MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belagavi)

Autonomous Programme
Master of Technology (M.Tech.)

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AI & DS)

SYLLABUS

I, II, III, IV Semester

(2025 – 2027 Admitted Batch)

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING

Academic Year 2025-2026

VISION

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns.

MISSION

1. Impart world class engineering education to produce technically competent engineers.
2. Provide facilities and expertise in advanced computer technology to promote research.
3. Enhance Industry readiness and entrepreneurial abilities through innovative skills
4. Nurture ethical values and social responsibilities

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: Graduates will be capable to adapt to new computing technology for professional excellence and Research and will be lifelong learners.

PEO 2: Graduates will work productively exhibiting ethical qualities for the betterment of society.

PEO 3: Graduates will possess leadership qualities, work harmoniously in a team with effective communication skills.

PROGRAM OUTCOMES

Post Graduates will be able to:

PO1	Engineering knowledge
PO2	Problem analysis
PO3	Design/development of solutions
PO4	Conduct investigations of complex problems
PO5	Engineering tool usage
PO6	The engineer and the world
PO7	Ethics
PO8	Individual and Collaborative Teamwork
PO9	Communication
PO10	Project management and finance
PO11	Life-long learning

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon graduation, students with a degree M.Tech in Artificial Intelligence & Data Science will be able to:

PSO1	Develop AI based efficient domain specific processes for effective decision making in several domains.
PSO2	Independently carry out research /investigation and development work to solve practical problems.

SCHEME OF EVALUATION

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50 % of the maximum marks. Minimum passing marks in SEE is 50 % of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION

1. Two CIE each of 20 Marks will be conducted.
2. Two assignments each of 10 Marks or one Skill Development Activity of 20 marks will be scaled down to 10 Marks.
3. The weighted sum of two tests, two assignments/ Skill Development Activities, will be evaluated to 50 marks. CIE methods/ question paper is designed to attain the different levels of as per the outcome defined for the course.

SEMESTER END EXAMINATION

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have six full questions.
3. Each full question is for 20 marks. There will be one full questions (with a maximum of four sub questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions.

Examination	Maximum marks	Minimum marks to qualify
CIE	**50**	**25**
SEE	**50**	**25**

Scheme & Syllabus for I Year

M.Tech. - Artificial Intelligence and Data Science

Academic Year 2025-26

I Semester					
Course Type	**Course Code**	**Course Title**	**L-P-SDA (Hours)**	**Credits**	**Contact Hours**
PCC	25MCS11	Artificial Intelligence	3-0-0	**3**	03
PCC	25MCS12	Data Science and Management	3-0-0	**3**	03
PCC	25MCS13	Data Structures and Algorithms for Problem Solving	3-0-0	**3**	03
IPCC	25MCS14	Python for Data Science	2-2-0	**4**	04
PCC	25MCS15	Deep Learning	3-0-0	**3**	03
PCCL	25MCS16	AI lab	0-4-0	**2**	04
NCMC	MRMI107	Research Methodology and IPR (Online)	Online courses (online.vtu.ac.in) (AUDIT)		
Total				**18**	**20**

Note: **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **PCC(PB)**: Professional Core Courses (Project Based), **PCCL**-Professional Core Course lab, **NCMC**- None Credit Mandatory Course, **L** - Lecture, **P** - Practical, **T/SDA** - Tutorial / Skill Development Activities(Hours are for Interaction between faculty and students), **MRMI107-Research Methodology and IPR (online)-** None Credit Mandatory Course (**NCMC**) if students have not studied this course in their undergraduate program then he /she has to take this course at **http://online.vtu.ac.in** and to qualify for this course is compulsory before completion of the minimum duration of the program (Two years), however, this course will not be considered for vertical progression, Students have to qualify for the award of the master's degree.

II Semester					
Course Type	**Course Code**	**Course Title**	**L-P-SDA (Hours)**	**Credits**	**Contact Hours**
PCC	25MCS21	Advances in Operating Systems	3-0-0	**3**	03
PCC	25MCS22	Big Data Analytics	3-0-0	**3**	03
PCC	25MCS23	Applications of Internet of Things	3-0-1	**4**	04
PEC	25MCS24X	Professional Elective Course 1	3-0-0	**3**	03
PEC	25MCS25X	Professional Elective Course 2	3-0-0	**3**	03
PCCL	25MCS26	Mini Project	3-0-0	**3**	03
PCCL	25MCS27	Big Data Analytics Laboratory	0-4-0	**2**	04
SEC	25MCS28	Skill Enhancement for Research Excellence-1	0-2-0	**1**	02
Total				**22**	**25**

Professional Elective I (Information Technology)		**Professional Elective II** (Computing Technologies)	
Course Code	**Course title**	**Course Code**	**Course title**
25MCS241	Artificial Intelligence in Cyber Security	25MCS251	Natural Language Processing
25MCS242	Machine Vision	25MCS252	Advanced Database Management System
25MCS243	Cloud Computing	25MCS253	Block Chain Technology
25MCS244	Business Intelligence & Analytics	25MCS254	Pattern Recognition

Scheme & Syllabus for II Year (2025-27 Batch)

M.Tech. - Artificial Intelligence and Data Science

Academic Year 2026-27

For the students who are willing to take up a two-semester duration Industry/Research Internship Leading to Project work /start-up					
III Semester (A)					
Course Type	**Course Code**	**Course Title**	**L-P-SDA**	**Credits**	**Contact Hours**
PEC	25MCS31A	(Online Courses) 12 weeks duration		3	--
PEC	25MCS32A	(Online Courses) 12 weeks duration		3	--
PEC	25MCS33A	(Online Courses) 12 weeks duration		3	--
INT	25MINT34A	Research Internship /Industry-Internship leading to project work/ Startup	Two-semester duration, SEE in the IV semester which leads to project work /start-up	3	--
Total			**0-0-0**	**12**	**--**

IV Semester (A)					
Course Type	**Course Code**	**Course Title**	**L-P-SDA**	**Credits**	**Contact Hours**
INT	25MINT41A	Research Internship / Industry Internship Leading to Project Work/Start-up	Two Semester Duration	12	--
PRJ	25MCS42A	Project Work	0-16-0	16	--
Total			**0-16-0**	**28**	**--**

INT: Industry/ Research Internship leading to the project work /startup **PRJ:** Project work outcome of Internship (Project Phase-II is Viva voce SEE)

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

Research Internship: A research internship is an opportunity for students or early career professionals to gain hands-on experience in conducting research under the guidance of a mentor or within a research team. These internships can take place in academic institutions, research organizations, government agencies, or private companies

Research /Industry Internship: In the third-semester Students have to be in touch with a guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE at the parent Institute.

Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

24Mxx301 to 303: MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd or 4th semester.

For the students who are willing to take an Industry Internship for one-semester duration and independent project work next semester

III Semester (B)

Course Type	Course Code	Course Title	L-P-SDA	Credits	Contact Hours
PEC	25MCS31B	(Online Courses) 12 weeks duration		3	--
PEC	25MCS32B	(Online Courses) 12 weeks duration		3	--
PEC	25MCS33B	(Online Courses) 12 weeks duration		3	--
INT	25MINT34B	Industry - Internship	One - semester duration	11	--
Total			**0-0-0**	**20**	**--**

IV Semester (B)

Course Type	Course Code	Course Title	L-P-SDA	Credits	Contact Hours
PRJ	25MCS41B	Project Work	0-20-0	20	--
Total			**0-20-0**	**20**	**--**

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned. The students who take up a one-semester Internship in the Industry have to appear SEE at the institute at the end of the semester as per the examination calendar.

Project Work: Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through Power Point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident

CIE marks for the project report (20 marks), seminar (20 marks) and question and answer (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of internal guide and a faculty from the department with the senior most acting as the Chairperson.

Semester End Examination SEE marks for the project report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of the report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

24Mxx301 to 303: MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd or 4th semester.

For the students who are willing to take a research-leading paper publication in Q1/Q2/Q3 Journals and to a PhD Registration

III Semester (C)

Course Type	Course Code	Course Title	L-P-SDA	Credits	Contact Hours
PEC	25MCS31C	(Online Courses) 12 weeks duration		3	--
PEC	25MCS32C	(Online Courses) 12 weeks duration		3	--
PEC	25MCS33C	(Online Courses) 12 weeks duration		3	--
PEC	25MCS34C	(Online Courses) 12 weeks duration		3	
PRJ	25MCS35C	Project Work Phase - I	0-12-0	6	--
Total			0-12-0	**18**	--

IV Semester (C)

Course Type	Course Code	Course Title	L-P-SDA	Credits	Contact Hours
PRJ	25MCS41C	Project Work Phase - II	0-20-0	22	--
Total			**0-20-0**	**22**	--

Project Work Phase-1: Typically the initial phase in any project, is crucial as it lays the foundation for the entire project. This phase involves defining the project's scope, objectives, and initial planning. Here's a structured approach to effectively carry out Project Phase-I:

- Project Charter: Outlines the project's purpose, objectives, and stakeholders.
- Scope Statement: Defines the project boundaries and deliverables.
- Requirements Document: Captures all project requirements.
- Project Plan: Details the approach, timeline, and resource allocation.
- Risk Management Plan: Identifies and plans for potential risks.
- Feasibility Study Report: Assesses technical, economic, and operational feasibility.

Students in consultation with the guide shall carry out literature survey/visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach the highest and become self-confident.

Continuous Internal Evaluation (100 Marks):

CIE marks for the project report (60 marks), seminar (20 marks) and question and answer (20marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of an internal guide and a faculty from the department with the senior most acting as the Chairperson.

Project Work Phase-II: Each student shall be involved in carrying out the project work jointly in constant consultation with internal guide and external guide and prepare the project report as per the norms of the university to avoid plagiarism. Phase II of a project typically involves the detailed execution of the planned activities, continuous monitoring and control of the project's progress, and making necessary adjustments to ensure the project stays on track. Keep detailed records of all project activities, decisions, and changes. Ensure all project documentation is organized and accessible. Conduct a final project review to evaluate overall performance, achievements, and lessons learned. Document best practices and areas for improvement for future projects.

