, Analyzing Facebook Pages, Examining Friendships. **Data Mining in Social Media: Introduction**, Data Mining in a Nutshell, Social Media, Motivations for Data Mining in Social Media, Data Mining Methods for Social Media, Data Representation, Data Mining - A Process, Social Networking Sites: Illustrative Examples, The Blogosphere: Illustrative Examples, Related Efforts, Ethnography and Netnography, Event Maps **Text Mining in Social Networks** Introduction, Keyword Search, Query Semantics and Answer Ranking, Keyword search over XML and relational data, Keyword search over graph data, Classification Algorithms, Clustering Algorithms, Transfer Learning in Heterogeneous Networks	9
Course Outcomes: Upon completion of this course, students will be able to: 1. Use Social Media Analytics and Web analytics, 2. Explain how to leverage social media for better services. 3. Develop KPIs and to build scorecards & dashboards to track KPIs. 4. Understand text mining and data mining in social networks. 5. Use ready-made web analytics tools (Google Analytics) and be able to understand a statistical programming language (R), also use its graphical development environment (Deduce) for data exploration and analysis	

Textbooks:

2. Matthew A. Russell," Mining of Social web, O'Reilly", Second Edition, ISBN-13: 978-1449367619, 2013,
3. Charu C Agarwal, "Social Network Data Analytics", Springer; October 2014.

Reference Books:

1. Hand, Mannila, and Smyth. "Principles of Data Mining", Cambridge, MA: MIT Press, 2001. ISBN: 026208290X.
2. Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity", John Wiley & Sons; Pap/Cdr edition (27 Oct 2009).
3. Tom Tullis, Bill Albert, "Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics", Morgan Kaufmann; 1 edition (28 April 2008).
4. Jim Sterne, "Social Media Metrics: How to Measure and Optimize Your Marketing Investment", John Wiley & Sons (16 April 2010).
5. Brian Clifton, "Advanced Web Metrics with Google Analytics", John Wiley & Sons; 3rd Edition

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2							1	1		1	1	1
CO2	2	2							1	1		1	1	1
CO3	1	2							1	1		1	2	1
CO4	2	2							1	1		1	1	1
CO5	2	2							1	1		1	3	2

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2	1.3.1, 1.4.1, 2.2.5	L2

CO2	1,2	1.3.1, 1.4.1, 2.2.5	L2
CO3	1,2	1.3.1, 1.4.1, 2.1.3,	L2
CO4	1,2	1.3.1, 1.4.1, 2.1.3,	L3
CO5	1,2	1.3.1, 1.4.1, 2.1.3, 2.2.5	L3

SOFT COMPUTING

(Effective from the academic year 2023 -2024)

Course Code	21AME043	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:

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

1. Understand basics of the constitutes and applications Soft Computing
2. Perform reproduce operations like mutations and crossover
3. Illustrate the concepts of neural networks.
4. Analyze the fuzzy member ship functions and models
5. Understand decision making strategies to real world examples

	Contact Hours
Unit I	
INTRODUCTION TO SOFT COMPUTING: Evolution of Computing, Soft and Hard Computing, Soft Computing characteristics, Constituents and Applications, AI Definitions and Intelligent systems architecture. **GENETIC ALGORITHMS:** Introduction to Genetic Algorithms (GA) – Conceptual GA algorithm, Reproduction operators Mutation and cross over, Applications of GA, Learning Definitions, strategies, Machine Learning Approach, applications and Architecture of learning agent	16
Unit II	
NEURAL NETWORKS : Introduction to Neural Networks, Applications, Structure and function of Biological Neuron, ANN introduction, Perceptron, Multi-layer feed forward Networks with Back propagation **FUZZY LOGIC:**	15

Fuzzy Sets, Operations on Fuzzy Sets, Membership Functions, Fuzzy Rules, Models, Fuzzy Reasoning and Fuzzy Inference Systems.

Unit III

DECISION MAKING AND EXPERT SYSTEMS: 08

Single person, multi person, Multi criteria and Multi stage decision making, Expert system features, architecture and applications

Course Outcomes:

1. Upon completion of this course, students will be able to:
2. Explain the constitutes and applications Soft Computing
3. Perform reproduce operations like mutations and crossover
4. Demonstrate the concepts of neural networks.
5. Explain the fuzzy member ship functions and models
6. Apply decision making strategies to real world examples

Textbooks:

1. Jyh-ShingRogerJang,Chuen-TsaiSun,EijiMizutani,"Neuro-Fuzzy and Soft Computing", Prentice-Hall of India,2003.
2. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications",Prentice Hall,1995.
3. James A. Freeman and David M.Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edition.,2003.
4. Simon Haylion "Neural Networks", Prentice-Hall of India,2003.

