YEAR – WISE AND SEMESTER WISE DISTRIBUTION OF SUBJECTS
SCHOOL OF INFORMATICS
B. SC. COMPUTER SCIENCE & MACHINE LEARNING
FIFTH SEMESTER, ACADEMIC YEAR 2025 – 26 OF 2023 – 26 BATCH (CBCS)

Sl. No.	Part	Subject code	Title of the Subject	Hour/ Week	Duration of the semester Exams	Marks			Credits
						Internal	External	Total	
THEORY									
1.	II	CSML25501A	Big Data Analytics **(DSE – 1)**	4	3	40	60	100	3
		CSML25501B	Social Media Analytics **(DSE – 1)**	4	3	40	60	100	3
2.	II	CSML25502A	Data Security **(DSE-2)**	4	3	40	60	100	3
		CSML25502B	Cyber Security **(DSE-2)**	4	3	40	60	100	3
3.	II	CSML25503	Optimization Theory **(SEC-4)**	5	3	40	60	100	4
4.	II	CSML25504	Deep Learning **(Core-15)**	4	3	40	60	100	4
5.	II	CSML25505	Cognitive Computing **(Core-16)**	5	3	40	60	100	4
6.	II	CSML25506	Natural language Processing **(Core-17)**	4	3	40	60	100	4
PRACTICALS									
7.	II	CSML25507	Deep Learning Practical's **(Core-15)**	2	3	40	60	100	1
8.	II	CSML25508	Natural language Processing Practical's **(Core-17)**	2	3	40	60	100	1

***Ability Enhancement Compulsory Course (AECC)**

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YEAR – WISE AND SEMESTER WISE DISTRIBUTION OF SUBJECTS
SCHOOL OF INFORMATICS
B. SC. COMPUTER SCIENCE & MACHINE LEARNING
SIXTH SEMESTER, ACADEMIC YEAR 2024 – 25 OF 2023 – 26 BATCH (CBCS)

Sl. No.	Part	Subject code	Title of the Subject	Hour/ Week	Duration of the semester Exams	Marks			Credits
						Internal	External	Total	
THEORY									
1.	II	CSML25601A	Cloud Computing **(DSE-3)**	5	3	40	60	100	3
		CSML25601B	Human Computer Interaction **(DSE-3)**	5	3	40	60	100	3
2.	II	CSML25602A	Internet of Things **(DSE-4)**	4	3	40	60	100	3
		CSML25602B	Block Chain **(DSE-4)**	4	3	40	60	100	3
3.	II	CSML25603	Computer Vision **(Core-18)**	5	3	40	60	100	4
PRACTICALS									
4.	II	CSML25604	Major Project **(DSE-5)**	15	3	40	60	100	6

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BIG DATA ANALYTICS

(Discipline Specific Elective-1)

Credits: 3 **Semester: V**

Course code: CSML25501A **No. of lecture hours: 60**

Objectives:

- To understand and learn about the concepts of Big Data.
- To Understand about Hadoop eco system and Map Reduce fundamentals
- To understand analytics through Map Reduce fundamentals.
- To Understand Hadoop YARN Architecture.
- To Understand big data analytics.

Outcomes:

Students will be able to

CO1: Explain the motivation for big data systems and identify the main sources of Big Data.

CO2: Develop technical skills in predicative and prescriptive modeling to support business decision-making.

CO3: Implement several Data Intensive tasks using the Map Reduce Paradigm.

CO4: Understand Hadoop ecosystems such as YARN and HIVE-QL for structured databases.

CO5: Demonstrate an ability map-reduce programming using PIG and NoSQL databases for storing purpose and process for Big Data Analytics

UNIT-I **12Hrs**

1.	Introduction to Big Data: History of Data Management-Evolution of Big Data	1
2.	Structuring Big Data, Elements of Big Data	1
3.	Big Data Analytics, Careers and Future of Big Data	1
4.	Use of Big Data in Social Networking	1
5.	Preventing Fraudulent Activities	1
6.	Distributed and Parallel Computing for Big Data	2
7.	Introducing Hadoop, Cloud Computing and Big Data	2
8.	Exploring the Big Data Stack, Virtualization and Big Data	2
9.	Virtualization Approaches	1

UNIT-II **12Hrs**

1.	Hadoop Ecosystem	2
2.	Hadoop Distributed File System	4
3.	HBase-Architecture, Regions	2
4.	The Map Reduce Frame work, Uses of Map Reduce	2
5.	Role of HBase in Big Data Processing	2

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UNIT– III
12hrs

1. Developing Simple Map Reduce Application	2
2. Controlling Map Reduce Execution with Input Format	1
3. Reading Data with Custom Record Reader	2
4. Organizing Output Data with Output Format	2
5. Customizing Data with Record Writer	2
6. Optimizing Map Reduce Execution with Combiner	2
7. Controlling Reducer Execution with Partitioner	1

UNIT–IV **12hrs**

1. Background and Advantages of YARN	2
2. YARN Architecture, Working of YARN, YARN Schedulers	2
3. YARN Configurations, YARN Commands, YARN Containers	2
4. Introducing Hive, Getting started with Hive	2
5. Data Types and Built-in functions in Hive ,Hive DDL	2
6. Data manipulation in Hive, Data Retrieval Queries, Using Joins in Hive	2

UNIT–V **12hrs**

1. Machine Learning: Introduction	2
2. Machine Learning with Big Data	2
3. Supervised Learning and Unsupervised Learning	2
4. Regression Model – Linear Regression	2
5. Collaborative Filtering	2
6. Big Data Analytics with BigR	2

ESSENTIAL READING:

1. Seema Acharya, Subhashini Chellappan, **Big Data and Analytics**, 2nd Ed, Wiley Publications, 2019.
2. DT Editorial Services.2016. **Big Data Black Book**. Dream tech Press.

SUGGESTED READING:

1. Raj Kamal, Preeti Saxena, **Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning**, McGraw Hill Education, 2019, First Edition.
2. White, Tom.2012. **Hadoop: The Definitive Guide**.3rd Edition. O'Reilly Media.