Paper Publication Process: Publishing a research paper based on your project in a Q1/Q2/Q3 journal involves several key steps, from writing the manuscript to navigating the peer review process. Here's a comprehensive guide:

Writing the Manuscript: Choose a clear and concise title that accurately reflects the content. Write an abstract summarizing the research question, methods, results, and conclusions.

Literature Review: Review relevant existing research to establish the foundation of your study. Identify gaps that your research aims to fill.

Methodology: Describe the research design, methods, and procedures in detail. Include information on data collection, analysis, and any tools or software used.

Results: Present the findings of your research clearly and logically. Use tables, figures, and charts to illustrate key results.

Discussion: Interpret the results and explain their implications. Compare your findings with existing research and discuss any discrepancies or new insights.

Conclusion: Summarize the main findings and their significance. Suggest potential future research directions.

References: Cite all sources used in your research following the journal's citation style.

Journal Selection: Choose a journal that aligns with the scope and focus of your research. Consider the journal's impact factor (Q1, Q2, Q3) and audience.

Review Journal Guidelines: Carefully read the journal's submission guidelines and ensure your manuscript adheres to them.

Prepare Your Manuscript: Format your manuscript according to the journal's guidelines. Include all required sections and supplementary materials.

Cover Letter: Write a cover letter to the journal editor highlighting the significance of your research and why it fits the journal.

Submit the Manuscript: Use the journal's online submission system to submit your manuscript. Ensure

all required information and documents are included.

Semester End Examination SEE marks for the project report (60 marks), seminar (20marks) and question and answer session (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

Course Title	**Artificial Intelligence**		
Course Code	**25MCS11**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours/ Week**	**03**
CIE	**50 Marks**	**SEE**	**50**
		Total hours	**40**

Course objective: To provide students with a comprehensive understanding of key concepts and techniques in artificial intelligence (AI), problem-solving agents, search strategies, knowledge representation, and machine learning.

Course Outcomes (COs):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze AI problems, design problem-solving agents, and apply search strategies and constraint satisfaction techniques for efficient problem-solving	1, 2, 3, 4	-
2.	Employ advanced search algorithms, apply knowledge representation and reasoning techniques, and design intelligent systems for solving complex AI problems	3, 4	-
3.	Apply machine learning techniques, perform data preparation, and design effective machine learning systems for real-world applications	2, 3, 5	1
4.	Apply regression, classification, unsupervised learning, and reinforcement learning techniques for solving real-world problems and evaluate their performance	3, 5	1

Course Contents:

Module –1	**8 Hrs.**
Introduction: AI problems, Agents and Environments, Structure of Agents, Problem-Solving Agents. **Basic Search Strategies:** Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening)	
Module –2	**8 Hrs.**
Basic Search Strategies (Contd...): Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search). Advanced Search: Constructing Search Trees, Stochastic Search, AO* Search Implementation, Minimax Search, Alpha-Beta Pruning	
Module –3	**8 Hrs.**
Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem.	
Module – 4	**8 Hrs.**
Machine Learning: Introduction. Machine Learning Systems, Forms of Learning: Supervised and Unsupervised Learning, reinforcement – theory of learning – feasibility of learning – Data Preparation – training versus testing and split.	

Supervised Learning: Regression: Linear Regression, multi-linear regression, Polynomial Regression, logistic regression, Non-linear Regression, Model evaluation methods.	
Module –5	**8 Hrs.**
Classification: Support vector machines (SVM), Naïve Bayes classification. **Unsupervised learning:** Nearest neighbor models – K-means – clustering around medoids – silhouettes – hierarchical clustering – k-d trees, Clustering trees – learning ordered rule lists – learning unordered rule. Reinforcement learning- Example: Getting Lost - State and Action Spaces.	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Artificial Intelligence: A Modern Approach, by Russell, S. and Norvig, P, Fourth Edition, Prentice-Hall, 2021. 2. MACHINE LEARNING An Algorithmic Perspective, by Stephen Marsland, Second Edition, by Taylor & Francis Group, LLC, 2015.	
REFERENCE BOOKS: 1. Artificial Intelligence by Elaine Rich, Kevin Knight, Shivasankar B. Nair, Third Edition, The McGraw Hill publications, 2009. 2. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, by George F. Luger, Sixth Edition, Pearson Education, 2009. 3. Introduction to Machine Learning, by Ethem Alpaydın, Second Edition, the MIT Press, Cambridge, Massachusetts, London, England. 4. Machine Learning, by Tom M. Mitchell, McGraw-Hill Science, ISBN: 0070428077.	

Course Title	**Data Science and Management**		
Course Code	**25MCS12**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours/ Week**	**03**
CIE	**50 Marks**	**SEE**	**50**
		Total hours	**40**

Course objective: To provide students with a comprehensive understanding of data science concepts, techniques, and tools.

Course Outcomes (COs):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understand the foundational concepts of data science, including its history, significance, and the data science process.	1, 2	-
2.	Apply statistical methods and data analysis techniques to interpret and draw insights from complex datasets.	3	1
3.	Utilize data visualization tools and techniques to effectively communicate findings and insights to diverse audiences.	2, 3, 5	-

Course Contents:

Module –1	**8 Hrs.**
Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, The Current landscape (with a little history) Data Science Job, A Data Science Profile. Statistical Inference, Exploratory Data Analysis and the Data Science Process, Statistical Thinking in the Age of Big Data, Statistical Inference, Populations and samples, Populations and samples of Big Data, Big Data can Mean Big Assumptions, Modeling, Exploratory Data Analysis, Philosophy of Exploratory Data Analysis, Exercise: EDA, the Data Science Process, The Data Scientist's Role in this Process.	
Module –2	**8 Hrs.**
Algorithms, Machine Learning Algorithm, Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbors (kNN), k-means, Naive Bayes, Bayes Law, A Spam Filter for Individual Words, A Spam Filter That Combines Words: Naïve Bayes Exercise: Basic Machine Learning Algorithms, Spam Filters, Naïve Bayes and Wrangling, Logistic Regression, Thought Experiment Classifiers, Logistic Regression Case Study, Estimating α *and* β , Newton's Methods, Stochastic Gradient Descent, Implementation, Evaluation, Sample R Code.	
Module –3	**8 Hrs.**
Time Stamps and Financial Modeling, Kyle Teague and GetGlue, Timestamps, Exploratory Data Analysis (EDA), Metrics and New Variables or Features, Financial Modeling, In Sample, Out-of-Sample and Causality, Preparing Financial Data, Log Returns.	
Module – 4	**8 Hrs.**

Extracting Meaning from Data, Background: Data Science Competitions, Background Crowdsourcing, The Kaggle Model, A Single Contestant, Their Customers, Data Visualization and Fraud Detection, Data Visualization History, A Sample of Data Visualization Projects, Marks Data Visualization, Data Science and Risk, About Square, The Risk Challenge, The Trouble with Performance Estimation, Model Building Type.	
Module –5	**8 Hrs.**
Data Engineering: MapReduce, Pregel, and Hadoop, MapReduce, Word Frequency Problem, Enter MapReduce, Other Examples of MapReduce, Pregel, Thought Experiment, On Being a Data Scientist, Data Abundance Versus Data Scarcity, Designing Models, Economic Interlude: Hadoop, A Brief Introduction to Hadoop, Cloudera, Next-Generation Data Scientist, Hubris, and Ethics.	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Doing Data Science - Straight Talk from The Frontline, by CathyO' Neiland Rachel Schutt, O'Reilly 2014. 2. Data Science from Scratch: First Principle with Python, by Joel Grus, Second Edition, 2019	
REFERENCE BOOKS: 1. The Elements of Statistical Learning, by Trevor Hastie, Robert Toshigami and Jerome Friedman, Second Edition, 2009	

Course Title	**Data Structures & Algorithms for Problem Solving**		
Course Code	**25MCS13**	**L-P- SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To reduce development time and the resources required to maintain existing application. To increase code reuse and provide a competitive advantage through effective use of data structures and algorithm.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze and apply fundamental data structures and algorithms to solve complex computational problems effectively	1, 2, 3, 5	-
2.	Evaluate and implement various searching, sorting to optimize algorithm performance.	4	-
3.	Design and analyze advanced tree and graph algorithms, including balanced search trees and graph traversal methods, to address real-world applications	3, 4, 5, 11	1

Course Contents:

Module –1	**8 Hrs.**
Elementary Data Structures: Data Structure Classification – Primitive and Non-Primitive, Linear – Static-Array, Dynamic-Linked List, Stack, Queue, Non Linear – Tree, Graph. **Search Trees:** Two Models of Search Trees. General Properties and Transformations. Height of a Search Tree. Basic Find, Insert, and Delete. Returning from Leaf to Root. Dealing with Non unique Keys. Queries for the Keys in an Interval. Building Optimal Search Trees. Converting Trees into Lists. Removing a Tree.	
Module –2	**8 Hrs.**
Balanced Search Trees: Height-Balanced Trees. Weight-Balanced Trees. (a, b)- And B-Trees. Red-Black Trees and Trees of Almost Optimal Height. Top-Down Rebalancing for Red-Black Trees. **Tree Structures for Sets of Intervals**. Interval Trees. Segment Trees. Trees for the Union of Intervals. Trees for Sums of Weighted Interval. Trees for Interval-Restricted Maximum Sum Queries. Orthogonal Range Trees. Higher-Dimensional Segment Trees. Other Systems of Building Blocks. Range-Counting and the Semi group Model. Kd-Trees and Related Structures.	
Module –3	**8 Hrs.**
Heaps: Balanced Search Trees as Heaps. Array-Based Heaps. Heap-Ordered Trees and Half Ordered Trees. Leftist Heaps. Skew Heaps. Binomial Heaps. Changing Keys in Heaps. Fibonacci Heaps. Heaps of Optimal Complexity. Double-Ended Heap Structures and Multidimensional Heaps. Heap-Related Structures with Constant-Time Updates.	