Reference Books:

2. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall,1998.
3. DavidE.Goldberg,"GeneticAlgorithmsinSearch,Optimizationand Machine Learning", Addison Wesley,1997.
4. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer,2007.
5. S. N. Sivanandam, S. N. Deepa,"IntroductiontoGeneticAlgorithms", Springer,2007.
6. Jacek M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishers,1992.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	2110	11	12	1	2

CO1	3	2	2		1								2	
CO2	3	3	3	2	3								3	
CO3	3	3	2	2	3								3	
CO4	3	3	2		1								2	
CO5	3	3	3	2	3								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO2	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO3	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2
CO4	PO1,PO2,PO3,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L3
CO5	PO1,PO2,PO3,PO4,PO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1, 2.1.2,2.2.1,3.1.1,3.1.2, 4.1.1,5.1.1,5.1.2	L2

SOLVE BUSINESS PROBLEMS WITH AI
(Effective from the academic year 2023 -2024)

Course Code	21AME044	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives:
This Course will enable students to:
1. Analyse the use of solving business problem with machine learning.
2. Understand the tools used in business.
3. Explain the automating customer interaction and data-based decision making.
4. Get the idea of predict the events and its outcome for business minds.
5. Describe and illustrate the idea of prompting data privacy and ethical practise.

Unit I	**Contact Hours**
Solve Business Problems with AI and Machine Learning Introduction, Identify Data-Driven Emerging Technologies Module Introduction, The Data Hierarchy, Big Data, Data Mining, Applied AI and ML in Business, Appropriate Business Problems, Challenges of AI/ML, Machine Learning Model, Machine Learning Workflow, Useful Skillsets, Concept Drift and Transfer Learning, Problem Formulation, Differences Between Traditional Programming and Machine Learning, Differences Between Supervised and Unsupervised Learning, Randomness and Uncertainty. **Machine Learning Outcomes** Overview, Guidelines for Following the Machine Learning Workflow, Guidelines for Formulating a Machine Learning Outcome, Applying AI and ML to Business Problems. **Select Appropriate Tools Module** Introduction, New Tools and Technologies, Hardware Requirements, Cloud Platforms, Overview, Open Source AI Tools, Proprietary AI Tools, GPU Platforms, Guidelines for Configuring a Machine Learning Toolset, Machine Learning Tools.	15
Unit II	
Automating Customer Interactions.	16

Choosing Natural Language Technologies, Review the Top Tools for Creating Chatbots and Virtual Agents, Chapter Takeaways, **Improving Data-Based Decision-Making** Choosing Between Automated and Intuitive Decision-Making, Gathering Data in Real Time from IoT Devices, Reviewing Automated Decision-Making Tools **Using Machine Learning to Predict Events and Outcomes** Machine Learning Is Really About Labelling, Data Looking at What Machine Learning Can Do, Predict What Customers Will Buy. Answer Questions Before They're Asked, Make Better Decisions Faster, Replicate Expertise in Your Business, Use Your Power for Good, Not Evil: Machine Learning Ethics. **Harnessing the Power of Natural Language Processing** Extracting Meaning from Text and Speech with NLU, Delivering Sensible Responses with NLG, Automating Customer Service, Reviewing the Top NLP Tools and Resources. **Building Artificial Minds** Separating Intelligence from Automation, Adding Layers for Deep Learning, Considering Applications for Artificial Neural Networks, Classifying Your Best Customers, Recommending Store Layouts , Analysing and Tracking Biometrics, Reviewing the Top Deep Learning Tools.	
Unit III **Promote Data Privacy and Ethical Practices** Introduction, Data Protection, Data Privacy Laws, Privacy by Design, Data Privacy Principles at Odds with Machine Learning, Compliance with Data Privacy Laws and Standards*5m*Data Sharing and Privacy, The Big Data Challenge, Preconceived Notions, The Black Box Challenge, Bias, Prejudice, and Discrimination, Ethics in NLP, Use of Data for Unintended Purposes, Intellectual Property, Humanitarian Principles, Asilomar AI Principles **Data Privacy** Overview, Guidelines for Protecting Data Privacy, Guidelines for Promoting Ethical Practices, Privacy and Data Governance for AI and ML, Guidelines for Establishing Policies Covering Data Privacy and Ethics.	08
Course Outcomes: Upon completion of this course, students will be able to: 1. Identify the source for solving business problems and machine learning outcome. 2. Identifythe tools used in business. 3. Applythedataidea of predict the events and its outcome for business. 4. Illustrate the idea of predict the events and its outcome for business minds	

Apply idea of prompting data privacy and ethical practise.