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SOCIAL MEDIA ANALYTICS

(Discipline Specific Elective-1)

Credits: 3 **Semester: V**

Course code: CSML25501B **No. of lecture hours: 60**

Objectives:

1. To introduce Types of social networks and data collection techniques
2. To introduce graph analytic techniques
3. To introduce topic models and random walks
4. To introduce recommendation systems and community detection

Outcomes:

The students will be able to

CO1: Understand types of social networks and use various sampling techniques to collect social networks data

CO2: Represent social network in the form of graph

CO3: Apply various analysis and inferential methods

CO4: Use random walk theory to analyze social network data

CO5: Detect community and predict links in social networks

UNIT-I: Introduction **12Hrs**

1. Types of social networks (e.g., Twitter, Facebook)	2
2. Measurement and Collection of Social Network Data	2
3. Social Networks - Basic Structure and Measures	2
4. Basics of Text Processing over Social Data	2
5. Entity linking and entity resolution for Social data	2
6. Characteristics of OSNs, Information Diffusion, Experimental studies over OSNs, Sampling	2

UNIT-II: Social Network Analysis **12Hrs**

1. Social network Analysis	3
2. Social network and its representation	3
3. Graph-matrix representation of social network	3
4. Inferential methods in Social network analysis	3

UNIT-III: Social Data Analytics **12Hrs**

1. Fundamentals of Social Data Analytics	3
2. Topic Models	3
3. Random Walks	3
4. Heterogeneous Information Networks	3

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UNIT-IV: Applied Social Data Analytics **12Hrs**

1. Applied Social Data Analytics 3
2. Recommendation Systems 3
3. Community identification 3
4. link prediction 3

UNIT-V: Case Studies **12Hrs**

1. Exploring Twitter's API and Cookbook 3
2. Google+ 3
3. Facebook 3
4. LinkedIn 3

ESSENTIAL READING:

1. 1 Song Yang and Franziska B Keller, — **Social Network Analysis**, Sage Publishers, 2017
2. 2 Mathew A Russel, —**Minig the Social Web** —, Orielly Publishers, 2nd Edition 2013

REFERENCE BOOKS:

1. Ravindran, Sharan Kumar, Garg, Vikram, 2015. **"Mastering Social media Mining with R"**.
2. **Social Media Data Mining and Analytics**, Gabor Szabo, Gungor Poaltkan, P. Oscar Boykin – 2018, Wiley publishers.

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DATA SECURITY

(Discipline Specific Elective-2)

Credits: 3 | **Semester: V**

Course code: CSML25502A | **No. of lecture hours: 60**

Objectives:

- Understanding the significance of privacy, ethics in data environment.
- Analysing the steps to secure data.

Outcomes:

The students will be able to

CO1: Identify some of the factors driving the need for data security
CO2: Examine and classify examples of attacks
CO3: Classify the terms vulnerability, threat and attack
CO4: Analyze physical points of vulnerability in simple networks
CO5: Compare and contrast symmetric and asymmetric encryption Systems and their vulnerability to attack and explain the characteristics of hybrid systems.

UNIT – I: Computer Security and Cryptography **12hrs**

1.	Introduction: The Need for Security, Security Approaches, Principles of Security, Types of Security Attack	2
2.	Security Services, Plain Text and Cipher Text, Stream Ciphers, Block Ciphers	2
3.	Security Mechanisms, A Model for Network Security	2
4.	Encryption and Decryption, Substitution Ciphers, Ceaser Cipher, Mon - Alphabetic Cipher, Play-Fair Cipher, Hill Cipher, Poly-Alphabetic Cipher, Transposition Techniques, One-Time Pads	2
5.	Introduction to Symmetric and Asymmetric Key Cryptography and Its Applications	2
6.	Crypt analysis, Types of Keys, Key Range and Key Size, Possible Types of Attacks	2

UNIT– II: Symmetric & Asymmetric Key Cryptography **12hrs**

1.	Block Cipher Principles, Symmetric Encryption Principles & Algorithm	2
2.	DES Algorithm, Strength of DES,Triple DES	2
3.	Block cipher modes of operation, Electronic Code Book Mode(ECB), Cipher Block Chaining Mode(CBC), Cipher Feedback Mode(CFB), Counters Mode(CTR)	3
4.	Principles of Public Key Cryptography, RSA Algorithm	2
5.	Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys	3

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UNIT– III: Intruders, Virus and Firewalls **12hrs**

1. Introduction to Intruders, Intrusion Detection Systems 2
2. Password Management, Password Protection, Password Selection Strategies 2
3. Viruses, Threats, Worms, Nature of Viruses, Types of Viruses, Malicious Programs 2
4. Virus Counter Measures, Anti- Virus Approaches, Generic Decryption, Digital Immune System, Behavior-Blocking Software 2
5. Firewall Design Principles, Firewall Characteristics, Types of Firewalls, Firewall Configurations. 2
6. Trusted Systems, Data Access Control, Concept of Trusted Systems, Trojan horse Defense 2

UNIT– IV: Information Hiding **12hrs**

1. Introduction to Information Hiding, Steganography, and Water marking 2
2. Importance of Digital Water marking, Importance of Steganography 2
3. Applications of Water marking, Applications of Steganography 2
4. Properties of Water marking Systems, Evaluating Water marking Systems 2
5. Properties of Steganography and Steganalysis Systems. Evaluating and Testing Steganographic Systems 2
6. Robust Water marking, Approaches, Robustness to Volumetric Distortions 2

UNIT– V: Information Hiding **12hrs**

1. Secure Inter-branch Payment Transactions 2
2. Cross site Scripting Vulnerability 2
3. Virtual Elections 2
4. Common Criteria for Information Technology Security Evaluation 2
5. Components, Enrollment, Authentication, Techniques, Accuracy, Applications 2
6. Internet Standards, Internet Society, Internet Organizations, Internet Standard Categories, RFCs 2

ESSENTIAL READING:

1. Stallings, William. **Cryptography and Network Security,** 4th Edition. New Delhi: Pearson Education.
2. Forouzan, Behrouz A. **Cryptography and Network Security.** McGraw Hill Edition.
3. Cox, Ingemar. Miller, Matthew. Bloom, Jeffrey and Fridrich, **Jessica. Digital Watermarking and Steganography.** 2nd Edition. India: TMH.

