KUMARAGURU COLLEGE OF TECHNOLOGY,

An autonomous Institution affiliated to Anna University, Chennai

COIMBATORE – 641 049.

M. Tech - DATA SCIENCE

REGULATION 2024

I to IV Semesters

Department of Information Technology

VISION

The department of Information Technology aspires to become a school of excellence in providing quality education, constructive research, and professional opportunities in Information Technology

MISSION

- To provide academic programs that engage, enlighten, and empower the students to learn technology through practice, service, and outreach
- To educate the students about social responsibilities and entrepreneurship
- To encourage research through continuous improvement in infrastructure, curriculum, and faculty development in collaboration with industry and institutions

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives of Data Science Postgraduate Program are

PEO1 : Graduates of the program will be employed in industry, government, and entrepreneurial endeavours to have a successful professional career.

PEO2 : Graduates of the program will pursue higher education and /or research.

PEO3 : Graduates of the program utilize the acquired technical skills and knowledge for the benefit of society.

PROGRAM OUTCOMES (POs)

Graduates of the Data Science Postgraduate Program should have the ability to:

PO1:	An ability to independently carry out research /investigation and development work to solve practical problems
PO2:	An ability to write and present a substantial technical report/document
PO3:	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4:	Apply knowledge of data science methodologies, algorithms, and technologies to design, develop, and implement data-driven applications that address real-world challenges
PO5:	Develop innovative and ethical data analytics solutions that cater to societal and industrial needs

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KUMARAGURU COLLEGE OF TECHNOLOGY

INFORMATION TECHNOLOGY
REGULATION 2024
M. Tech Data Science Curriculum – 2024 Batch

Semester I

S.No	Course code	Course Title	Course Mode	Course Type	L	T	P	J	C
1	24DSP501	Technical Communication in Data Science	Practical	HS	0	0	4	0	2
2	24MAI505	Mathematics for Data Science	Embedded	BS	3	0	2	0	4
3	24DSI502	Research Methodology and Ethics	Embedded	BS	3	0	2	0	4
4	24DSI503	Data Analysis and Visualization	Embedded	PC	3	0	2	0	4
5	24DSI504	Artificial Intelligence and Machine Learning	Embedded	PC	3	0	2	0	4
6	24DSI505	Data Security and Privacy	Embedded	PC	3	0	2	0	4
7	24--O0--	Open Elective – I	Theory	OE	3	0	0	0	3
								Total Credits	**25**
								Total Contact Hours/week	**32**

Semester II

S.No	Course code	Course Title	Course Mode	Course Type	L	T	P	J	C
1	24DSP506	Exploratory Research and Ideation	Practical	HS	0	0	4	0	2
2	24DSI507	Bigdata Technologies	Embedded	PC	3	0	2	0	4
3	24DSI508	Natural language Processing Techniques	Embedded	PC	3	0	2	0	4
4	24DS-0--	Professional Elective – I	Embedded	PE	*	*	*	*	3
5	24DS-0--	Professional Elective – II	Embedded	PE	*	*	*	*	3
6	24DS-0--	Professional Elective – III	Embedded	PE	*	*	*	*	3
7	24--O0--	Open Elective – II	Theory	OE	3	0	0	0	3
								Total Credits	**22**
								Total Contact Hours/week	**29**

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Semester III									
S.No	**Course code**	**Course Name**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	24DS-0--	Professional Elective – IV	Theory	PE	*	*	*	*	3
2	24DSJ601	Project Phase-I	Project	PRJ	0	0	0	20	10
3	24DSJ603	Internship*	Project	PRJ	0	0	0	0	2
								Total Credits	**15**
								Total Contact Hours/week	**24**
* Mandatory for a minimum period of Three Weeks									
Semester IV									
1	24DSJ602	Project Phase-II	Project	PRJ	0	0	0	40	20
								Total Credits	**20**
								Total Contact Hours/week	**40**

LIST OF PROFESSIONAL ELECTIVES									
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	24DSE001	Internet of Things	Embedded	PE	2	0	2	0	3
2	24DSE002	Cloud and Data Engineering	Embedded	PE	2	0	2	0	3
3	24DSC003	Generative AI	Embedded	PE	2	0	2	0	3
4	24DSE004	Computer Vision	Theory	PE	3	0	0	0	3
5	24DSC005	Blockchain Technologies and DApp Development	Embedded	PE	2	0	0	2	3
6	24DSC006	Network Science and Social Analytics	Embedded	PE	2	0	2	0	3
7	24DSC007	Business Intelligence and Strategic Decision Analytics	Embedded	PE	2	0	2	0	3
8	24DSC008	Advanced Geospatial Data Science	Embedded	PE	2	0	2	0	3