Textbooks:

1. Doug Rose “Artificial Intelligence for Business , What we need to do know about machine learning “ , 2nd edition Pearson.

Applied Artificial Intelligence: A Handbook for Business Leaders" by Mariya Yao, Adelyn Zhou, and Marlene Jia.

Reference Books:

1. Prediction Machines: The Simple Economics of Artificial Intelligence by Ajay Agrawal, Joshua Gans, and Avi Goldfarb.
2. The AI Advantage: How to Put the Artificial Intelligence Revolution to Work" by Thomas H. Davenport.

MOOC :

1. https://www.coursera.org/learn/solve-problems-ai-machine-learning

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	
CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom’s Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

SPEECH PROCESSING
(Effective from the academic year 2023 -2024)

Course Code	21AME045	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning objectives

1. Learn the speech production system and describe the fundamentals of speech
2. Understand the different speech parameters.
3. Describe an appropriate statistical speech model for a given application.
4. Study the speech recognition system.
5. Understand the different speech synthesis techniques

Unit I	**Contact Hours**
BASIC CONCEPTS Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods. MFCC vectors -Acoustic Likelihood Computation -Evaluation. Triphones – Discriminative Training -Modelling Variation. Computational Phonology- Finite-State Phonology –Computational Optimality Theory -Syllabification -Learning Phonology and Morphology□.	15
Unit II **Speech Analysis**: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.	16

SPEECH MODELING
Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, and Implementation issues.

Unit III

Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody, Applications and present status

08

Course Outcomes:
Upon completion of the course, students will be able to:
1. Model speech production system and describe the fundamentals of speech.
2. Extract and compare different speech parameters.
3. Choose an appropriate statistical speech model for a given application.
4. Design a speech recognition system.
5. Use different speech synthesis techniques

Textbooks:
1. Lawrence RabinerandBiing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2.Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education

Reference Book:
1.Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
2.Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2								2	
CO2	3	2			2								2	
CO3	3	2			2								2	
CO4	3	2			2								2	

CO5	3	2			2								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3, 5.1.1	L3
CO2	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO3	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO4	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1	L3
CO5	PO1, PO2, PO5	1.3.1,1.4.1, 2.1.2, 3.1.1,3.1.2,3.1.3,5.1.1, 5.3.1	L3

SYSTEM MODELLING AND SIMULATION
(Effective from the academic year 2023 -2024)

Course Code	21AME046	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

	Contact Hours
Unit I	
Introduction: When simulation is the appropriate tool and when it is not appropriate, Advantages and disadvantages of Simulation; Areas of application, Systems and system environment; Components of a system; Discrete and continuous systems, Model of a system; Types of Models, Discrete-Event System Simulation Simulation examples: Simulation of queuing systems. General Principles. **Statistical Models in Simulation**: Review of terminology and concepts, Useful statistical models, Discrete distributions. Continuous distributions, Poisson process, Empirical distributions. **Queuing Models:** Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems, Long-run measures of performance of queuing systems, Steady-state behavior of M/G/1 queue, Networks of queues,	15
Unit II	
Random-Number Generation: Properties of random numbers; Generation of pseudo-random numbers, Techniques for generating random numbers, Tests for Random Numbers, **Random-VariateGeneration:**,Inverse transform technique Acceptance-Rejection technique. **Input Modeling:** Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models.	15
Unit III	
Estimation of Absolute Performance: Types of simulations with respect to output analysis, Stochastic nature of output data, Measures of performance and their estimation, Measures of performance and their estimation, Output analysis for terminating simulations, Output analysis for steady-state simulations.	09

Verification, Calibration And Validation: Optimization: Model building, verification and validation, Verification of simulation models, Verification of simulation models, Calibration and validation of models, Optimization via Simulation.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the system concept and apply functional modeling method to model the activities of a static system
2. Describe the behavior of a dynamic system and create an analogous model for a dynamic system;

Simulate the operation of a dynamic system and make improvement according to the simulation results.