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CYBER SECURITY

(Discipline Specific Elective-2)

Credits: 3 **Semester: V**

Course code: CSML25502B **No. of lecture hours: 60**

Objectives:

- To understand various types of cyber-attacks and cyber-crimes
- To learn threats and risks within context of the cyber security
- To have an overview of the cyber laws & concepts of cyber forensics
- To study the defensive techniques against these attacks

Outcomes:

The students will be able to

CO1: Analyze and evaluate the cyber security needs of an organization.
CO2: Understand Cyber Security Regulations and Roles of International Law.
CO3: Understand Security for Mobile and Wireless Devices.
CO4: Design and develop a security architecture for an organization.
CO5: Understand fundamental concepts of data privacy attacks

UNIT– I: Introduction to Cyber Security **12hrs**

1. Basic Cyber Security Concepts, layers of security	2
2. Vulnerability, threat, Harmful acts	2
3. Internet Governance Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers	3
4. Active attacks, passive attacks, Software attacks, hardware attacks	1
5. Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism	2
6. Cyber Espionage, etc., Comprehensive Cyber Security Policy	2

UNIT– II: Cyberspace and the Law & Cyber Forensics **12hrs**

1. Introduction, Cyber Security Regulations, Roles of International Law.	2
2. The INDIAN Cyberspace, National Cyber Security Policy.	2
3. Introduction, Historical background of Cyber forensics, Digital Forensics Science	2
4. The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email	3
5. Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics	3

UNIT– III: Cybercrime: Mobile and Wireless Devices **12hrs**

1. Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility	2
2. Credit card Frauds in Mobile and Wireless Computing Era Security Challenges Posed by Mobile Devices,	3

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3. Registry Settings for Mobile Devices	2
4. Authentication service Security, Attacks on Mobile/Cell Phones	3
5. Organizational security Policies and Measures in Mobile Computing Era, Laptops.	2

UNIT– IV: Cyber Security: Organizational Implications **12hrs**

1. Introduction, cost of cybercrimes and IPR issues	2
2. Web threats for organizations	2
3. Security and privacy implications	2
4. Social media marketing: security risks and perils for organizations	3
5. Social computing and the associated challenges for organizations	3

UNIT– V: Privacy Issues **12hrs**

1. Basic Data Privacy Concepts: Fundamental Concepts	1
2. Data Privacy Attacks	2
3. Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.	2
4. **Examples:** Official Website of Maharashtra Government Hacked Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.	4
5. **Mini-Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.	3

ESSENTIAL READINGS:

1. Nina Godbole and Sunit Belpure, **Cyber Security Understanding Cyber Crimes, ComputerForensics and Legal Perspectives**, Wiley
2. B.B. Gupta, D.P. Agrawal, Haoxiang Wang, **Computer and Cyber Security: Principles,Algorithm, Applications, and Perspectives,** CRC Press,2018.

SUGGESTED READINGS:

1. **Cyber Security Essentials**, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. **Introduction to Cyber Security**, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&FGroup.

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OPTIMIZATION THEORY

(Skill Enhancement Course -4)

Credits: 4 **Semester: V**

Course code: CSML25503 **No. of lecture hours: 75**

Objectives:

- To introduce the fundamental concepts of optimization, including problem formulation, design variables, constraints, objective functions, and optimization algorithms.
- To equip students with methods for solving single-variable optimization problems using various algorithms.
- To introduce gradient-based optimization techniques (e.g., Newton-Raphson, Secant, and Bisection methods) and multivariable optimization algorithms.
- To explain the characteristics of constrained optimization problems and introduce both direct and indirect methods.
- To provide an understanding of advanced optimization algorithms such as Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, and Differential Evolution.

Outcomes:

Students will be able to

CO1: **Formulate** real-world engineering problems into mathematical optimization models, identifying key components such as design variables, objective functions, and constraints.

CO2: **Apply** bracketing and region-elimination methods, such as Fibonacci Search and Interval Halving, to solve single-variable optimization problems.

CO3: **Implement** gradient-based methods and solve multivariable optimization problems using techniques like Newton's Method and the Simplex Method and apply multi-objective optimization methods such as Pareto optimization.

CO4: **Solve** constrained optimization problems using direct methods (e.g., Complex and Cutting Plane methods) and indirect methods (e.g., Penalty Function and Transformation techniques).

CO5: **Apply** advanced optimization algorithms like Genetic Algorithms (GA), Particle Swarm Optimization (PSO), and Differential Evolution (DE) to solve complex optimization problems.

UNIT-I: Introduction **15Hrs**

1.	Optimal problem formulation	2
2.	Design variables constraints	2
3.	Objective function	2
4.	Variable bounds	3
5.	optimization problems	3
6.	Optimization algorithms	3

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UNIT-II: Single-variable Optimization Algorithm **15Hrs**

1. Optimality Criteria 2
2. Bracketing methods: Exhaustive search methods 3
3. Region- Elimination methods 2
4. Interval halving method 2
5. Fibonacci search method 2
6. Point estimation method 2
7. Successive quadratic estimation method 2

UNIT-III : Multivariable Optimization Algorithm **15Hrs**

1. Newton-Raphson method, Bisection method 2
2. Secant method, Computer programs 2
3. Optimality criteria, unidirectional search 2
4. **Direct search methods:** Evolutionary optimization method 1
5. Simplex search method, Hooke-Jeeves pattern search method 3
6. Cauchy's (Steepest descent) method, Newton's method 3
7. multi-objective optimization, Pareto optimization 2

UNIT-IV: Constrained Optimization Algorithm **15Hrs**

1. Characteristics of a constrained problem 2
2. **Direct methods:** The complex method 2
3. Cutting plane method 2
4. **Indirect method:** Transformation Technique 2
5. Basic approach in the penalty function method 2
6. Interior penalty function method 3
7. Convex method 2

UNIT-V: Advanced Optimization Algorithms **15Hrs**

1. Genetic Algorithm (GA) 2
2. Working principles, GA operators 2
3. Selection methods, Advanced GAs 2
4. Computer programs, Simulated annealing 2
5. Particle Swarm Optimization (PSO) 2
6. Differential Evolution (DE) Algorithm 2
7. Bacterial Foraging Algorithm, Ant Colony Optimization Algorithm 3

ESSENTIAL READING:

1. Optimization for Engineering Design-Algorithms & Examples – K. Deb, PHI, 2nd Ed., 2012.
2. Multi-objective Optimization Using Evolutionary Algorithms-K. Deb, John Wiley & Sons, 1st Ed., 2001.