Module – 4	**8 Hrs.**
Graph Algorithms: Bellman-Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkers on method; Maximum bipartite matching. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.	
Module –5	**8 Hrs.**
String-Matching Algorithms: Naïve string Matching; Rabin-Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer– Moore algorithms.	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Advanced Data Structures, by Peter Brass, Cambridge University Press, 2008. 2. Algorithms, by Kenneth A. Berman, Cengage Learning. 2002. 3. Introduction to Algorithms, by T. H Cormen, C E Leiserson, R L Rivestand and C Stein. Third Edition, PHI, 2010	
REFERENCE BOOKS: 1. Data Structures and Algorithm Analysis in C++, by Mark Allen Weiss, Fourth Edition, 2014, Pearson. 2. Data structures with Java, by Ford and Topp, Pearson Education. 3. Fundamentals of Computer Algorithms, by Ellis Horowitz, SartajSahni, S. Rajasekharan, Second Edition, Universities press, 2007 4. Data structures and Algorithms in Java, by M.T. Goodrich, R. Tomassia, Third edition, Wiley India Edition.	

Course Title	**Python for Data Science**		
Course Code	**25MCS14**	**L-P-SDA-C**	**2-2-0-4**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**50**

Course objective: To provide students with a comprehensive understanding of implementation of Data Science concepts using Python Programming.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understand the fundamentals of Data Science and Database Systems	1, 2	-
2.	Explore data analysis, data science process, and Python programs for the algorithms	3, 5	-
3.	Analyze the proficiency in creating data visualizations using tools like Matplotlib and seaborn	3, 5, 11	-
4.	Ability to manipulate, clean and analyze datasets using Python libraries such as Pandas and NumPy.	5	-

Course Contents:

Module –1	**10 Hrs.**
Introduction: AI, Machine Learning, and Data Science, What is Data Science? Data Science Classification, Data Science Algorithms **Introduction to RDBMS**: Definition and Purpose of RDBMS Key Concepts: Tables, Rows, Columns, and Relationships, Primary Keys, Foreign keys, Unique, Relationships: One-to-One, One-to-Many, Many-to Many. **SQL Basics:** SELECT, INSERT, UPDATE, and DELETE, Importance of RDBMS in Data Management for Data Science.	
Module –2	**10 Hrs.**
Data Science Process: Prior Knowledge, Data Preparation, Modeling, Application. **Data Exploration:** Objectives of Data Exploration, Datasets, Descriptive Statistics, Data Visualization. Why Python for Data Analysis? Essential Python Libraries, Installation and Setup. **Python Language Basics, IPython, and Jupyter Notebooks:** The Python Interpreter, IPython Basics, Python Language Basics.	
Module –3	**10 Hrs.**
Built-In Data Structures, Functions, and Files: Data Structures and Sequences, Functions, Files and the Operating System. **NumPy Basics: Arrays and Vectorized Computation:** The NumPy and array: A Multidimensional Array Object, Pseudorandom Number Generation, Universal Functions: Fast Element-Wise	

ArrayFunctions, Array-Oriented Programming with Arrays, File Input and Output with Arrays, Linear Algebra.
Module – 4 **10 Hrs.**
Getting Started with pandas: Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics. **Data Loading, Storage, and File Formats:** Reading and Writing Data in Text Format, Binary Data Formats, interacting with Web APIs, Interacting with Databases.
Module –5 **10 Hrs.**
Data Cleaning and Preparation: Handling Missing Data, Data Transformation, Extension Data Types, String Manipulation, Categorical Data. **Plotting and Visualization**: A Brief matplot lib API Primer, Plotting with pandas and sea born.
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.
TEXT BOOKS: 1. Data-Science-Concepts-and-Practice, by Vijay Kotuand, Bala Deshpande, Morgan Kaufmann publisher, Second Edition Elsevier, 2019. (1.1,1.2,1.4,1.5,2.1,2.2,2.3,2.4, 3.1,3.2,3.3,3.4 2. Python for Data Analysis, by Wes McKinney, Second Edition, 2018. (1.2,1.3,1.4, 2.1,2.2,2.3, 3.1,3.2,3.3, 4.1 to 4.6, 5.1 -5.3, 6.1-6.4, 7.1 -7.5, 9.1-9.3**)**
REFERENCE BOOKS: 1. An Introduction to Statistical Learning, by Gareth James, Daniela Witten, Trevor Hastie, and Robert Toshigami, Second Edition, 2021. 2. The Elements of Statistical Learning, by Trevor Hastie, Robert Toshigami, and Jerome Friedman, Second Edition, 2009. 3. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, by Foster Provost and Tom Fawcett, Second Edition, 2013.

Course Title	**Deep Learning**		
Course Code	**25MCS15**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To provide students with a comprehensive understanding of deep learning algorithms and techniques, enabling them to apply these methods to solve real-world problems and evaluate their performance using appropriate metrics.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understand the basics of Machine Learning	1	-
2.	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.	1, 3	-
3.	Implement deep learning algorithms and solve real-world problems.	2, 5	1
4.	Execute performance metrics of Deep Learning Techniques.	5	-

Course Contents:

Module –1	**8 Hrs.**
Machine Learning Basics: Learning Algorithms, Capacity, Over fitting and Under fitting, Hyper parameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics.	
Module –2	**8 Hrs.**
Machine Learning Basics (Conti…): Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning. **Deep Feed forward Networks:** Gradient-Based Learning, Hidden Units, Architecture Design, and Back Propagation.	
Module –3	**8 Hrs.**
Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.	
Module – 4	**8 Hrs.**
Convolutional Networks: The Convolution Operation, Motivation, Pooling, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms.	
Module –5	**8 Hrs.**

Sequence Modelling: Recurrent and Recursive Nets, Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks.

Skill Development Activities Suggested:

The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.

TEXT BOOKS:

1. Deep Learning, by Lan Good fellow and Yoshua Bengio MIT Press 2016.

REFERENCE BOOKS:

1. Neural Networks: Systematic Introduction, by Raúl Rojas 1996.

2. Pattern Recognition and Machine Learning, by Chirstopher Bishop 2007.

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Course Title	**AI Lab**		
Course Code	**25MCS16**	**L-P-SDA-C**	**0-4-0-2**
Exam	**03 Hours**	**Hours / Week**	**04**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**28**

Course objective: Implement and evaluate algorithm and AI in python programming language

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Conduct research independently	2, 4, 11	-
2.	Choose research designs, sampling designs, measurement and scaling techniques, and also different methods of data collections	2, 3, 11	2
3.	Statistically interpret the data and draw inferences	4, 5, 11	-

Course Contents:

Installation procedure of the required software must be demonstrated, carried out in groups and documented in the journal	
#	
1	Implement a simple linear regression algorithm to predict a continuous target variable based on a given dataset.
2	Develop a program to implement a Support Vector Machine for binary classification. Use a sample dataset and visualize the decision boundary.
3	Develop a simple case-based reasoning system that stores instances of past cases. Implement a retrieval method to find the most similar cases and make predictions based on them.
4	Write a program to demonstrate the ID3 decision tree algorithm using an appropriate dataset for classification.
5	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test it with suitable datasets.
6	Implement a KNN algorithm for regression tasks instead of classification. Use a small dataset, and predict continuous values based on the average of the nearest neighbours.
7	Create a program that calculates different distance metrics (Euclidean and Manhattan) between two points in a dataset. Allow the user to input two points and display the calculated distances.
8	Implement the k-Nearest Neighbor algorithm to classify the Iris dataset, printing both correct and incorrect predictions.
9	Develop a program to implement the non-parametric Locally Weighted Regression algorithm, fitting data points and visualizing results.
10	Implement a Q-learning algorithm to navigate a simple grid environment, defining the reward structure and analyzing agent performance.

Conduct of Practical Examination:

- Experiment distribution.
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution (Coursed to change in accordance with university regulations)
  - For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  - For laboratories having PART A and PART B
    - i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    - ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

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II Semester					
Course Type	**Course Code**	**Course Title**	**L-P-SDA (Hours)**	**Credits**	**Contact Hours**
PCC	25MCS21	Advances in Operating Systems	3-0-0	**3**	03
PCC	25MCS22	Big Data Analytics	3-0-0	**3**	03
PCC	25MCS23	Applications of Internet of Things	3-0-1	**4**	04
PEC	25MCS24X	Professional Elective Course 1	3-0-0	**3**	03
PEC	25MCS25X	Professional Elective Course 2	3-0-0	**3**	03
PCCL	25MCS26	Mini Project with Seminar	3-0-0	**3**	03
PCCL	25MCS27	Big Data Analytics Laboratory	0-4-0	**2**	04
SEC	25MCS28	Skill Enhancement for Research Excellence-1	0-2-0	**1**	02
Total				**22**	**25**

Professional Elective I (Information Technology)		**Professional Elective II** (Computing Technologies)	
Course Code	**Course title**	**Course Code**	**Course title**
25MCS241	Artificial Intelligence in Cyber Security	25MCS251	Natural Language Processing
25MCS242	Machine Vision	25MCS252	Advanced Database Management System
25MCS243	Cloud Computing	25MCS253	Block Chain Technology
25MCS244	Business Intelligence & Analytics	25MCS254	Pattern Recognition

Course Title	**Advances in Operating Systems**		
Course Code	**25MCS21**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To provide students with a comprehensive understanding of the characteristics of operating systems for multiprocessor and multicomputer architectures.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze the characteristics of operating systems for multiprocessor and multicomputer architectures.	1, 2	-
2.	Understand and address the challenges related to designing operating systems and their implications.	1, 2, 3	-
3.	Explore the latest trends in developing mobile operating systems and evaluate their impact on performance.	2, 5	1