Textbook:

Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5 th Edition, Pearson Education, 2010.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2		1								2	
CO2	3	2	2	2	1								2	
CO3	3	3	3	2	3								2	
CO4	3	3	3	3	3								3	
CO5	3	3	3	3	3								3	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2,3,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1	L2
CO2	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2	L2

		4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	
CO3	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L2
CO4	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L3
CO5	1,2,3,4,5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 4.1.1,4.1.2,4.2.1,4.3.1,5.1.1,5.2.1	L3

TEXT MINING

(Effective from the academic year 2023 -2024)

Course Code	21AME047	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Course Learning Objectives

1. Design text extraction techniques.
2. Design clustering techniques for text.
3. Design classification techniques for text
4. Practice visualization methodologies using tools.
5. Practice feature extraction using tools

	Contact Hours
Unit I	
Text Extraction Text Extraction: Introduction, Rapid automatic keyword extraction: candidate keywords, keyword scores, adjoining keywords, extracted keywords, Benchmark evaluation: precision and recall, efficiency, stoplist generation, Evaluation on new articles. Clustering Clustering: Multilingual document clustering: Multilingual LSA, Tucker1 method, PARAFAC2 method, LSA with term alignments, LMSA, LMSA with term alignments.	15
Unit II	
Classification: Content-based spam email classification using machine-learning algorithms, Utilizing nonnegative matrix factorization for email classification problems, Constrained clustering with k-means type algorithms. Anomaly and trend detectionAnomaly and trend detection: Text Visualization techniques such as tag clouds, authorship and change tracking, Data Exploration and the search for noval patterns, sentiment tracking, visual analytics and FutureLens, scenario discovery, adaptive threshold setting for novelty mining.	16
Unit III	
Text streams Text streams: Introduction, Text streams, Feature extraction and data reduction, Event detection, Trend detection, Event and trend descriptions, Embedding semantics in LDA topic models: Introduction, vector space modeling, latent semantic	08

analysis, probabilistic latent semantic analysis, Latent Dirichlet allocation, embedding external semantics from Wikipedia, data-driven semantic embedding.

Course Outcomes:

Upon completion of this course, the students will be able to:

6. Design text extraction techniques.
7. Design clustering techniques for text.
8. Design classification techniques for text
9. Practice visualization methodologies using tools.

Practice feature extraction using tools

Textbooks:

1. Michael W. Berry & Jacob Kogan ,"Text Mining Applications and Theory", Wiley publications.

Aggarwal, Charu C., and ChengXiangZhai, eds. Mining text data. Springer Science & Business Media, 2012.

Reference Book:

1. Miner, Gary, et al. Practical text mining and statistical analysis for non-structured text data applications. Academic Press, 2012.
2.Srivastava, Ashok N., and Mehran Sahami. Text mining: Classification, clustering, and applications. Chapman and Hall/CRC, 2009.
3.Buitelaar, Paul, Philipp Cimiano, and Bernardo Magnini, eds. Ontology learning from text: methods, evaluation and applications. Vol. 123. IOS press, 2005.

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2							1	1		1	1	1
CO2	2	2							1	1		1	1	1
CO3	1	2							1	1		1	2	1
CO4	2	2							1	1		1	1	1
CO5	2	2							1	1		1	3	2

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	1,2	1.3.1, 1.4.1, 2.2.5	L2
CO2	1,2	1.3.1, 1.4.1, 2.2.5	L2
CO3	1,2	1.3.1, 1.4.1, 2.1.3,	L2
CO4	1,2	1.3.1, 1.4.1, 2.1.3,	L3
CO5	1,2	1.3.1, 1.4.1, 2.1.3, 2.2.5	L3

UNIX SYSTEM PROGRAMMING (Effective from the academic year 2023 -2024)			
Course Code	21AME048	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives:

1) Interpret the features of UNIX and basic commands.
2) Demonstrate different UNIX files and permissions
3) Implement shell programs.
4) Explain UNIX process, IPC and signals.