SUGGESTED READING:

1. Optimization: Theory and Applications - S.S. Rao, Wiley Eastern Ltd, 2nd Ed., 1979.

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DEEP LEARNING

(Core Course -15)

Credits: 4 **Semester: V**

Course code: CSML25504 **No. of lecture hours: 60**

Objectives:

- To give a practical introduction to Deep Learning using Keras.
- To understand the concepts of deep learning and their implementation.

Outcomes:

Students will be able to

CO1: Understand the basics of deep learning
CO2: Understand the usage of tensors in deep learning
CO3: Apply Python deep-learning framework Keras, with Tensor-Flow as a backend engine.
CO4: Understand the LSTM and GRU layers
CO5: Apply Auto encoders

UNIT-I: Introduction	**12Hrs**
1. History, Hardware, Data, Algorithms, Neural Networks, Data representations for neural networks, Scalars (0D tensors)	3
2. Vectors (1D tensors), Matrices (2D tensors), 3D tensors and higher-dimensional tensors,Key attributes	3
3. Manipulating tensors in NumPy, The notion of data batches	2
4. Real-world examples of data tensors	1
5. Vector data, Time series data or sequence data, Image data, Video data	3

UNIT-II: Tensor operations	**12Hrs**
1. Element-wise operations	3
2. Broadcasting, Tensor dot	2
3. Tensor reshaping	1
4. Geometric interpretation of tensor operations	3
5. A geometric interpretation of deep learning	3

UNIT-III: Tensor operations	**12Hrs**
1. Gradient-based optimization	2
2. Derivative of a tensor operation	1
3. Stochastic gradient descent	3
4. **Chaining derivatives:** The Back propagation algorithm	3
5. **Neural networks:** Anatomy, Layers, Models,	2
6. Loss functions and optimizers	1

UNIT-IV: Introduction to Keras	**12Hrs**
1. Keras, Tensor Flow	3
2. Theano and CNTK	3

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3. **Recurrent Neural Networks:** A recurrent layer in Keras	3
4. Understanding the LSTM and GRU layers	3

UNIT-V: Auto encoders **12Hrs**

1. Types of Auto Encoders and its applications	4
2. **Generative Adversarial Networks:** Generative Adversarial Network	4
3. Deep Convolutional Generative Adversarial Networks	4

ESSENTIAL READING:

1. François Chollet. Deep Learning with Python. Manning Publications, 2018

SUGGESTED READING:

1. Aurélien Géron. Hands on Machine Learning with SciKit-Learn, Keras and Tensor Flow.O'Reily, 2019
2. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.Link: https://www.deeplearningbook.org
3. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, 2020Link: Dive into Deep Learning — Dive into Deep Learning 0.16.6 documentation (d2l.ai)

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COGNITIVE COMPUTING

(Core Course -16)

Credits: 4 **Semester: V**

Course code: CSML25505 **No. of lecture hours: 75**

Objectives:

- To understand the fundamental concepts of Cognitive Computing
- To recognize the use of Cognitive Computing in various Industries
- To understand the principles of NLP in Cognitive Computing
- To understand the Cognitive Application

Outcomes:

Students will be able to

CO1: Understand the fundamental concepts of Cognitive Computing
CO2: Recognize the use of Cognitive Computing in various Industries
CO3: Understand the principles of NLP in Cognitive Computing
CO4: Understand the principles of Cloud & Cognitive Computing.
CO5: Create and Build the Cognitive Application and **understand** their usages.

UNIT-I: Foundations of Cognitive Computing **15Hrs**

1.	Cognitive computing as new generation	2
2.	Uses of cognitive systems, making a system cognitive	3
3.	Gaining insights from data, AI as foundation of Cognitive computing	3
4.	Understanding cognition, two systems of Judgement and choice	2
5.	Understanding complex relationships between systems	2
6.	Elements of Cognitive system	3

UNIT-II: Design Principles of Cognitive Computing **15Hrs**

1.	Components of Cognitive System	3
2.	Building the Corpus, Bringing data into the Cognitive system	4
3.	Machine Learning	3
4.	Hypothesis Generation and Scoring	2
5.	Presentation and visualization services	3

UNIT-III: Natural Language Processing in Cognitive System **15Hrs**

1.	Role of NLP in Cognitive system	2
2.	Semantic web	2
3.	Application of NLP in business problems	3
4.	**Big Data and Cognitive Computing:** Dealing with human-generated data, defining big data	3

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5. Architectural foundation for big data, Hadoop	3
6. Data in motion and streaming data, Integrating with traditional data	2

UNIT-IV: The Role of Cloud and Distributed Computing **15Hrs**

1. Leveraging Distributed computing for Shared resources	3
2. Cloud services are fundamental to Cognitive system	3
3. Characteristics, cloud models, delivery models in cloud	3
4. Managing workloads, Security and Governance	3
5. Data integration and management in cloud	3

UNIT-V: Process of Building cognitive application **15Hrs**

1. Emerging cognitive platform, defining objective and domain	2
2. Understanding intended users and defining their attributes	3
3. Defining questions and Exploring insights	2
4. Creating and refining corpora, training and testing	3
Use Cases:	
5. Building cognitive healthcare application	3
6. Cognitive Computing Opportunities for the Travel Industry	1
7. Cognitive Computing Opportunities for Security and Threat Detection	1

ESSENTIAL READING:

1. Hurwitz, Kaufman and Bowles, **Cognitive computing and Big Data Analytics,** Wiley, 2015.

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NATURAL LANGUAGE PROCESSING

(Core Course-17)

Credits: 4 **Semester: V**

Course code: CSML25506 **No. of lecture hours: 60**

Objectives:

- To give a practical introduction to NLP.
- To deal with morphological processing, syntactic parsing, information extraction, probabilistic NLP and classification of text using Python's NLTK Library.