Course Contents:

Module –1	**8 Hrs.**
Multiprocessor Operating Systems: System Architectures- Structures of OS – OS design issues – Process synchronization – Process Scheduling and Allocation- Memory Management.	
Module –2	**8 Hrs.**
Distributed Operating Systems: System Architectures- Design issues – Communication models – clock synchronization – mutual exclusion – election algorithms- Distributed Deadlock detection.	
Module –3	**8 Hrs.**
Distributed scheduling - Distributed shared memory - Distributed File system – Multimedia file systems - File placement – Caching.	
Module – 4	**8 Hrs.**
Database Operating Systems: Requirements of Database OS – Transaction process model – Synchronization primitives - Concurrency control algorithms.	
Module –5	**8 Hrs.**
Mobile Operating Systems: ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming - Runtime issues- Approaches to power management.	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	

TEXT BOOKS:

1. Advanced Concepts in Operating Systems, by M Singhal and NG Shivaratri, Tata McGraw Hill Inc, 2001

REFERENCE BOOKS:

1. Distributed Operating Systems, by A S Tanenbaum, Pearson Education Asia, 2001

2. Mobile Operating Systems, Source Wikipedia, General Books LLC, 2010

Course Title	**Big Data Analytics**		
Course Code	**25MCS22**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To equip students with the skills to analyze, interpret and derive insights from large, complex datasets using advanced tools and techniques for informed decision making.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Figure out concepts of managing big data using Hadoop and SPARK technologies	1, 11	-
2.	Explain HDFS and MapReduce concepts	1, 3	-
3.	Install, configure, and run Hadoop and HDFS	1, 3, 5	-
4.	Perform map-reduce analytics using Hadoop and related tools.	1, 5, 8	1

Course Contents:

Module –1	**8 Hrs.**
Meet Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals MapReduce: A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming The Hadoop Distributed File systemThe Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, HadoopFilesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write.	
Module –2	**8 Hrs.**
YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness. Hadoop I/O Data Integrity, Data Integrity in HDFS, Local File System, Checksum File System, Compression, Codecs, Compression and Input Splits, Using Compression in Map Reduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: Sequence File.	

Module –3	**8 Hrs.**
Developing a Map Reduce Application: The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The Map Reduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, Map Reduce Workflows: Decomposing a Problem into Map Reduce Jobs, Job Control, Apache Oozie How Map Reduce Works Anatomy of a Map Reduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers.	
Module – 4	**8 Hrs.**
Map Reduce Types and Formats: Map Reduce Types, Input Formats: Input Splits and Records, Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output, Flume Installing Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog.	
Module –5	**8 Hrs.**
Pig Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data. **Spark An Example:** Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Hadoop: The Definitive Guide, by Tom White, 3rd Edition, O'Reilley, 2012. 2. SPARK: The Definitive Guide, by Bill Chambers MateiZaharia, O'Reilley 2018.	

REFERENCE BOOKS:

1. Apache Flume: Distributed Log Collection for Hadoop, by D'Souza and Steve Hoffman O'Reilley 2014.

Course Title	**Applications of Internet of Things**		
Course Code	**25MCS23**	**L-P-SDA-C**	**3-0-1-4**
Exam	**03 Hours**	**Hours / Week**	**04**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**50**

Course objective: To provide students with a comprehensive understanding of distributed databases, transaction management, object-oriented databases, temporal and spatial databases, deductive databases, active databases and multimedia database systems.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop schemes for the applications of IOT in real time scenarios	1, 2, 3	-
2.	Manage the Internet resources	2	-
3.	Model the Internet of things to business	1, 2, 3	-
4.	Work with different case studies with the practical knowledge gained.	4	-

Course Contents:

Module –1	**8 Hrs.**
What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation. Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Application Examples Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation.	
Module –2	**8 Hrs.**
Automotive Applications, Home Automation, Smart Cards, Tracking, Over. The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications. Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches.	
Module –3	**8 Hrs.**
Constrained Application Protocol, Representational State Transfer, ETSI M2M,,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF Ipv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M.	
Module – 4	**8 Hrs.**
Cellular and Mobile Network Technologies for IoT/M2M, Layer 3 Connectivity: Ipv6 Technologies for the IoT, Overview and Motivations. Address Capabilities, Ipv6 Protocol Overview, Ipv6 Tunnelling, Ipsec in Ipv6, Header Compression Schemes.	

Module –5	**8 Hrs.**
Quality of Service in Ipv6, Migration Strategies to Ipv6 Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.	
Skill Development Activities Suggested (10Hrs): The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Building the Internet of Things with Ipv6 and MIPv6: The Evolving World of M2M Communications, by Daniel Minoli Wiley 2013. 2. Internet of Things: A Hands-on Approach, by Arshdeep Bahga, Vijay Madisetti Universities Press 2015.	
REFERENCE BOOKS: 1. The Internet of Things, by Michael Miller, First Edition, Pearson 2015. 2. Designing Connected Products, by Claire Rowland, Elizabeth Goodman et.al, First Edition, O'Reilly, 2015.	

Course Title	**Artificial intelligence in Cyber Security**		
Course Code	**25MCS241**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To provide students with the knowledge and skills to apply artificial intelligence technique for enhancing threat detection, prevention and response in cyber security.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify cyber threats and limitations of machine learning in security.	1, 3, 4, 7	-
2.	Apply machine learning methods to detect anomalies.	3, 5	-
3.	Apply feature generation and the theory of network defense.	3, 5	-
4.	Apply supervised learning for abuse problems.	1, 2, 4	-

Course Contents:

Module –1	**8 Hrs.**
Cyber threats and landscape, The cyber attack's economy, What is Machine learning?, Real-world uses of Machine learning in Security, Spam fighting: an iterative approach, Limitations of machine learning in Security, Training algorithms to learn.	
Module –2	**8 Hrs.**
Supervised classification algorithms, Practical consideration in classification, Clustering, When to use anomaly detection versus supervised learning, Intrusion detection with Heuristics, data-driven methods, feature engineering for anomaly detection, anomaly detection with data and algorithms, Challenges of using machine learning in anomaly detection.	
Module –3	**8 Hrs.**
Understanding malware, feature generation, from features to classification, Theory of Network defense, machine learning and network security, building a predictive model to classify network attacks.	
Module – 4	**8 Hrs.**
Monetizing the consumer web, types of abuse and the data that can stop them, Supervised learning for abuse problems, clustering abuse, further direction in clustering, defining machine learning system maturity and scalability.	
Module –5	**8 Hrs.**
Data quality, model quality, performance, maintainability, monitoring and alerting, Security and reliability, feedback and usability.	
Skill Development Activities Suggested:	

The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.
TEXT BOOKS: 1. Machine Learning and Security by Clarence Chio, David Freeman, Released February 2018 Publisher(s): O'Reilly Media, Inc.
REFERENCE BOOKS: 1. Hands-On Artificial Intelligence for Cybersecurity by Alessandro Parisi Released August 2019 Publisher(s): Packt Publishing.

Course Title	**Machine Vision**		
Course Code	**25MCS242**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To equip students with the knowledge and skills to develop algorithms and applications for analyzing, processing and interpreting visual data from the real word.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Implement fundamental image processing techniques required for computer vision	1, 3, 5	1
2.	Implement boundary tracking techniques	1, 3, 5	-
3.	Apply chain codes and other region descriptors	1, 3	-
4.	Apply Hough Transform for line, circle, and ellipse detections.	1, 2	

Course Contents:

Module –1	**8 Hrs.**
CAMERAS: Pinhole Cameras, 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.	
Module –2	**8 Hrs.**
Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, 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.	
Module –3	**8 Hrs.**
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	
Module – 4	**8 Hrs.**
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.	
Module –5	**8 Hrs.**
Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization, Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Computer Vision – A Modern Approach, by David A. Forsyth and Jean Ponce PHI Learning.	
REFERENCE BOOKS: 1. Computer and Machine Vision – Theory, Algorithms and Practicalities, by E. R. Davies, Fourth edition Elsevier, 2013.	

Course Title	**Cloud Computing**		
Course Code	**25MCS243**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To provide students with comprehensive concepts, architectures and services enabling them to design, deploy and manage cloud based solutions effectively.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Compare the strengths and limitations of cloud computing	1, 2	-
2.	Identify the architecture, infrastructure and delivery models of cloud computing	2, 5	-
3.	Apply suitable virtualization concept for the related application.	1, 5, 8	-
4.	Address the core issues of cloud computing such as security, privacy and interoperability.	2, 3, 8	-

Course Contents:

Module –1	**8 Hrs.**
Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.	
Module –2	**8 Hrs.**
Cloud Computing: Application Paradigms: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.	
Module –3	**8 Hrs.**
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization, Case Study: Xen a VMM based para virtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems	
Module – 4	**8 Hrs.**
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management,	

Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start- time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

Module –5	**8 Hrs.**

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis. Exercises and problems.

Skill Development Activities Suggested:

The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.

TEXT BOOKS:

1. Cloud Computing Theory and Practice, by Dan C Marinescu, Elsevier (MK) 2013.
2. Computing Principles and Paradigms, by RajkumarBuyya, James Broberg, Andrzej Goscinski Willey 2014.