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OPEN ELECTIVES									
S.No	**Course code**	**Course Title**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	24MEO001	Sustainable Innovations and Practices	Theory	OE	3	0	0	0	3
2	24MEO002	Electric and Autonomous Mobility	Theory	OE	3	0	0	0	3
3	24IEO074	Modern Financial Strategies and Innovations	Theory	OE	3	0	0	0	3
4	24IEO075	Sports Analytics and Emerging Technologies	Theory	OE	3	0	0	0	3
5	24IEO076	Healthcare Innovation and Technology	Theory	OE	3	0	0	0	3
6	24IEO077	Corporate Strategy and Innovation	Theory	OE	3	0	0	0	3
7	24IEO078	Gamification and Gaming	Theory	OE	3	0	0	0	3
8	24IEO079	Environmental Innovations and Management	Theory	OE	3	0	0	0	3

Semester-wise Credits	
Semester – I	25
Semester – II	22
Semester – III	15
Semester – IV	20
Total Credits	**82**

Course types	**Credits**
Humanities and Social Sciences	4
Basic Sciences	8
Professional Core	20
Professional Elective	12
Open / General Electives	6
Experiential Learning (Projects/Internship)	32
Total Credits	**82**

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24DSP501	Technical Communication in Data Science	L	T	P	J	C
		0	0	4	0	2
HSS		SDG	4, 9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Develop the skills necessary to effectively communicate complex data science concepts and results to diverse audiences.
2	Create clear, concise, and compelling technical documents, presentations, and visualizations in data science.
3	Understand the key principles of technical writing, data storytelling, and the ethical considerations in data science.
4	Present data-driven insights in a manner that is accessible to both technical and non-technical stakeholders.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the principles of technical communication and their application in data science and develop familiarity with the key terminology and language used in data science.	U
CO 2	Develop clear and concise technical documents, reports, research papers, presentations, and documentation.	Ap
CO 3	Enhance storytelling and visualization skills to create compelling narratives around data.	An
CO 4	Tailor technical communication to different audiences, including peers, management, and the public.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	2	3	3		
2	2	3	3		
3	2	3	3		
4	2	3	3		

Course Content

VOCABULARY FOR DATA SCIENCE Basic Sentence Structure in Technical Writing, Overview of Data Science Terminology, Commonly Used Data Science Acronyms and Abbreviations, Key Data Science Vocabulary: Statistics, Machine Learning, AI, etc., Using Precise Language to Describe Data and Algorithms, Common Phrasing and Sentence Structures in Data Science Writing, Building a Technical Vocabulary Bank. Demonstrate command of Data Science vocabulary by writing short papers on Data Science fields.	**12 Hours**

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COMPREHENDING DATA SCIENCE THROUGH REPORTS Identifying Key Ideas and Supporting Details, Summarizing Technical Content, Reading Strategies for Understanding Complex Data Science Texts, Structure of a Technical Report, Writing Clear and Concise Abstracts, Developing an Introduction, Methodology, and Conclusion, Using Data Visualizations and Explaining Results, Structure of a Research Paper in Data Science, Developing Logical Arguments and Supporting Evidence and Citation Styles and Avoiding Plagiarism. Develop the ability to comprehend data science literature and write technical reports.	**12 Hours**
DOCUMENTATION, AND PREPARING PROJECT REPORTS IN DATA SCIENCE REPORTING Writing User Manuals and Technical Documentation, Documenting Code and Algorithms, Creating Data Science Project Reports, Best Practices for Clear and Effective Documentation. Understand the structure and elements of a document, research article, etc. in data science, and represent the same.	**12 Hours**
ORAL PRESENTATIONS AND COLLABORATION IN DATA SCIENCE Structuring a Data Science Presentation, Using Visual Aids Effectively (Graphs, Charts, Tables), Techniques for Explaining Complex Data Clearly**,** Handling Questions and Engaging the Audience, Effective Communication in Data Science Teams, Discussing Data Science Concepts in English, Collaborative Writing and Peer Reviews, Managing and Leading Data Science Meetings. Develop Oral Presentation skills and contribute to collaborative communication.	**12 Hours**
CASE STUDIES, PROJECTS, AND PRESENTATIONS IN DATA SCIENCE Analyzing Case Studies in Data Science, Writing Case Study Reports, Group Discussions on Case Study Outcomes, Practical Exercises in Data-Driven Decision Making, Individual or Group Projects: Writing and Presenting a Data Science Report, Peer Review and Feedback Sessions, Final Presentation of Data Science Projects and Course Reflection and Language Development Plan. Analyze case studies and prepare reports on case studies in Data Science.	**12 Hours**

Theory Hours: 0	**Tutorial Hours:** 0	**Practical Hours:** 60	**Project Hours:** 0	**Total Hours:** 60

Learning Resources

Textbooks

1. Leo Finkelstein, Jeanine Elise Aune and Leslie Potter “Technical Writing for Engineers & Scientists” Fourth Edition, McGraw Hill, (2016)
2. Jeff Leek, "The Elements of Data Analytic Style" First Edition, (2015)
3. Foster Provost and Tom Fawcett, "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" First Edition, Shroff, (2013)

Reference books/ Web Links

1. Towards Data Science

Online Resources

1. English for Science, Technology, Engineering, and Mathematics | Coursera
2. Data Science Ethics Professional Certificate | edX

