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ENGINEERS WITH
SOCIAL RESPONSIBILITY

PROGRAM: MASTER OF SCIENCE IN DATA SCIENCE, M.SC (DS)

PO No.	Program Outcomes
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

Course Outcomes (COs) – Program Outcomes (POs) – Program Specific Outcomes (PSOs)

PSO No.	Programme Specific Outcomes (PSOs)
PSO1	To model computational problems by applying mathematical concepts and solving real-world problems using algorithmic techniques.
PSO2	To apply the mathematical and statistical approaches for analyzing, designing and development of computing systems in interdisciplinary applications.
PSO3	To work as a socially responsible professional by drawing statistical inference using software tools in real-world problems.

SC613 Mathematical Foundation for Data Science (3-1-0-4)

Course Objective: To provide a strong foundation of the important mathematical concepts for modern data sciences, to be covered in two modules:

- Probability and Random Variables and
- Linear Algebra

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

- Course forms the foundation of most methods used in data science and machine learning [PO1, PO12].
- To help develop a better intuition for machine learning algorithms and not treat them as black boxes [PO2, PO4].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X	X		X								X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Course forms the foundation of most methods used in data science and machine learning	PO1, PO12 / PSO1	U	F, C
2	CO2: To help develop a better intuition for machine learning algorithms and not treat them as black boxes	PO2, PO4 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on data science, machine learning.
Focus on Skill development	Yes	The students develop necessary skills to develop foundational knowledge in data science and linear algebra.
Focus on entrepreneurship	No	-

IT605 Data Structures and Algorithms (Lab:Python) (3-0-2-4)

Course Objective :

- Learn different data structures such as arrays, linked list, queue, stack, trees, graphetc.
- Learn algorithms implementation to perform a specific task using these data structures.
- Learn how to measure the execution time of some of these algorithms using asymptotic notation.

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

- Understand basic and abstract data types [PO1, PO12].
- Analyze complexity of various data structures [PO2, PO3, PO4].
- Apply skills for solving problems [PO2, PO3, PO4]

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
X	X	X	X	X							X

Course Outcomes and Competencies

Sr. No	Course Outcome	PO/PSO	CPD	KD
1	CO1: Understand basic and abstract data types	PO1, PO12 / PSO1	U	F, C
2	CO2: Analyze complexity of various data structures	PO2, PO3, PO4 / PSO1, PSO2	U. Ap	F, C, P
3	CO3: Apply skills for solving problems	PO2, PO3, PO4 / PSO1, PSO2	U. An	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C. Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on software development, coding and computing.
Focus on Skill development	Yes	The students develop necessary skills to develop foundational knowledge in data structures that become prerequisite for other subsequent courses.
Focus on entrepreneurship	Yes	Data structure is a foundational course that helps in exploring startups, entrepreneurship.

SC614 Statistical Methods (Lab:R) (3-0-2-4)

Course Objective: The objective of this course is to cover the basic methods of Statistical decision making. Initial lectures are devoted to strengthening the statistical foundation of students. Thereafter, different statistical decision making methods have been briefly introduced.

Course Outcomes: After completion of this course, students will

- Learn the fundamental concepts and the basic tools of statistics used in Data Science [PO1. PO12].
- Learn to use R/Python for implementation of the statistical tools [PO1 PO2. PO11].
- Acquire the skill to analyze data in a systematic and logical manner to answer important research questions arising in different disciplines [PO2. PO4].
- Know how to measure and attach a measure of uncertainty to the inference drawn from data [PO4, PO5].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X	X		X	X							

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Learn the fundamental concepts and the basic tools of statistics used in Data Science	PO1, PO12 / PSO1	U	F, C
2	CO2: Learn to use R/Python for implementation of the statistical tools	PO1, PO2, PO11 / PSO1, PSO2	U, Ap	F, C, P
3	CO3: Acquire the skill to analyze data in a systematic and logical manner to answer important research questions arising in different disciplines	PO2, PO4 / PSO1, PSO2	U, An	F, C, P

4	CO4: Know how to measure and attach a measure of uncertainty to the inference drawn from data	PO4, PO5 / PSO2	Ap, An	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on data science.
Focus on Skill development	Yes	The students develop necessary skills to develop foundational knowledge in statistical methods.
Focus on entrepreneurship	No	-

IT606 Programming Lab (0-0-4-2)

Course Objective: This course focuses on the core syntax and semantics of the Python programming language. The course also helps in working with structuring the data using lists, dictionaries, tuples and sets. This course provides the ability to the students to analyze and criticize the data using Python.