REFERENCE BOOKS:

1. Cloud Computing Implementation, Management and Security, by John W Rittinghouse, James F Ransome CRC Press 2013.

MASTER OF TECHNOLOGY - ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

2025 - 27 BATCH SYLLABUS

Course Title	**Business Intelligence & Analytics**		
Course Code	**25MCS244**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: Empower students to analyze data, generate insights and support strategic decision making using advanced tools and methodologies.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the fundamentals of business intelligence and Link data mining with business intelligence.	1	-
2.	Apply various modelling techniques for suitable applications.	1, 5, 8	-
3.	Explain the data analysis and knowledge delivery stages.	3, 5	-
4.	Apply business intelligence methods to various situations.	5, 8	-

Course Contents:

Module –1	**8 Hrs.**
BUSINESS INTELLIGENCE: Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.	
Module –2	**8 Hrs.**
KNOWLEDGE DELIVERY: The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.	
Module –3	**8 Hrs.**
EFFICIENCY: Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices; cross efficiency analysis – virtual inputs and outputs – Other models. Pattern matching – cluster analysis, outlier analysis.	
Module – 4	**8 Hrs.**
BUSINESS INTELLIGENCE APPLICATIONS: Marketing models – Logistic and Production models – Case studies.	
Module –5	**8 Hrs.**
FUTURE OF BUSINESS INTELLIGENCE: Future of business intelligence – Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics – Advanced	

Visualization – Rich Report, Future beyond Technology.

Skill Development Activities Suggested:

The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.

TEXT BOOKS:

1. Decision Support and Business Intelligence Systems, by Efraim Turban, Ramesh Sharda, Dursun Delen, Ninth Edition, Pearson 2013.
2. Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making, by Larissa T. Moss, S. Atre, Addison Wesley, 2003.

REFERENCE BOOKS:

1. Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Vercellis ,Wiley Publications, 2009.
2. Business Intelligence: The Savvy Manager's Guide, David Loshin Morgan, Kaufman Second Edition, 2012.
3. Successful Business Intelligence: Secrets to Making BI a Killer App, Cindi Howson, McGraw- Hill, 2007. 4. The Data Warehouse Lifecycle Toolkit, Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, , Wiley Publication Inc.,2007

Course Title	**Natural Language Processing**		
Course Code	**25MCS251**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To enable students to develop systems and algorithms that understand, interpret and generate human language for various real world applications.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the fundamental concept of NLP, grammar-based language model and statistical-based language model.	1, 2	-
2.	Model morphological analysis using Finite State Transducers and parsing using context-free grammar and different parsing approaches.	4, 10	-
3.	Apply the concepts of information retrieval, lexical semantics, lexical dictionaries such as WordNet, lexical computational semantics, distributional word similarity.	3, 5	-

Course Contents:

Module –1	**8 Hrs.**
OVERVIEW AND LANGUAGE MODELLING: Overview: Origins and challenges of NLP- Language and Grammar- Processing Indian Languages- NLP Applications-Information Retrieval. Language Modelling: Various Grammar-based Language Models-Statistical Language Model.	
Module –2	**8 Hrs.**
WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite State Automata- Morphological Parsing-Spelling Error Detection and correction-Words and Word Classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing Probabilistic Parsing.	
Module –3	**8 Hrs.**
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.	
Module – 4	**8 Hrs.**
Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual	

Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically Based Text Mining: Related Work, A Semantically Guided Model for Effective Text Mining.

Module –5	**8 Hrs.**

Information Retrieval And Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical. Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Skill Development Activities Suggested:

The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.

TEXT BOOKS:

1. Natural Language Processing and Information Retrieval, by TanveerSiddiqui, U.S. Tiwary, Oxford University Press, 2008.
2. Natural Language Processing and Text Mining, by Anne Kao and Stephen R. Potee, Springer-Verlag London Limited. 2007.

REFERENCE BOOKS:

1. Speech and Language Processing: Anintroduction to Natural Language Processing, by Computational Linguistics and SpeechRecognition. Daniel Jurafsky and James H Martin. Prentice Hall, 2008 2nd Edition.

2. Natural Language Understanding, by James Allen. Benjamin/Cumming, Second Edition, publishing company, 1995.

3. Information Storage and Retrieval systems. Gerald J. Kowalski and Mark.T. Maybury. Kluwer academic Publishers, 2000.

4. Natural Language Processing with Python.Steven Bird, Ewan Klein, Edward Loper. O'Reilly Media, 2009.

Course Title	**Advanced Database Management System**		
Course Code	**25MCS252**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To provide students with a comprehensive understanding of distributed databases, transaction management, object-oriented databases, temporal and spatial databases, deductive databases, active databases and multimedia database systems.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understanding of fundamental Database concepts and apply Normalization techniques to design efficient database schemas.	1, 2	-
2.	Analyze distributed database principles, functions of NOSQL databases and big data technologies for handling large scale data with hadoop and map reduce.	2, 3	-
3.	Analyze data mining techniques and data warehousing concepts for effective data management and decision making.	2, 3	-
4.	Design and implement solutions with map reduce and data models for processing and managing complex data.	3, 5, 11	-

Course Contents:

Module –1	**8 Hrs.**
Database System Concepts: Data models, schemas, instance, three schema architecture, data independence, database language, interface, functional dependencies, normal form based on primary key, second normal form, third normal form, Boyce-codd normal formal form, multi-valued dependency and fourth normal form.	
Module –2	**8 Hrs.**
Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database , Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalog Management.	
Module –3	**8 Hrs.**
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. **Big Data Technologies Based on MapReduce and Hadoop**: What Is Big Data? Introduction to Map Reduce and Hadoop, Hadoop Distributed File System (HDFS).	

Module – 4	**8 Hrs.**
Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases.	
Module –5	**8 Hrs.**
Data Mining: overview of data mining technology, Association rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools. **Overview of Data Warehousing and OLAP:** Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modeling for Data Warehouses.	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS: 1. Fundamentals of Database Systems, by Elmasri and Navathe, Pearson Education, 2013. 2. Database Management Systems, by Raghu Ramakrishnan and Johannes Gehrke, Third Edition, McGraw-Hill, 2013.	
REFERENCE BOOKS: 1. Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Sixth Edition McGraw Hill, 2010.	

Course Title	**Block Chain Technology**		
Course Code	**25MCS253**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To explore the Block Chain technology, its applications and ability to develop decentralized applications using Block Chain frameworks..

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Interpret the types, benefits and limitation of block chain.	2, 4, 7	-
2.	Explore the block chain decentralization and cryptography concept.	1, 4	-
3.	Enumerate the Bitcoin features and its alternative options.	2, 10	-

Course Contents:

Module –1	**8 Hrs.**
Block chain 101: Distributed systems, History of block chain, Introduction to block chain, Types of block chain, CAP theorem and block chain, Benefits and limitations of block chain.	
Module –2	**8 Hrs.**
Decentralization and Cryptography: Decentralization using block chain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys	
Module –3	**8 Hrs.**
Bitcoin and Alternative Coins A: Bitcoin, Transactions, Block chain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash	
Module – 4	**8 Hrs.**
Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum block chain, Elements of the Ethereum block chain, Precompiled contracts.	
Module –5	**8 Hrs.**
Alternative Block Chains: Block chains Block chain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media	
Skill Development Activities Suggested: The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.	
TEXT BOOKS:	

1. Bashir, Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition, 2nd Revised edition edition. Birmingham: Packt Publishing, 2018.
2. Bitcoin and Cryptocurrency Technologies, by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016

REFERENCE BOOKS:

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps, by Daniel Drescher, First Edition, Apress, 2017
2. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, First Edition, O'Reilly Media, 2014

Course Title	**Pattern Recognition**		
Course Code	**25MCS254**	**L-P-SDA-C**	**3-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course objective: To equip students with the knowledge and techniques to identify patterns in data through statistical, machine learning and computational methods for real-world applications

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain pattern recognition principals	2, 3	-
2.	Choose appropriate algorithms for Pattern Recognition.	3, 5	-
3.	Apply Decision tree and clustering techniques to various applications	5	-

Course Contents:

Module –1	**8 Hrs.**
Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems	
Module –2	**8 Hrs.**
Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation	
Module –3	**8 Hrs.**
Nearest Neighbour based classifiers & Bayes classifier: Nearest neighbour algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network	
Module – 4	**8 Hrs.**
Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM	
Module –5	**8 Hrs.**
Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, kmeans, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition	
Skill Development Activities Suggested:	

The students with the help of the course faculty can take up relevant technical activities which will enhance their skills. The prepared report shall be evaluated for CIE marks.
TEXT BOOKS: 1. Pattern Recognition: An Introduction, by V Susheela Devi, M Narsimha Murthy, Universities press, 2011. 2. Pattern Recognition & Image Analysis, Earl Gose, Richard Johnson baugh, Steve Jost , PH, 1996.
REFERENCE BOOKS: 1. Pattern Classification, by Duda R. O., P.E. Hart, D.G. Stork, John Wiley and sons, 2000.

Course Title	**Mini Project**		
Course Code	**25MCS26**	**L-P-SDA-C**	**0-6-0-3**
Exam	**03 Hours**	**Hours / Week**	**06**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**40**

Course Objective: Design and implement solution for an identified real world problem.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Identify the requirements of a chosen real world problem	1, 2, 6, 7	1
2	Design the solution for the chosen problem and document the same.	1, 3, 4, 10	-
3	Implement the design using appropriate tools	3, 5, 8, 11	2
4	Demonstrate the project work along with report	1, 5, 10	2
5	Demonstrate the ability to work effectively as a project member.	1, 9	2

Mini-Project: Each student shall involve in carrying out the project work in constant consultation with internal guide/co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

The Project team must submit a Brief Project Report (25 to 30 Pages) after completion with the following contents

- Introduction
- Requirements
- Development Process and Models Adopted
- Analysis and Design Models
- Implementation
- Testing

The project report will be evaluated for 25 marks, Demonstration for 50 marks and Viva Voce for 25 marks.