Outcomes:

Students will be able to

CO1: Write Python programs to manipulate and analyze language data
CO2: Understand key concepts from NLP and linguistics to describe and analyze language
CO3: Understand Tagging
CO4: Understand classification of text
CO5: Create feature-based grammar

UNIT-I: Introduction	**12Hrs**
1. **Language Processing and Python**: Computing with Language: Texts and Words, A CloserLook at Python: Texts as Lists of Words.	4
2. **Computing with Language:** Simple Statistics, Back to Python: Making Decisions and TakingControl, Automatic Natural Language Understanding	4
3. **Accessing Text Corpora and Lexical Resources**: Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet	4

UNIT-II: Introduction to Key Concepts	**12Hrs**
1. **Processing Raw Text:** Accessing Text from the Web and from Disk	2
2. **Strings:** Text Processing at the Lowest Level	1
3. Text Processing with Unicode	1
4. Regular Expressions for Detecting Word Patterns	1
5. Useful Applications of Regular Expressions, Normalizing Text	2
6. Regular Expressions for Tokenizing Text, Segmentation,	3
7. Formatting: From Lists to Strings	2

UNIT-III: Categorizing and Tagging Words	**12Hrs**
1. Using a Tagger	2
2. Tagged Corpora	2
3. Mapping Words to Properties Using Python Dictionaries	2
4. Automatic Tagging	2
5. N-Gram Tagging	4

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UNIT-IV: Classification and Extracting Information from Text **12Hrs**

1.	**Learning to Classify Text:** Supervised Classification	1
2.	Evaluation	1
3.	Naive Bayes Classifiers	1
4.	Information Extraction	1
5.	Chunking, Developing and Evaluating Chunkers	2
6.	Recursion in Linguistic Structure, Named Entity Recognition, Relation Extraction	2
7.	Analyzing Sentence Structure Some Grammatical Dilemmas, Use of Syntax	2
8.	Context-Free Grammar,Parsing with Context-Free Grammar	2

UNIT-V: Feature-based Grammars **12Hrs**

1.	Graphical features	1
2.	Processing feature	2
3.	Natural language understanding	1
4.	Propositional logic, First order logic	3
5.	Introduction to Generative AI in NLP	2
6.	Introduction to LLM in NLP	3

ESSENTIAL READING:

1. Steven Bird, Ewan Klein, and Edward Loper. 2009. **Natural Language Processing with Python**.1st Edition. O'Reily.
2. C. Arun, S. Karthick, S. Selvakumara Samy, B. Hariharan and Po-Ming Lee, **"Generative AI Models and LLM: Training Techniques and Evaluation Metrics"** from the book **"Generative AI and LLMs"**, Published by De Gruyter, 2024, https://doi.org/10.1515/9783111425078-003.
3. **Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python.** Akshay Kulkarni, Adarsha Shivananda, A press, 2019.

SUGGESTED READING:

1. Allen James, **Natural Language Understanding**, Benjamin/Cumming,1995.
2. Charniack, Eugene, **Statistical Language Learning**, MIT Press, 1993.

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DEEP LEARNING PRACTICALS

(Core Course -15)

Credits: 1 **Semester: V**

Course code: CSML25507 **No. of lecture hours: 30**

Objectives:

- To develop deep learning models using Keras.
- To introduce the basic concepts and techniques of Deep Learning and the need of Deep Learning techniques in real-world problems.
- To provide understanding of various Deep Learning algorithms and the way to evaluate performance of the Deep Learning algorithms.
- To apply Deep Learning to learn, predict and classify the real-world problems.
- To understand, learn and design Artificial Neural Networks of Supervised Learning for the selected problems and very the different parameters.
- To understand the concept of CNN, RNN, GANs, Auto-encoders.

Outcomes:

The students will be able to:

- **Understand** the basic concepts and techniques of Deep Learning and the need of Deep Learning techniques in real-world problems.
- **Understand** CNN algorithms and the way to evaluate performance of the CNN architectures.
- **Apply** RNN and LSTM to learn, predict and classify the real-world problems in the paradigms of Deep Learning.
- **Understand** the concept of Auto-encoders and enhancing GANs

List of Experiments:

(Note: A minimum of 10 experiments to be done)

1. Build a deep neural network model start with linear regression using a single variable.
2. Build a deep neural network model start with linear regression using multiple variables.
3. Write a program to convert speech into text.
4. Write a program to convert text into speech.
5. Write a program to convert video into frames.
6. Write a program for Time-Series Forecasting with the LSTM Model.
7. Build a feed forward neural network for prediction of logic gates.
8. Write a program to implement deep learning Techniques for image segmentation.
9. Write a program for object detection using image labeling tools.
10. Write a program to predict a caption for a sample image using LSTM.
11. Write a program for character recognition using CNN.
12. Write a program to predict a caption for a sample image using CNN.
13. Write a program for character recognition using RNN and compare it with CNN.
14. Write a program to detect Dog image using YOLO Algorithm.
15. Write a program to develop Autoencoders using MNIST Handwritten Digits.
16. Write a program to develop a GAN for Generating MNIST Handwritten Digits.

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NATURAL LANGUAGE PROCESSING PRACTICALS

(Core Course -17)

Credits: 1 **Semester: V**

Course code: CSML25508 **No. of lecture hours: 30**

Objectives:

- To discuss the current and likely future performance of several NLP applications.
- To describe briefly a fundamental technique for processing language for several subtasks, such as morphological processing.
- To Implement parsing, word sense disambiguation and etc.
- To Understand how these techniques draw on and relate to other areas of computer science.
- To Understand the basic principles of designing and running an NLP experiment.

Outcomes:

The students will be able to:

- Implement LSI, NER.
- Implement TD-IDF method and Ngram models
- Develop a Part of speech tagger.
- Classify the text based on part of speech tagger.
- Implement several NLP applications.

List of Experiments:

(Note: A minimum of 10 experiments to be done.)

1. Write a python program to perform tokenization by word and sentence using nltk.
2. Write a python program to eliminate stop words using nltk.
3. Write a python program to perform stemming using nltk.
4. Write a python program to perform Parts of Speech tagging using nltk.
5. Write a python program to perform lemmatization using nltk.
6. Write a python program for chunking using nltk.
7. Write a python program to perform Named Entity Recognition using nltk.
8. Write a python program to find Term Frequency and Inverse Document Frequency (TF-IDF).
9. Write a python program to find all unigrams, bigrams and trigrams present in the given corpus.
10. Write a python program to find the probability of the given statement "This is my cat" by taking the example corpus into consideration.
11. Write the python code to perform sentiment analysis using NLP.
12. Write the python code to develop Spam Filter using NLP
13. Write the python code to detect Fake News using NLP

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CLOUD COMPUTING

(Discipline Specific Elective-3)

Credits: 3 **Semester: VI**

Course code: CSML25601A **No. of lecture hours: 75**

Objectives:

- To know what a distributed system is and to understand properties of distributed system.
- To implement basics, techniques and tools for Cloud Computing.
- To understand any kind of heterogeneous resources over a network using open standards.