Course Outcomes: After completion of this course, students should be able to:
- Understand Python programming basics. [PO1, PO12]
- Represent compound data using Python lists, tuples, and dictionaries. [PO4, PO5]
- Develop ML models and perform the analysis of data using NumPy, pandas and matplotlib [PO3, PO4, PO12]

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
X		X	X	X							X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Understand Python programming basics	PO1, PO12 / PSO1	U	F, C
2	CO2: Represent compound data using Python lists, tuples, and dictionaries	PO4, PO5 / PSO1, PSO2	U, Ap	F, C, P
3	CO3: Develop ML models and perform the analysis of data using NumPy, pandas and matplotlib	PO3, PO4, PO12 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on coding, software development.

Focus on Skill development	Yes	The students develop necessary skills to develop knowledge in Python programming.
Focus on entrepreneurship	No	-

IT607 Database Management Systems (3-0-2-4)

Course objective: This course covers all essential topics in database management, in particular, relational databases. The exposure obtained by the students in this course serve as a required prerequisite to several elective courses in the areas of Software Engineering.

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

• Understand the principles of relational algebra and entity-relationship diagrams [PO1, PO2, PO4].

• Understand and apply the concepts of database design and implementation [PO2, PO4, PO5, PO12].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
X	X		X	X							X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Understand the principles of relational algebra and entity-relationship diagrams	PO1, PO2, PO4 / PSO1	U	F, C

2	CO2: Understand and apply the concepts of database design and implementation	PO2, PO4, PO5, PO12 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking DBMS course can be employed to industries focusing on database and software development.
Focus on Skill development	Yes	The students develop necessary skills to work with real use cases using databases.
Focus on entrepreneurship	Yes	The students can work on real time projects focusing on development of small, medium and large enterprises through entrepreneurship/self-employability and start-ups.

IT608 Machine Learning (3-0-2-4)

Course Objective: The course starts with linear regression and then discusses supervised and unsupervised learning.

Course Outcomes: After completion of this course, students will

- Develop a deep understanding of the fundamental mathematical and statistical concepts used in machine learning models [PO1, PO12].
- Develop the systematic and deep understanding of the popular machine learning models [PO4, PO5].
- Apply the variants of machine learning model to solve the real-time problems [PO4, PO5].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X			X	X							X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Develop a deep understanding of the fundamental mathematical and statistical concepts used in machine learning models	PO1, PO12 / PSO1	U	F, C
2	CO2: Develop the systematic and deep understanding of the popular machine learning models	PO4, PO5 / PSO1, PSO2	U, Ap	F, C, P
3	CO3: Apply the variants of machine learning model to solve the real-time problems	PO4, PO5 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on machine learning.
Focus on Skill development	Yes	The students develop necessary skills to develop knowledge in machine learning.

Focus on entrepreneurship	Yes	Machine Learning offers enormous scope for entrepreneurship.

SC602 Numerical Methods for Data Science (3-0-2-4)

Course Objective: The course discusses the role of numerical methods for data analysis problems.

Course Outcomes: After completion of this course, students should be able to:

- Understand the depth understanding of the fundamental numerical and mathematical concepts used in data science methods [PO1, PO12].
- Ability to understand the precision issues that arise when applying iterative numerical methods to solve optimization problems [PO4, PO5].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X			X	X							X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Understand the depth understanding of the fundamental numerical and mathematical concepts used in data science methods	PO1, PO12 / PSO1	U	F, C
2	CO2: Ability to understand the precision issues that arise when applying iterative numerical methods to solve optimization problems	PO4, PO5 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on data science.
Focus on Skill development	Yes	The students develop necessary skills to develop foundational knowledge in Numerical methods for data science.
Focus on entrepreneurship	No	-

IT609 Big-Data Processing (2-0-2-3)

Course Objective: The course discusses Big-data processing and storage techniques using industry relevant tools and techniques.

Course Outcomes: After completion of this course, students should be able to

- Explain why traditional data processing techniques do not work on big data problems [PO1, PO4].
- Work on some of popular large data processing frameworks like hadoop, spark, and some of no-sql databases [PO1, PO4, PO5].
- Appreciate techniques for iterative data access for data mining tasks [PO1, PO12].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
X			X	X							X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Explain why traditional data processing techniques do not work on big data problems	PO1, PO4 / PSO1	U	F, C
2	CO2: Work on some of popular large data processing frameworks like hadoop, spark, and some of no-sql databases	PO1, PO4, PO5 / PSO1, PSO2	U, Ap	F, C, P
3	CO3: Appreciate techniques for iterative data access for data mining tasks	PO1, PO12 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on Big-Data, Analytics.
Focus on Skill development	Yes	The students develop necessary skills to develop knowledge in big-data processing.
Focus on entrepreneurship	Yes	Big-Data, Data Analytics provide enough opportunities for entrepreneurship.