Rubrics for Evaluation of Mini Project					
Phase I (Project Proposal Submission and Evaluation Scheme):					
After finalizing the topic with the guidance of Supervisor, students should submit the project proposal along with Synopsis not exceeding 10 pages. Approval of synopsis is done for 15 marks by concerned project committee.					
SL No.	**Performance Indicators**	**Needs Improvement (0-1 mark)**	**Average (2-3 marks)**	**Good (4-5 marks)**	**Max marks**
1	Literature Survey	Survey of	Survey of	Literature	5

		literature is not recent or no literature survey	literature is not clear	survey is sufficient.	
2	Synopsis writing	Objective of the work is not identified.	Objective of the work is identified but no evidence of Inter disciplinary approach found.	Objective of the work is identified with evidence of Inter disciplinary approach found.	5
3	Presentation	Contents not delivered completely.	Contents not delivered clearly.	Contents delivered clearly with confidence.	5
				Total	**15**

Phase II (Project Progress):					
Evaluation of project phase II is carried out by evaluation committee.					
SL No.	**Performance Indicators**	**Needs Improvement (0-1 mark)**	**Average (2-3 marks)**	**Good (4-5 marks)**	**Max marks**
1	System design and development	System specification is not identified.	System specification is identified but not satisfactory.	System specification is identified correctly.	5
2	Identification of appropriate tool for application	Application tools are not identified.	Application tools identified but not used.	Application tools identified and used.	5
3	Oral presentation	Entire contents not delivered.	Contents not delivered clearly.	Contents delivered clearly with confidence.	5
				Total	**15**

Phase III (Project Demonstration):					
Evaluation of project phase III is carried out by evaluation committee.					
SL No.	**Performance Indicators**	**Needs Improvement (0-1 mark)**	**Average (2-3 marks)**	**Good (4-5 marks)**	**Max marks**
1	Design and Implementation	Not done	Incomplete.	Complete.	5
2	Demonstration	Incomplete	Complete but not satisfactory.	Complete and satisfactory	5
3	Documentation	Organization and clarity of report and technical content is not clear and complete	Organization and clarity of report and technical content is clear but not complete.	Organization and clarity of report and technical content is clear and complete.	5
4	Oral presentation	Presentation with ppt is not clear.	Presentation with ppt is clear but not satisfactory	Presentation with ppt is clear and satisfactory.	5
				Total	**20**

Semester End Evaluation				
Evaluation committee consists of panel of examiners containing external as well as internal evaluators. This evaluation is carried out for 50 marks.				
SL No.	**Performance Indicators**		**Marks allocated**	**Marks awarded**
1	Project Execution	Project specification	5	
		Progress	5	
	Methodology/Result Analysis	System Design	5	
		System Implementation	5	
		System Testing	5	
	Project Report	Organization and Clarity	5	
		Technical content	5	
		Conclusion and Future Work	5	

Final Presentation		10	
Total Marks		50	
Rubrics for Semester End Exam			
	Marks	**Overall Criteria**	
1	48-50	Project is reaching professional standards.	
2	40-47	Project is excellent and may contain publishable material. Presentation is excellent.	
3	35-39	Project and presentation are very good. All design aims are met.	
4	30-34	Project and presentation are good. Most design aims are met.	
5	25-29	Minimum core of design aims has been met. Presentation is satisfactory.	
6	20-24	Design aims and implementation are met partially. Presentation is moderate.	
7	0-20	Most design aims are not met and implementation does not work. Presentation is not satisfactory.	

Course Title	**Big Data Analytics Laboratory**		
Course Code	**25MCS27**	**L-P-SDA-C**	**0-4-0-2**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**28**

Course objective: Impart the architectural concepts of Hadoop and practice programming tools PIG and HIVE in Hadoop eco system.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply various suitable scripts using suitable MapReduce, Hadoop and Hive system	2, 3, 5	-
2	Implement, document and present the Data Analytics projects for the chosen problems.	4, 5, 11	-

Course Contents:

Demonstration:

Install VMWare to setup the Hadoop environment and its ecosystems.

Implement the basic commands of LINUX Operating System – File/Directory creation, deletion, update operations.

#	Experiments
1	Implement the following file management tasks in Hadoop: i. Adding files and directories ii. Retrieving files iii. Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities
2	Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
3	Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.
4	Implement matrix multiplication with Hadoop Map Reduce
5	Run the Pig Latin Scripts to find Word Count.
6	Run the Pig Latin Scripts to find a max temp for each and every year.
7	Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

Conduct of Practical Examination:

- Experiment distribution.
  - For laboratories having only one part: Students are allowed to pick one experiment

from the lot with equal opportunity.
    - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution (Coursed to change in accordance with university regulations)
    - For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
    - For laboratories having PART A and PART B
        - i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
        - ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

Course Title	**Skill Enhancement for Research Excellence-1**		
Course Code	**25MCS28**	**L-P-SDA-C**	**0-2-0-1**
Exam	**03 Hours**	**Hours / Week**	**03**
CIE	**50 Marks**	**SEE**	**50 Marks**
		Total hours	**28**

Course Objective: To provide students with an opportunity to delve into a specific topic within the field of AI and data science, conduct independent research, and demonstrate their understanding and analytical skills.

Course Outcomes (Cos):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Develop advanced research and analytical skills for further study, research, and professional work in the field of artificial intelligence and data science	1, 2, 3, 4, 5, 8, 9, 11	1, 2

The term paper is an integral part of the course and provides students with an opportunity to investigate a specific topic within the discipline. Here are some important considerations regarding Term Paper:

- The primary objective of Term Paper is to provide students with the opportunity to conduct autonomous research, delve into a specific area of interest, and demonstrate their comprehension of AI and data science concepts.
- Students are typically permitted to select an AI and data science-related topic that corresponds with their interests and academic objectives. The subject must be well-defined, specific, and pertinent to the course material.
- Students are expected to conduct an exhaustive investigation in order to collect pertinent data, scholarly articles, research papers, and case studies pertinent to their chosen topic. They should evaluate the gathered data critically and draw meaningful conclusions.
- Students are encouraged to demonstrate originality and creativity in their term papers while building on prior knowledge. This may involve proposing new approaches, addressing emerging challenges, or recommending innovative solutions within their selected subject area.
- Depending on the nature of the topic, students may use a variety of research methodologies or examine authentic datasets. It is essential to explicitly describe the methodology employed and justify its selection.
- The term paper should have a distinct introduction, a coherent body, and a succinct conclusion. To improve intelligibility, students should maintain a logical flow and provide appropriate transitions between sections.

- It is essential to properly cite all sources consulted throughout the research process. Students must use the recommended citation style (e.g., APA, MLA) and provide a complete inventory of references at the conclusion of their papers.
- Writing and Presentation Skills: The term paper requires effective communication. Students should ensure that their writing is concise, plain, and error-free. In addition, they may be required to present and defend their term paper, demonstrating their presentation and public speaking skills.
- Throughout the term paper, students must adhere to academic integrity principles. Plagiarism and other forms of intellectual dishonesty are strictly prohibited and carry severerepercussions.
- The term paper will be evaluated based on the faculty's provided criteria. Research profundity, critical analysis, clarity of writing, originality, and adherence to guidelines may be considered when assigning a grade.

SCHEME FOR TERM PAPER EVALUATION (CIE & SEE)

Sl. No.	Particulars	CIE Marks	SEE Marks
1.	Topic selection, Organization, and Clarity	5	5
2.	Literature Review and Research Methodology	10	10
3.	Findings and Analysis	15	15
4.	Discussion and Conclusion	10	10
5.	Presentation	10	10
Total		50	50

Scheme & Syllabus for II Year (2025-27 Batch)

M.Tech. - Artificial Intelligence and Data Science

Academic Year 2026-27

For the students who are willing to take up a two-semester duration Industry/Research Internship Leading to Project work /start-up					
III Semester (A)					
Course	**Course Code**	**Course Title**	L-P-SDA	**Total Credits**	**Total Contact Hours**
PEC	25MCS31A	(Online Courses) 12 weeks duration		3	--
PEC	25MCS32A	(Online Courses) 12 weeks duration		3	--
PEC	25MCS33A	(Online Courses) 12 weeks duration		3	--
INT	25MINT34A	Research Internship /Industry-Internship leading to project work/ Startup	Two-semester duration, SEE in the IV semester which leads to project work /start-up	3	--
Total			**0-0-0**	**12**	**--**

IV Semester (A)					
Course	**Course Code**	**Course Title**	L-P-SDA	**Total Credits**	**Total Contact Hours**
INT	25MINT41A	Research Internship / Industry Internship Leading to Project Work/Start-up	Two Semester Duration	12	--
PRJ	25MCS42A	Project Work	0-16-0	16	--
Total			**0-0-0**	**28**	**--**

INT: Industry/ Research Internship leading to the project work /startup **PRJ:** Project work outcome of Internship (Project Phase-II is Viva voce SEE)

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

Research Internship: A research internship is an opportunity for students or early career professionals to gain hands-on experience in conducting research under the guidance of a mentor or within a research team. These internships can take place in academic institutions, research organizations, government agencies, or private companies

Research /Industry Internship: In the third-semester Students have to be in touch with a guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE at the parent Institute.

Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

24Mxx301 to 303: MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd or 4th semester.

For the students who are willing to take an Industry Internship for one-semester duration and independent project work next semester

III Semester (B)

Course	Course Code	Course Title	L-P-SDA	Total Credits	Total Contact Hours
PEC	25MCS31B	(Online Courses) 12 weeks duration		3	--
PEC	25MCS32B	(Online Courses) 12 weeks duration		3	--
PEC	25MCS33B	(Online Courses) 12 weeks duration		3	--
INT	25MINT34B	Industry - Internship	One - semester duration	11	--
Total			**0-0-0**	**20**	**--**

IV Semester (B)

Course	Course Code	Course Title	L-P-SDA	Total Credits	Total Contact Hours
PRJ	25MCS41B	Project Work	0-20-0	20	--
Total			**0-20-0**	**20**	**--**

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned. The students who take up a one-semester Internship in the Industry have to appear SEE at the institute at the end of the semester as per the examination calendar.

Project Work: Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through Power Point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident

CIE marks for the project report (20 marks), seminar (20 marks) and question and answer (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of internal guide and a faculty from the department with the senior most acting as the Chairperson. **Semester End Examination** SEE marks for the project report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of the report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

24Mxx301 to 303: MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd or 4th semester.