Outcomes:

The students will be able to:
CO1: Understand basic cloud computing
CO2: Analyze cloud architectural information in the present generation of market
CO3: Explain cloud computing technology and examples
CO4: Analyze virtualization and virtualization techniques
CO5: Apply market oriented cloud computing in various applications

UNIT-I: Introduction to Cloud Computing **15Hrs**

1.	Cloud Computing Overview - Introduction to Cloud Computing, Cloud Components, Infrastructure Services	3
2.	Benefits – Scalability, Simplicity, Knowledgeable Vendors, More Internal Resources, Security	3
3.	Limitations - Your Sensitive Information, Applications Not Ready, Developing Your Own Applications, Features of Cloud Platform	3
4.	System Models for Advanced Computing – Clusters of Cooperative Computing, Grid Computing and Cloud Computing.	3
5.	Software Systems for Advanced Computing-Service Oriented Software, Parallel and Distributed Programming Models with Introductory Details	3

UNIT-II: Cloud Computing Architecture **15Hrs**

1.	Introduction	1
2.	**The Cloud Reference Model:** Architecture, Infrastructure and Hardware as a service (HAAS), Platform as a Service (PAAS), Software as a Service (SAAS)	4
3.	**Types of clouds:** Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds	4
4.	Economics of the Cloud	2
5.	**Open Challenges:** Cloud Definition, Cloud Interoperability and Standards, Scalability and Fault Tolerance, Security, Trust and Privacy, Organizational Aspects	4

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UNIT-III: Cloud Computing Technology **15Hrs**

1. **Hardware and Infrastructure:** Clients, Mobile, Thin, Thick	3
2. **Local Clouds and Thin Clients:** Virtualization, How to Virtualize, Concern and Security	3
3. Virtualization and Cloud Computing	3
4. Pros and Cons of Virtualization	2
5. **Cloud security:** Data security, Access control	2
6. **Auditing:** internal and External audit, Authentication and Authorization	2

UNIT-IV: Cloud Storage and Virtualization **15Hrs**

1. Virtualization: Introduction and Characteristics of Virtualized Environments	3
2. Increased Security, Managed Execution, Portability	2
3. **Taxonomy of Virtualization Techniques:** Execution Virtualization, Other Types of Virtualizations	4
4. **Cloud Storage Overview:** The Basics, Storage as a Service, Providers, Security	3
5. **Virtualization types**: Microsoft Hyper-V, VMware, VMware Infrastructure	3

UNIT-V: Cloud Platforms in Industry and Applications **15Hrs**

1. **Amazon web services:** Compute services, Storage services, Communication services, Additional Services	4
2. **Google App Engine:** Architecture and core, concepts, Application life cycle, Cost model	3
3. **Microsoft Azure:** Azure core concepts, SQL Azure, Windows Azure platform appliance	3
Scientific Applications:	
4. Healthcare: ECG analysis in the Cloud	1
5. Biology: protein structure prediction	1
6. Geoscience: satellite image processing	1
Business and consumer applications:	
7. CRM and ERP	1
8. Multiplayer online gaming	1

ESSENTIAL READING:

1. Anthony T Velte, Toby J Velte, Robert Elsenpeter, **Cloud Computing, A Practical Approach,** MC Graw Hill, 2010
2. Rajkumar Buyya, Christian Vecchiola and S. Tanurai Selvi, **Mastering Cloud Computing,** Morgan Kaufmann is an imprint of Elsevier, India: TMH, 2013

SUGGESTEDREADING:

1. Cloud Computing, John W. Ritting House and James F Ramsome, CRC Press,2012.
2. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press,2012.

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HUMAN COMPUTER INTERACTION

(Discipline Specific Elective-3)

Credits: 3 | **Semester: VI**

Course code: CSML25601B | **No. of lecture hours: 75**

Objectives:

- To gain an overview of Human-Computer Interaction (HCI), with an understanding of user interface design in general, and alternatives to traditional "keyboard and mouse" computing.

Outcomes:

The students will be able to:

CO1: Explain HCI and principles to interaction design.
CO2: Design certain tools for blind or PH people.
CO3: Understand Navigation schemes
CO4: **Evaluation** through user participation
CO5: **Design** Application

UNIT-I: Introduction	**15Hrs**
1. Importance of user Interface – definition, importance of good design.	3
2. Benefits of good design. A brief history of Screen design.	2
3. The graphical user interface – popularity of graphics, the concept of direct manipulation	3
4. Graphical system, Characteristics.	2
5. Web user Interface popularity, characteristics	3
6. Principles of user interface design	2

UNIT-II: Design Process	**15Hrs**
1. **Design process** – Human interaction with computers, importance of human characteristics	2
2. Human Consideration in the design of business systems, Human interaction speeds	3
3. **Human considerations in interface and screen design-** interface design goals, test for a good design Screen and web page meaning and purpose, Organizing elements clearly and meaningfully, Consistency, Starting point, Ordering of data and content, Navigation and flow, Visual pleasing composition.	5
4. Window characteristics, components, presentation styles, types of windows	5

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UNIT-III: Proper screen-based controls **15Hrs**

1.	Operable controls, text entry / read only controls,	2
2.	Selection controls, Combination entry / selection controls	3
3.	Other operable controls, custom controls	3
4.	Presentation controls	2
5.	Icons, multimedia, graphics, color- RGB, HSV	3
6.	Dithering, color uses	2

UNIT-IV: Design Rules & Evaluation techniques **15Hrs**

1.	HCI in the software process, The software life cycle Usability engineering Iterative design	3
2.	Prototyping, Design rationale	2
3.	Principles to support usability, Standards	3
4.	Golden rules and heuristics, HCI patterns	2
5.	Goals of evaluation, Evaluation through expert analysis and user participation	3
6.	Choosing an evaluation method	2

UNIT-V: Communication and collaboration models **15Hrs**

1.	Introduction, face-to-face communication,	2
2.	Conversation, text-based communication	3
3.	Dialog, dialog design notations,	3
4.	Diagrammatic notations, textual dialog notations	3
5.	Dialog semantics, dialog analysis and design	4

ESSENTIAL READING:

1. **The Essential Guide To User Interface Design,** Wilbert O Galitz, Wiley Dream Tech. 3rd Edition. (Units 1, 2, 3)
2. **Human – Computer Interaction.** Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education 3rd Edition. (Units 4,5)

REFERENCE BOOKS:

1. **Designing the user interface.** 3rd Edition Ben Shneider mann, Pearson Education Asia.
2. **Interaction Design** Prece, Rogers, Sharps. Wiley Dream tech.
3. **User Interface Design,** Soren Lauesen , Pearson Education.
4. **Human –Computer Interaction,** D. R. Olsen, Cengage Learning.
5. **Human –Computer Interaction,** Smith - Atakan, Cengage Learning

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INTERNET OF THINGS

(Discipline Specific Elective-4)

Credits: 3 **Semester: VI**

Course code: CSML25602A **No. of lecture hours: 60**

Objectives:

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices

Outcomes:

The students will be able to:

CO1: **Identify** the importance of IOT and its applications.
CO2: **Differentiate** between IOT and M2M, SDN and NFV
CO3: **Apply** IOT design methodology.
CO4: **Understand** building of IOT devices and Raspberry PI.
CO5: **Explain** working of application of IOT.