SC601 Optimization (2-0-2-3)

Course Objective: The main purpose of this course is to provide the students working knowledge of optimization methods in a few selected areas.

Course Outcomes: After successful completion of the course the student will have the ability to:

- Understand and analyze complicated engineering and real-world situations by physical reasoning in terms of simple fundamental physical laws [PO1, PO12].
- Formulate mathematical models by applying abstract concepts to complex problems and solving the model using approximations if necessary [PO2, PO3, PO4]

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X	X	X	X								X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Understand and analyze complicated engineering and real-world situations by physical reasoning in terms of simple fundamental physical laws	PO1, PO12 / PSO1	U	F, C
2	CO2: Formulate mathematical models by applying abstract concepts to complex problems and solving the model using approximations if necessary	PO2, PO3, PO4 / PSO1, PSO2	U, Ap	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on data science.
Focus on Skill development	Yes	The students develop necessary skills to develop knowledge in optimization.
Focus on entrepreneurship	No	-

IT641 Deep Learning (3-0-2-4)

Course Outcomes:

- Students will obtain conceptual or physical and mathematical knowledge sufficiently in-depth such that students will be able to understand and solve various data mining problems using deep learning techniques. The student will work effectively and efficiently as an individual or with the team in various multi-disciplinary data analysis projects [PO1, PO2, PO12].

- Students will be able to understand the complex data mining problem and then identify or develop optimal deep learning techniques to solve the problem. They will be able to review the technical or research literature, may identify new data mining problems that can be better solved using deep learning techniques and possibly the advancement or development of better deep learning techniques [PO2, PO3, PO4, PO5].

- Students will explore projects in data mining, artificial intelligence and machine learning expertise or go for higher education and research in the related domain [PO4, PO6].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X	X	X	X	X	X						X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1. Students will obtain conceptual or physical and mathematical knowledge sufficiently in-depth such that students will be able to understand and solve various data mining problems using deep learning techniques. The student will work effectively and efficiently as an individual or with the team in various multi-disciplinary data analysis projects	PO1, PO2, PO12 / PSO1	U	F, C
2	CO2: Students will be able to understand the complex data mining problem and then identify or develop optimal deep learning techniques to solve the problem. They will be able to review the technical or research literature, may identify new data mining problems that can be better solved using deep learning techniques and possibly the advancement or development of better deep learning techniques	PO2-PO5 / PSO1, PSO2	U, Ap	F, C, P
3	CO3: Students will explore projects in data mining, artificial intelligence and machine learning expertise or go for higher education and research in the related domain	PO4, PO6 / PSO1, PSO2	U, Ap, An	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on machine learning.
Focus on Skill development	Yes	The students develop necessary skills to develop knowledge in machine learning.
Focus on entrepreneurship	Yes	Machine Learning offers enormous scope for entrepreneurship.

IT642 Interactive Data Visualization (3-0-2-4)

Course Objective: In this course, students will learn the foundations of information visualization and design.

Course Outcomes:

- Understand the fundamental design principles and different types of data visualization [PO1, PO12].
- Demonstrate the best practice that presents a story in the process of creating data visualization [PO2, PO3, PO4].
- Practice the core principles using Tableau (widely used interactive data visualization software) [PO2, PO4, PO5].

CO-PO Matrix :

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
X	X		X	X				X	X		X

Course Outcomes and Competencies

Sr. No.	Course Outcome	PO/PSO	CPD	KD
1	CO1: Understand the fundamental design principles and different types of data visualization	PO1, PO12 / PSO1	U	F, C
2	CO2: Demonstrate the best practice that presents a story in the process of creating data visualization	PO2, PO3, PO4 / PSO1, PSO2	U, Ap	F, C, P
3	CO3: Practice the core principles using Tableau (widely used interactive data visualization software)	PO2, PO4, PO5 / PSO1, PSO2	U, Ap, An	F, C, P

CL: Cognitive Process Domain [R: Remember; U: Understand; Ap: Apply; An: Analyze; E: Evaluate; C: Crete]

KC: Knowledge Domain [F: Factual; C: Conceptual; P: Procedural; M: Metacognitive]

Focus Area	Yes/No	Details
Focus on Employability	Yes	The students taking the course can be employed in industries focusing on computer vision, data analytics.
Focus on Skill development	Yes	The students develop necessary skills to develop knowledge in data visualization.
Focus on entrepreneurship	No	-

Executive Registrar
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