For the students who are willing to take a research-leading paper publication in Q1/Q2/Q3 Journals and to a PhD Registration

III Semester (C)

Course	Course Code	Course Title	L-P-SDA	Total Credits	Total Contact Hours
PEC	25MCS31C	(Online Courses) 12 weeks duration		3	--
PEC	25MCS32C	(Online Courses) 12 weeks duration		3	--
PEC	25MCS33C	(Online Courses) 12 weeks duration		3	--
PEC	25MCS34C	(Online Courses) 12 weeks duration		3	
INT	25MCS35C	Project Work Phase - I	0-12-0	6	--
Total			**0-12-0**	**18**	**--**

IV Semester (C)

Course	Course Code	Course Title	L-P-SDA	Total Credits	Total Contact Hours
PRJ	25MCS41C	Project Work Phase - II	0-20-0	22	--
Total			**0-20-0**	**22**	**--**

Project Work Phase-1: Typically the initial phase in any project, is crucial as it lays the foundation for the entire project. This phase involves defining the project's scope, objectives, and initial planning. Here's a structured approach to effectively carry out Project Phase-I:

• Project Charter: Outlines the project's purpose, objectives, and stakeholders.

• Scope Statement: Defines the project boundaries and deliverables.

• Requirements Document: Captures all project requirements.

• Project Plan: Details the approach, timeline, and resource allocation.

• Risk Management Plan: Identifies and plans for potential risks.

• Feasibility Study Report: Assesses technical, economic, and operational feasibility.

Students in consultation with the guide shall carry out literature survey/visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a faculty, is required to

• Present the seminar on the selected project orally and/or through power point slides.

• Answer the queries and be involved in debate/discussion.

• Submit two copies of the typed report with a list of references.

• The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach the highest and become self-confident.

Continuous Internal Evaluation (100 Marks):

CIE marks for the project report (60 marks), seminar (20 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of an internal guide and a faculty from the department with the senior most acting as the Chairperson.

Project Work Phase-II: Each student shall be involved in carrying out the project work jointly in constant consultation with internal guide and external guide and prepare the project report as per the norms of the university to avoid plagiarism. Phase II of a project typically involves the detailed execution of the planned activities, continuous monitoring and control of the project's progress, and making necessary adjustments to ensure the project stays on track. Keep detailed records of all project activities, decisions, and changes. Ensure all project documentation is organized and accessible. Conduct a final project review to evaluate overall performance, achievements, and lessons learned. Document best practices and areas for improvement for future projects.

Paper Publication Process: Publishing a research paper based on your project in a Q1/Q2/Q3 journal involves several key steps, from writing the manuscript to navigating the peer review process. Here’s a comprehensive guide:

Writing the Manuscript: Choose a clear and concise title that accurately reflects the content. Write an abstract summarizing the research question, methods, results, and conclusions.

Literature Review: Review relevant existing research to establish the foundation of your study. Identify gaps that your research aims to fill.

Methodology: Describe the research design, methods, and procedures in detail. Include information on data collection, analysis, and any tools or software used.

Results: Present the findings of your research clearly and logically. Use tables, figures, and charts to illustrate key results.

Discussion: Interpret the results and explain their implications. Compare your findings with existing research and discuss any discrepancies or new insights.

Conclusion: Summarize the main findings and their significance. Suggest potential future research directions.

References: Cite all sources used in your research following the journal's citation style.

Journal Selection: Choose a journal that aligns with the scope and focus of your research. Consider the journal's impact factor (Q1, Q2, Q3) and audience.

Review Journal Guidelines: Carefully read the journal's submission guidelines and ensure your manuscript adheres to them.

Prepare Your Manuscript: Format your manuscript according to the journal's guidelines. Include all required sections and supplementary materials.

Cover Letter: Write a cover letter to the journal editor highlighting the significance of your research and why it fits the journal.

Submit the Manuscript: Use the journal's online submission system to submit your manuscript. Ensure all required information and documents are included.

Semester End Examination SEE marks for the project report (60 marks), seminar (20marks) and question and answer session (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

Course Title	**(Online Courses) 12 weeks duration**		
Course Code	**25MCS31*, 25MCS32*, 25MCS33* and 25MCS34C**	**Credits**	**03**

a) Courses (prescribed in respective program) to be completed in Third semester or Fourth semester, the student has to complete the online courses as notified by the department, offered by NPTEL and complete the courses irrespective of the number of attempts with final score (Online Assignments: 25% and Final Exam: 75%) leading to NPTEL Elite (60 to 75%)/Elite + Silver (76 to 89%)/Elite + Gold (> = 90%).

b) The student shall be permitted to drop the registered coursework & select alternative coursework in case they do not appear for the proctored exam or do not complete the proctored exam.

c) The Department shall announce the BOS approved list of MOOC Courses corresponding to each program. The department shall have the freedom to review and approve additional online courses from time to time.

d) The student shall choose the number of online courses with credits summing up to 9 credits from the list of approved online courses.

Course Title	**Research Internship /Industry-Internship leading to project work/ Startup**		
Course Code	**25MINT34A**	**L-P-SDA-C**	**0-0-0-3**
Exam	**03 Hours**	**Hours / Week**	**--**
CIE	**100 Marks**	**SEE**	**--**
		Total hours	**--**

Course Objective: To gain the perspective of work environment in Research organization/Industry.

Course Outcomes (COs):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply the domain knowledge in solving the real world problems.	1, 2	1
2	Work as a team member towards the chosen problem	9	-
3	Work with industry professionals and practice ethics in work environment.	8, 10, 11	-
4	Document, publish and present the work carried out.	9, 10, 11	2

Guideline:

INT: Industry/ Research Internship leading to the project work /startup **PRJ:** Project work outcome of Internship (Project Phase is Viva voce SEE)

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

Research Internship: A research internship is an opportunity for students or early career professionals to gain hands-on experience in conducting research under the guidance of a mentor or within a research team. These internships can take place in academic institutions, research organizations, government agencies, or private companies

Research /Industry Internship: In the third-semester Students have to be in touch with a

guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE at the parent Institute.

Internship Leading to Start-up: An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

Phase I Evaluation Rubrics for Industry/Research Internship (100 Marks Total) Includes: Topic Relevance, Application of Technology, Weekly Report (Diary), Presentation

Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (30M)	26-30	21-25	11-20	0-10
Ability to demonstrate effective oral and written communication skills (20M)	16-20	11-15	5-10	0-4
Presentation & Weekly Report (30M)	26-30	21-25	11-20	0-10
Ethical behavior and integrity (20M)	16-20	11-15	5-10	0-4

Course Title	**Research Internship /Industry-Internship leading to project work/ Startup**		
Course Code	**25MINT41A**	**L-P-SDA-C**	**0-0-0-12**
Exam	**03 Hours**	**Hours / Week**	**--**
CIE	**100 Marks**	**SEE**	**100**
		Total hours	**--**

Course Objective: To gain the perspective of work environment in Research organization/Industry.

Course Outcomes (COs):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply the domain knowledge in solving the real world problems.	1, 2	1
2	Work as a team member towards the chosen problem	9	-
3	Work with industry professionals and practice ethics in work environment.	8, 10, 11	-
4	Document, publish and present the work carried out.	9, 10, 11	2

Guideline:

INT: Industry/ Research Internship leading to the project work /startup **PRJ:** Project work outcome of Internship (Project Phase is Viva voce SEE)

Taking up a two-semester Industry/Research Internship that leads to project work or a start-up can be a highly rewarding experience for students. It allows them to apply theoretical knowledge in practical settings, gain valuable industry or research experience, and potentially develop innovative solutions or business ideas. Here are some key steps and considerations for students pursuing such an internship:

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned.

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Research /Industry Internship: In the third-semester Students have to be in touch with a

guide/mentor/coordinator and regularly submit the report referred to the progress internship. Based on the progress report the Guide/Mentor/coordinator has to enter the CIE marks at the end of the 3rd semester. At the beginning of the 4th semester, students have to define the project topic out of the learning due to the Internship, upon completion of the project work he/she has to attend the SEE at the parent Institute.

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Rubrics (CIE-100):

Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (20M)	Apply domain knowledge for design and development of all issues (20M)	Apply domain knowledge for design and development of most issues (15M)	Apply domain knowledge for design and development of specific issues (10M)	Unable to apply complete domain knowledge for design and development issues. (5M)
Ability to develop / implement the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/implement all the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/ implement most of the solutions with appropriate techniques, resources and contemporary tools (15M)	Able to develop/implement specific solutions with appropriate techniques, resources and contemporary tools (10M)	Not confident to develop/implement solutions with appropriate techniques, resources and contemporary tools (5M)
Ability to work independently and in collaboration / multidisciplinary environment. (20)	Able to work independently and in collaboration/ multidisciplinary environment. (20M)	Able to work independently with minimal guidance and in collaboration/ multidisciplinary environment. (15 M)	Able to work independently with more guidance and in collaboration/ multidisciplinary environment. (10M)	Unable to work independently without guide support and in collaboration/ multidisciplinary environment. (5M)
Ability to allocate time effectively and manage to complete the work allotted within appropriate time.	Able to allocate time effectively and complete all the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete most of the work allotted within appropriate time.	Able to allocate time effectively and manage to complete the work allotted (5M)	Unable to use time effectively and complete the work allotted.(3M)

(15M)		(10M)		
Ability to exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (15M)	Able to effectively exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (15M)	Able to moderately exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (10M)	Able to partially exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (6M)	Unable to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (3M)
Ability to demonstrate effective oral and written communication skills (10M)	Able to demonstrate effective oral and written communication skills (10M)	Able to demonstrate oral and written communication skills moderately. (7M)	Able to demonstrate oral and written communication skills minimally. (5M)	Unable to demonstrate effective verbal and written communication skills (2M)

Semester End Evaluation:

Scheme for Evaluation

Sl. No.	Particulars	Distribution of Marks
1	Ability to apply domain knowledge	**15**
2	Working Methodology	**20**
3	Ability to demonstrate effective oral and written communication skills	**30**
4	Internship Report	**15**
5	Ethical behavior, Integrity & Weekly Report	**20**
	Total	**100**

Course Title	**Project Work**		
Course Code	**25MCS42A**	**L-P-SDA-C**	**0-0-0-16**
Exam	**03 Hours**	**Hours / Week**	**--**
CIE	**100 Marks**	**SEE**	**100**
		Total hours	**--**

MAIN PROJECT:

Each student of the project batch shall be involved in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism. Follow the Software Development life cycle Data Collection, Planning, Design the Test cases Validation and verification of attained results. Significance of parameters w.r.t scientific quantified data. Publish the project work in referred Journal/conferences (UGC/SCOPUS/WoS)

Continuous Internal Evaluation:

SCHEME FOR EVALUATION

Sl. No.	**Particulars**	**Distribution of Marks**
1.	Project Report	30
2.	Paper publication	30
3.	Project Demonstration & Presentation	30
4.	Question and Answer	10
Total		**100**

Note: Plagiarism check shall be carried out for Project report using Turn-it-in with less than 25% similarity and Drill-bit with less than 10% similarity index.