Unit I	Contact Hours
Introduction: UNIX and ANSI Standards: The ANSI C Standard, The ANSI/ISO C++ Standards, Difference between ANSI C and C++, The POSIX Standards, The POSIX.1 FIPS Standard, The X/Open Standards. UNIX and POSIX APIs: The POSIX APIs, The UNIX and POSIX Development Environment, API Common Characteristics. **UNIX Files and APIs:** File Types, The UNIX and POSIX File System, The UNIX and POSIX File Attributes, Inodes in UNIX System V, Application Program Interface to Files, UNIX Kernel Support for Files, Relationship of C Stream Pointers and File Descriptors, Directory Files, Hard and Symbolic Links. UNIX File APIs: General File APIs, File and Record Locking, Directory File APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs	15
Unit II	
UNIX Processes and Process Control: The Environment of a UNIX Process: Introduction, main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Shared Libraries, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions, UNIX Kernel Support for Processes. Process Control: Introduction, Process Identifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 Functions, Race Conditions, exec Functions, Changing User IDs and Group IDs, Interpreter Files, system Function, Process Accounting, User Identification, Process Times, I/O Redirection. Process Relationships: Introduction, Terminal Logins, Network Logins, Process Groups, Sessions, Controlling Terminal, tcgetpgrp and tcsetpgrp Functions, Job Control, Shell Execution of Programs, Orphaned Process Groups. **Signals and Daemon Processes:** Signals: The UNIX Kernel Support for Signals, signal, Signal Mask, sigaction, The SIGCHLD Signal and the waitpid Function, The sigsetjmp and siglongjmp Functions, Kill, Alarm, Interval Timers, POSIX.lb Timers. Daemon Processes: Introduction, Daemon Characteristics, Coding Rules, Error Logging, Client-Server Model.	15

Unit III	
Interprocess Communication: Overview of IPC Methods, Pipes, popen, pclose Functions, Coprocesses, FIFOs, System V IPC, Message Queues, Semaphores. Shared Memory, Client-Server Properties, Stream Pipes, Passing File Descriptors, An Open Server-Version 1, Client-Server Connection Functions.	9

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the basic concepts of UNIX Architecture, File system and basic commands.
2. Understand the basic file system commands, concepts of Shell programming.
3. Describe the concepts UNIX API's and process control.
4. Explain the concepts of process accounting, User identification and different IPC mechanisms.
5. Understand signal handling mechanism, daemon characteristics, coding rules and error logging.

Textbooks:

1. Unix System Programming Using C++ - Terrence Chan, PHI, 1999.
2. Advanced Programming in the UNIX Environment - W.Richard Stevens, Stephen A. Rago, 3nd Edition, Pearson Education / PHI, 2005.

Reference Books:

1. Advanced Unix Programming- Marc J. Rochkind, 2nd Edition, Pearson Education, 2005.
2. The Design of the UNIX Operating System - Maurice.J.Bach, Pearson Education / PHI, 1987.
3. Unix Internals - Uresh Vahalia, Pearson Education, 2001.

E Books / MOOCs/ NPTEL:

1) https://nptel.ac.in/courses/117106113
2) https://www.udemy.com/course/linux-system-programming/

Table 1: Mapping Levels of COs to Pos

Cos	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												2
CO2	3	2												2
CO3	3	2												2
CO4	3	2												2
CO5	3	3												2

WEB APPLICATIONS USING ML (Effective from the academic year 2023 -2024)			
Course Code	21AME049	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03
Credits – 3			

Course Learning Objectives

1. Gain technical competencies in web application development and maintenance.
2. Implement interactive web pages and apply validation checks using client side programming languages like HTML, CSS, Java Script and AngularJS.
3. Process the business data and generate responses dynamically using PHP.
4. Use web application development frameworks for designing web applications
5. Understand the IOT connectivity..

Unit I	**Contact Hours**
HTML5:Overview of HTML5, New features in HTML5, Removed elements from HTML, HTML5 Semantic elements, HTML5 input types, HTML5 new form elements and attributes, HTML5 Video and Audio. CASCADING STYLE SHEETS (CSS): Introduction, Levels of style sheets, style specification formats, selector forms, Property Value forms, Font properties, List properties, Color, Alignment of Text, The Box model, Background images, The and tags, Conflict resolution.THE BASICS OF JAVASCRIPT:Overview, Object orientation and JavaScript, General syntactic characteristics, Primitives, Operations, and Expressions, Screen output and keyboard input, control statements, Object creation and modification, Arrays, Functions, Constructors, Patterns matching using Regular Expressions, Errors in Scripts.JAVASCRIPT The JavaScript Execution Environment, The Document object model, Element access in JavaScript, Events and Event handling, Handling events from Body elements, Handling events from Button elements, Handling events from Text Box and Password elements.	15
Unit II	
IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.	15