UNIT-I: Design & Levels of IOT	**12Hrs**
1. Introduction to Internet of Things –Definition and Characteristics of IoT	1
2. Physical Design of IoT	2
3. Logical Design of IoT	2
4. IoT Enabling Technologies	2
5. IoT Levels and Deployment Templates,	2
6. Domain Specific IoTs – Home Automation Cities, Environment, Agriculture, Industry, health, and Lifestyle	3

UNIT-II: IOT Systems Management	**12Hrs**
1. IoT and M2M- Introduction to M2M, Difference between IoT and M2M	1
2. SDN and NFV for IoT	2
3. Need for IoT Systems Management, SNMP	2
4. Network Operator requirements, NETCONF, YANG	2
5. IoT Systems Management with NETCONF-YANG	2
6. IoT Design Methodology	3

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UNIT-III: IOT Physical Devices and Cloud Storage Models **12Hrs**

1.	Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces	3
2.	Programming Raspberry Pi with Python	2
3.	Other IoT devices	2
4.	Introduction to Cloud Storage models and Communication API	2
5.	WAMP-AutoBahn for IoT, Xively Cloud for IoT	3

UNIT-IV: Exploring IoT Data and Analytics **12Hrs**

1.	Cloud security and analytics	2
2.	Applying big data technology to storage	2
3.	Exploring and visualizing data	2
4.	Techniques to understand data quality	2
5.	Basic time series analysis	2
6.	Statistical analysis	2

UNIT-V: Machine Learning in IoT Analytics **12Hrs**

1.	Introduction to Machine Learning	2
2.	Machine Learning Methods	3
3.	Feature engineering with IoT data	2
4.	Validation methods	3
5.	Understanding the bias–variance tradeoff	2

ESSENTIAL READING:

1. Bahga, Arshdeep and Madisetti, Vijay. 2015. **Internet of Things - A Hands-on Approach.** Universities Press.
2. Minteer, Andrew, **Analytics for the Internet of Things (IoT)**, Packt Publishing Ltd. July 2017.
3. **Internet of Things Projects with Esp32: Build exciting and powerful IoT projects,** 1st Edition, by Agus Kurniawan
4. Richardson, Matt and Wallace Shawn. 2014. **Getting started with Raspberry PI.** O'Reilly (SPD).

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BLOCK CHAIN

(Discipline Specific Elective-4)

Credits: 3 | **Semester: VI**

Course code: CSML25602B | **No. of lecture hours: 60**

Objectives:

- This course is intended to study the basics of Blockchain technology.
- During this course, the learner will explore various aspects of Blockchain technology, like applications in various domains.
- By implementing, learners will have idea about private and public Blockchain, and Smart contracts.

Outcomes:

The students will be able to:

CO1: Understand and explore the working of Blockchain technology
CO2: Analyse the working of Smart Contracts
CO3: Understand and analyse the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

UNIT-I: Introduction to Cryptography and Block chain	**12Hrs**
1. Blockchain: Introduction, History, Objectives	2
2. Blochchain Technology Mechanisms & Networks, Blockchain Challenges	2
3. Transactions and Blocks, P2P Systems, Keys as Identity	2
4. Digital Signatures,	2
5. Hashing, and public key cryptosystems	2
6. Private vs. public Blockchain	2

UNIT-II: Bitcoin and Cryptocurrency	**12Hrs**
1. Bitcoin: Introduction, The Bitcoin Network	1
2. The Bitcoin Mining Process, Mining Developments	2
3. Bitcoin Wallets	1
4. Decentralization and Hard Forks	2
5. Blockchain and Digital Currency, Transactional Blocks	2
6. Impact of Blockchain Technology on Cryptocurrency	2
7. Bitcoin Security: Security principles, Developing Bitcoin Systems Securely, The Root of Trust, User Security Best Practices	2

UNIT-III: Introduction to Ethereum	**12Hrs**
1. Ethereum: Introduction to Ethereum, Ethereum Accounts	2
2. Consensus Mechanisms: History, Types of Consensus, Future of consensus, Mechanisms, Metamask Setup	3

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3. Ethereum Virtual Machine (EVM), Merkle Tree, Double- Spend Problem	2
4. Transactions: Transaction Lifecycle, Broadcasting Transactions to the Bitcoin Network, Transaction Structure, Transaction Outputs and Inputs	3
5. Smart Contracts: Life Cycle of Smart Contracts	2

UNIT-IV: Introduction to Hyperledger and Solidity Programming **12Hrs**

1. Hyperledger: Distributed Ledger Technology & its Challenges	3
2. Hyperledger Fabric	2
3. Hyperledger Composer	2
4. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet	2
5. Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types	3

UNIT-V: Block Chain Use Cases **12Hrs**

1. Ten Steps to Your First Blockchain application	4
2. **Healthcare Blockchain Use Cases:** Electronic Health Records	1
3. **Financial Technology:** Discovering future global bank trends-Uncovering new investment vehicles- Exposing risk in banking blockchain -Developing new financing strategies.	2
4. **Real Estate:** Evaluating global real estate trends-Discovering dead capital and ways to fix it-Uncovering how Fannie Mae will fit in a blockchain world	2
5. **Supply Chain Management use cases:** Transport & Logistics, Food Industry, Manufacturing	2
6. **IOT Use Cases:** IoT Security for Remote Monitoring	1

ESSENTIAL READING:

1. (PDF) BLOCKCHAIN FUNDAMENTALS TEXT BOOK Fundamentals of Blockchain (researchgate.net)
2. Ashok Kumar Yadav, Munesh Chandra Trivedi, **Blockchain Technology: and its Applications,** TechSar Pvt. Ltd., 2024
3. https://www.hhs.gov/sites/default/files/blockchain-for-healthcare-tlpwhite.pdf
4. https://www.antiersolutions.com/blogs/top-5-real-life-blockchain-use-cases-in-supply-chain-in-2023

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COMPUTER VISION

(Core Course -18)

Credits: 4 **Semester: VI**

Course code: CSML25603 **No. of lecture hours: 75**

Objectives:

- To understand Computer vision and its fundamentals
- To perform object detection and motion analysis
- To understand different use cases of Computer vision

Outcomes:

The students will be able to:

CO1: Understand basics concepts of Images
CO2: Compute manipulation on images
CO3: Differentiating and segmenting images
CO4: Experimenting object detection using OpenCV
CO5: Develop Object tracking and motion analysis

UNIT-I: Introduction to Image Processing **15Hrs**

1.	Point Operators	3
2.	Linear Filtering	3
3.	Neighborhood Operators	3
4.	Geometric Transformations	3
5.	Image Classification	3

UNIT-II: Feature Detection and Matching **15Hrs**

1.	Object Detection	2
2.	Semantic Segmentation	1
3.	Points and Patches	2
4.	Edges and Contours	2
5.	Contour Tracking	2
6.	Lines and Vanishing Points	2
7.	Segmentation	2

UNIT-III: Image Alignment, stitching and Motion Analysis **15Hrs**

1.	2D and 3D images alignment	2
2.	Image stitching	3
3.	Global Alignment	2
4.	Compositing	2
5.	Parametric motion	2
6.	Optical Flow	2
7.	Layered Motion	2

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UNIT-IV:3D Reconstruction **15Hrs**

1.	Shape from X: Shape from shading, Photometric stereo, Shape from texture, shape from focus	3
2.	3D Scanning	2
3.	Surface representations	2
4.	Point based representations	2
5.	Volumetric representations	2
6.	Model based reconstruction	2
7.	Recovering texture maps and albedos	2

UNIT-V:Computer Vision Case Studies **15Hrs**

Case -1: Face Detection and Recognition

1.	Facial feature detection	2
2.	Frontalization	2
3.	The face as a part of 3D object	2

Case – 2: Surveillance

4.	The basic Geometry	1
5.	Foreground – background separation	2
6.	Particle Filters	2
7.	Use of Color Histograms for tracking	1
8.	Chamfer matching, Tracking and Occlusion	2
9.	License Plate location	1

SUGGESTED READING:

1. Richard Szeliski, **Computer Vision – Algorithms and Applications**, 2nd Edition, Spinger, 2022. (Unit – 1,2,3,4)
2. E.R. Davies, **Computer Vision – Principles, Algorithms, Applications, Learning**, 5th Edition, Elsevier Academic Press, 2018. (Unit – 4,5)

REFERENCE READING:

1. https://www.udemy.com/course/master-computer-vision-with-opencv-in-python/
2. JanErikSolem.2012.**ProgrammingComputerVisionwithPython**.FirstEdition. OReilly.

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MAJOR PROJECT

(Discipline Specific Elective-5)

Credits: 6 **Semester: VI**

Course code: CSML25604 **No. of lecture hours: 15**

EVALUATION CRITERIA FOR MAJOR PROJECT

Third year students in the Sixth Semester are required to take up project work which carries a total of 100 marks i.e. internal 40 marks and external 60 marks.

The criteria for the Internal Evaluation of Project for 40 marks are as follows:

1. Attendance **5 Marks**
2. Review of weekly report **5 Marks**
3. Internal Project Presentation–every weekend (Presentation & communication skills, objectives, Work submission, methodology, results, and Practical relevance) **10 Marks**
4. Final internal presentation- at the end of semester (50% marks Evaluation done by the internal guide, and 50% marks evaluated by other internal lecturers guiding the projects) **15 Marks**
5. Project Report **5 marks**

External Evaluation of the Project (60 marks):

The Controller of Examination sends the Project Reports to the External Examiner in advance. The External Examiner evaluates the project for 60 marks based on project work done by the student. (The Project Report is evaluated for 40 marks and Viva-voce for 20 marks).

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ADD – ON COURSE

Title: AUTOML

Semester: VI **No. of lecture hours: 30**

Objectives:

- To Automate tasks in a machine learning workflow.
- To determine the benefits and limitations of using AutoML with machine learning model, Enumerate the common AutoML patterns and apply them to ML projects.

Outcomes:

The students will be able to:

CO1: Understand the basic concepts of AUTOML
CO2: Understand preprocessing of data
CO3: Apply Automated Algorithms
CO4: Analyse Optimizations
CO5: Understand AUTOML Pipelines

UNIT-I: Introduction to AUTOML	**6Hrs**
1. Scope of machine learning	1
2. Introduction to AUTOML	1
3. AUTOML usage and its importance	2
4. Overview of AUTOML libraries	2
UNIT-II: Data Preprocessing	**6Hrs**
1. Technical Requirements	1
2. Numerical Data Transformation, Categoral Data Transformation	2
3. Text preprocessing	1
4. Feature Selection, Feature Generation	2
UNIT-III: Automated Algorithm Selection	**6Hrs**
1. Computational Complexity, Differences in training and scoring time	2
2. Linearity versus Non-linearity	1
3. Supervised ML, Unsupervised AUTOML	3
UNIT-IV: Hyperparameter Optimization	**6Hrs**
1. Hyperparameters	1
2. Warm start	2
3. Bayesian-based hyperparameter tuning	2
4. An example system	1

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UNIT-V: AUTOML Pipelines
6Hrs

1.	Introduction to AUTOML Pipelines	2
2.	A Sample pipeline	2
3.	Function Transformer, A Complex pipeline	2

SUGGESTED READING:

1. Sibanjan Das, Umit Mert Cakmak, **Hands-On Automated Machine Learning: A beginner's guide to building automated machine learning systems using AutoML and Python,** Packt Publishing, 2018

REFERENCE READING:

1. Frank Hutter, Lars Kotthoff, Joaquin Vanschoren, **AutoML: Methods, Systems, Challenges (first book on AutoML),** The Springer Series, 2019, https://doi.org/10.1007/978-3-030-05318-5_1

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