Semester End Evaluation:

SCHEME FOR EVALUATION

Sl. No.	**Particulars**	**Distribution of Marks**
1.	Project Report	30
2.	Procedure Writing	15
3.	Project Demonstration & Presentation	40
4.	Question and Answer	15
Total		**100**

Course Title	**Industry - Internship**		
Course Code	**25MINT34B**	**L-P-SDA-C**	**0-0-0-11**
Exam	**03 Hours**	**Hours / Week**	**--**
CIE	**100 Marks**	**SEE**	**100**
		Total hours	**--**

Course Objective: To gain the perspective of work environment in Research organization/Industry.

Course Outcomes (COs):

Upon completion of the course, students shall be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply the domain knowledge in solving the real world problems.	1, 2	1
2	Work as a team member towards the chosen problem	9	-
3	Work with industry professionals and practice ethics in work environment.	8, 10, 11	-
4	Document, publish and present the work carried out.	9, 10, 11	2

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned. The students who take up a one-semester Internship in the Industry have to appear SEE at the institute at the end of the semester as per the examination calendar.

Rubrics (CIE-100):

Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (20M)	Apply domain knowledge for design and development of all issues (20M)	Apply domain knowledge for design and development of most issues (15M)	Apply domain knowledge for design and development of specific issues (10M)	Unable to apply complete domain knowledge for design and development issues. (5M)
Ability to develop / implement the solutions with appropriate techniques, resources and contemporary	Able to develop/implement all the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/ implement most of the solutions with appropriate techniques, resources and contemporary	Able to develop/implement specific solutions with appropriate techniques, resources and contemporary tools (10M)	Not confident to develop/implement solutions with appropriate techniques, resources and contemporary

tools (20M)		tools (15M)		tools (5M)
Ability to work independently and in collaboration / multidisciplinary environment. (20)	Able to work independently and in collaboration/ multidisciplinary environment. (20M)	Able to work independently with minimal guidance and in collaboration/ multidisciplinary environment. (15 M)	Able to work independently with more guidance and in collaboration/ multidisciplinary environment. (10M)	Unable to work independently without guide support and in collaboration/ multidisciplinary environment. (5M)
Ability to allocate time effectively and manage to complete the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete all the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete most of the work allotted within appropriate time. (10M)	Able to allocate time effectively and manage to complete the work allotted (5M)	Unable to use time effectively and complete the work allotted.(3M)
Ability to exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (15M)	Able to effectively exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (15M)	Able to moderately exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (10M)	Able to partially exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report. (6M)	Unable to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (3M)
Ability to demonstrate effective oral and written communication skills (10M)	Able to demonstrate effective oral and written communication skills (10M)	Able to demonstrate oral and written communication skills moderately. (7M)	Able to demonstrate oral and written communication skills minimally. (5M)	Unable to demonstrate effective verbal and written communication skills (2M)

Semester End Evaluation:

Scheme for Evaluation

Sl. No.	Particulars	Distribution of Marks
1	Ability to apply domain knowledge	**15**
2	Working Methodology	**20**
3	Ability to demonstrate effective oral and written communication skills	**30**
4	Internship Report	**15**
5	Ethical behavior, Integrity & Weekly Report	**20**
	Total	**100**

Course Title	**Project Work**		
Course Code	**25MCS41B**	**L-P-SDA-C**	**0-20-0-20**
Exam	**03 Hours**	**Hours / Week**	20
CIE	**100 Marks**	**SEE**	--
		Total hours	**--**

MAIN PROJECT:

Each student of the project batch shall be involved in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism. Follow the Software Development life cycle Data Collection, Planning, Design the Test cases Validation and verification of attained results. Significance of parameters w.r.t scientific quantified data. Publish the project work in referred Journal/conferences (UGC/SCOPUS/WoS)

Continuous Internal Evaluation:

SCHEME FOR EVALUATION

Sl. No.	**Particulars**	**Distribution of Marks**
5.	Project Report	30
6.	Paper publication	30
7.	Project Demonstration & Presentation	30
8.	Question and Answer	10
Total		**100**

Note: Plagiarism check shall be carried out for Project report using Turn-it-in with less than 25% similarity and Drill-bit with less than 10% similarity index.

Semester End Evaluation:

SCHEME FOR EVALUATION

Sl. No.	**Particulars**	**Distribution of Marks**
5.	Project Report	30
6.	Procedure Writing	15
7.	Project Demonstration & Presentation	40
8.	Question and Answer	15
Total		**100**

Course Title	**Project Work Phase - I**		
Course Code	**25MCS35C**	**L-P-SDA-C**	**0-6-0-6**
Exam	**03 Hours**	**Hours / Week**	**12**
CIE	**100 Marks**	**SEE**	**--**
		Total hours	**--**

Course Objective: To be able to identify a relevant problem that requires technical solution and conduct survey for the same.

Course Outcomes (COs):

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

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Identify a problem, through Extensive literature Survey leading to publication of a survey paper.	1, 2	1
2	Plan & design the solution to the chosen problem	3	-
3	Make oral presentation and documentation of the work carried out	9, 10	2

Course Contents:

Project Work Phase-1: Typically the initial phase in any project, is crucial as it lays the foundation for the entire project. This phase involves defining the project's scope, objectives, and initial planning. Here's a structured approach to effectively carry out Project Phase-I:

- Project Charter: Outlines the project's purpose, objectives, and stakeholders.
- Scope Statement: Defines the project boundaries and deliverables.
- Requirements Document: Captures all project requirements.
- Project Plan: Details the approach, timeline, and resource allocation.
- Risk Management Plan: Identifies and plans for potential risks.
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Students in consultation with the guide shall carry out literature survey/visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and be involved in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach the highest and become self-confident.

Continuous Internal Evaluation (100 Marks):

CIE marks for the project report (60 marks), seminar (20 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question

and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of an internal guide and a faculty from the department with the senior most acting as the Chairperson.

Course Title	**Project Work Phase - II**		
Course Code	**25MCS41C**	**L-P-SDA-C**	**0-20-0-22**
Exam	**03 Hours**	**Hours / Week**	**20**
CIE	**100 Marks**	**SEE**	**--**
		Total hours	**--**

Course Objective: Design and implement solution for the identified real world problem in Phase I

Course Outcomes (COs):

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

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Implement the design with appropriate techniques, resources and contemporary tools	3, 5	1
2	Communicate effectively with team members and mentors, make presentations and prepare technical document	9, 10, 11	-
3	Use ethical practices in all endeavors	8	-
4	Share the responsibilities for carrying out the project & playing individual roles appropriately	9	-
5	Implement the design with appropriate techniques, resources and contemporary tools	3, 5	2

Course Contents:

Project Work Phase-II: Each student shall be involved in carrying out the project work jointly in constant consultation with internal guide and external guide and prepare the project report as per the norms of the university to avoid plagiarism. Phase II of a project typically involves the detailed execution of the planned activities, continuous monitoring and control of the project's progress, and making necessary adjustments to ensure the project stays on track. Keep detailed records of all project activities, decisions, and changes. Ensure all project documentation is organized and accessible. Conduct a final project review to evaluate overall performance, achievements, and lessons learned. Document best practices and areas for improvement for future projects.

Paper Publication Process: Publishing a research paper based on your project in a Q1/Q2/Q3 journal involves several key steps, from writing the manuscript to navigating the peer review process. Here's a comprehensive guide:

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Literature Review: Review relevant existing research to establish the foundation of your study. Identify gaps that your research aims to fill.

Methodology: Describe the research design, methods, and procedures in detail. Include information on data collection, analysis, and any tools or software used.

Results: Present the findings of your research clearly and logically. Use tables, figures, and charts to

illustrate key results.

Discussion: Interpret the results and explain their implications. Compare your findings with existing research and discuss any discrepancies or new insights.

Conclusion: Summarize the main findings and their significance. Suggest potential future research directions.

References: Cite all sources used in your research following the journal's citation style.

Journal Selection: Choose a journal that aligns with the scope and focus of your research. Consider the journal's impact factor (Q1, Q2, Q3) and audience.

Review Journal Guidelines: Carefully read the journal's submission guidelines and ensure your manuscript adheres to them.

Prepare Your Manuscript: Format your manuscript according to the journal's guidelines. Include all required sections and supplementary materials.

Cover Letter: Write a cover letter to the journal editor highlighting the significance of your research and why it fits the journal.

Submit the Manuscript: Use the journal's online submission system to submit your manuscript. Ensure all required information and documents are included.

Semester End Examination SEE marks for the project report (60 marks), seminar (20marks) and question and answer session (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.