IoT Case Studies: Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, and Productivity Applications.	
Unit III	
Managing Data in web apps, Data Integration, Extracting and organizing SQL databases, deployment, Visualization, Integrating,	09

Course Outcomes:

Upon completion of this course, students will be able to:

1. Gain technical competencies in web application development and maintenance.
2. Implement interactive web pages and apply validation checks using client side programming languages like HTML, CSS, Java Script and AngularJS.
3. Process the business data and generate responses dynamically using PHP.
4. Use web application development frameworks for designing web applications.

Understand the IOT connectivity..

Textbooks:

1. HTML5 Black Book: Covers CSS3, Javascript, XML, XHTML, Ajax, PHP and Jquery", Kogent Learning Solutions Inc. Dreamtech Press, First Edition, ISBN 9789350040959.
2. Html, Xthml, CSS & XML by Example", TeodoreGugoiu Publication –FIREWAL MEDIA

Reference Books:

1. "Beginning PHP5", Dave W. Mercer, Allan Kent, Steven D. Nowicki, David Mercer, Wrox Publication, First Edition, ISBN 978-0764557835
2. "Commence Web Development with PHP and MySQL", Sagar S. Sawant & Ashwini B. Patil, Aruta Publication, First Edition, ISBN-978-93-81476-13-0
3. "Real-World Solutions for Developing High-Quality PHP Frameworks and Applications", Sebastian Bergmann, Stefan Priebsch, Wrox, ISBN:978-1-4571-0652- 1.

Table 1: Mapping Levels of COs to POs														
COs	**Program Objectives (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2							1	1		1	1	1
CO2	2	2							1	1		1	1	1
CO3	1	2							1	1		1	2	1
CO4	2	2							1	1		1	1	1
CO5	2	2							1	1		1	3	2

Table 2: Mapping of COs to PIs, POs and BTL			
Course outcomes	**Program Outcomes**	**Performance Indicators**	**Bloom's Taxonomy Level**
CO1	1,2	1.3.1, 1.4.1, 2.2.5	L2
CO2	1,2	1.3.1, 1.4.1, 2.2.5	L2
CO3	1,2	1.3.1, 1.4.1, 2.1.3,	L2
CO4	1,2	1.3.1, 1.4.1, 2.1.3,	L3
CO5	1,2	1.3.1, 1.4.1, 2.1.3, 2.2.5	L3

WIRELESS SENSOR NETWORKS

(Effective from the academic year 2023 -2024)

Course Code	21AME050	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	39	**Exam Hours**	03

Credits – 3

Unit I	**Contact Hours**
CHARACTERISTICS OF WSN Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations. **MEDIUM ACCESS CONTROL PROTOCOLS** Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.	15
Unit II	
ROUTING AND DATA GATHERING PROTOCOLS Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing – Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.	15
Unit III	
EMBEDDED OPERATING SYSTEMS Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.	09

Course Outcomes:

Upon completion of this course, students will be able to:

6. Know the basics , characteristics and challenges of Wireless Sensor Network
7. Apply the knowledge to identify appropriate physical and MAC layer protocol
8. Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement

Be familiar with the OS used in Wireless Sensor Networks and build basic modules

Textbooks:

2. Kazem Sohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks Technology, Protocols, and Applications, John Wiley & Sons, 2007

Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Network, John Wiley & Sons, 2005

Reference Books:

1. David Gay and Philip A. Levis, TinyOS Programming, Cambridge University Press, 2009
2. Mohammad S. Obaidat, Sudip Misra, Principles of Wireless Sensor Networks, Cambridge University Press, 2014

Table 1: Mapping Levels of COs to POs

COs	Program Objectives (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1		1								2	
CO2	3	3	1		1								2	
CO3	3	2	1		1								2	
CO4	3	2	1		1								3	
CO5	3	2	2		1								2	

Table 2: Mapping of COs to PIs, POs and BTL

Course outcomes	Program Outcomes	Performance Indicators	Bloom's Taxonomy Level
CO1	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO2	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO3	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO4	P1, P2, P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2
CO5	P1, P2,P3, P5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.2,3.1.1,3.1.2 5.1.1,5.2.1,5.2.2,5.3.1	L2