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Assessment
Assignments/Reports, Oral Presentation, Model Exam

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
-	-	Dr. P. C. Thirumal, Department of Information Technology	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24MAI505	Mathematics for Data Science	L	T	P	J	C
		3	0	2	0	4
BS		SDG	3,4,8,9,11,12,13			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	Normal Distribution Table

Course Objectives:	The purpose of taking this course is to:
1	Develop a strong foundation in vector spaces and linear transformations to enable students to solve matrix operations, eigenvalue problems, and their applications in data science.
2	Provide a solid understanding of probability theory and random variables to help students model, analyze, and solve problems involving uncertainty in data.
3	Equip students with the ability to analyze distributions and apply statistical theorems such as the Central Limit Theorem for data interpretation.
4	Train students in curve fitting, regression analysis, and multivariate analysis techniques to assess predictive models and reduce dimensionality in large datasets.
5	Enable students to apply optimization techniques to solve constrained and unconstrained problems in engineering and data science using methods like Lagrange multipliers.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Apply the properties of vector spaces, subspaces, and linear transformations to solve problems related to matrix operations and eigenvalue computation.	Ap
CO 2	Apply concepts of probabilities, expected values, and Baye's theorem to discrete and continuous random variables in real-world scenarios.	Ap
CO 3	Apply marginal and conditional distributions and apply the Central Limit Theorem and normal distribution to interpret statistical data.	Ap
CO 4	Evaluate the reliability of regression models using correlation and regression techniques by fitting curves to data using the method of least squares.	E
CO 5	Apply the multivariate concepts, including principal component analysis (PCA), to reduce data dimensionality and compute covariance and correlation matrices.	Ap
CO 6	Apply Lagrange multipliers to solve constrained and unconstrained optimization problems to determine optimal solutions in engineering contexts.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3	2	3		
2	2	1	3		
3	3	1	3		
4	3	2	3		
5	3	2	3		
6	3	2	3		

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Course Content

VECTOR SPACES Vector spaces and subspaces - Null spaces, column spaces and linear transformations –Bases – Dimension of a vector space – Rank – Change of basis – Eigenvalues and Eigenvectors of Real Symmetric Matrices – Diagonalization of symmetric matrices – Singular value decomposition. **Practical Component** Understanding the MATLAB Interface and Basic MATLAB Commands. Vectors and Matrices, plotting, saving and loading data, writing and running scripts. Understanding the R Interface and Basic R Commands. Vectors and Matrices, Plotting in R, Data Frames and Basic Data Manipulation, Importing Data from a CSV File, Writing and Running Scripts. Basic vector operations, Basis and Dimension in MATLAB, Eigenvalues and Eigenvectors in MATLAB, Singular Value Decomposition (SVD) in MATLAB.	**8 Hours** **8 Hours**
PROBABILITY AND RANDOM VARIABLES Axioms of probability - Conditional probability – Statistical independence - Law of total probability – Baye's theorem - Random variable – Discrete and Continuous random variables - Probability mass function – Probability density function – Expected value of a random variable. **Practical Component** Probability Distributions, Expected Value Calculation in R.	**9 Hours** **4 Hours**
TWO-DIMENSIONAL RANDOM VARIABLES Pairs of random variables – Marginal and conditional distributions – Expected values of functions of two variables– Central limit theorem - Normal distribution –properties – Bivariate Normal distribution – Multivariate Normal distribution. **Practical Component** Marginal and Conditional Distributions in R, Central Limit Theorem in MATLAB, Normal Distribution in R.	**9 Hours** **4 Hours**
REGRESSION ANALYSIS AND ESTIMATION Curve fitting by method of least squares – Assessing the reliability of predictions using goodness-of-fit measures such as R^2, Adjusted R^2, RMSE, MAE, and MAPE – Correlation – Properties of correlation coefficient – Linear regression – Least square estimation of regression coefficients – Regression lines – Maximum Likelihood Estimation. **Practical Component** Correlation, Linear Regression in R and Curve Fitting using Least Squares in MATLAB.	**9 Hours** **6 Hours**
MULTIVARIATE ANALYSIS Random vector –Mean Vector – Correlation Matrix - Covariance Matrix – Principal components – Population Principal Components - Principal Components from standardized variables. **Practical Component** Principal Component Analysis (PCA) in R and Covariance and Correlation Matrix in MATLAB.	**5 Hours** **4 Hours**
CLASSICAL OPTIMIZATION THEORY Unconstrained optimization problems – Equality constraints – Lagrange's method. **Practical Component** Solve constrained optimization problems using Lagrange multipliers in MATLAB.	**5 Hours** **4 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 75

Textbooks

1. Veerarajan T., "Probability, Statistics and Random Process", Tata McGraw Hill, 4th Edition, 2021.
2. Devore J. L., "Probability and Statistics for Engineering and the Science", 9th Edition, Cengage Learning, 2021.
3. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan and Sons, New Delhi, 12th Edition, (2020).
4. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, Asia, (2019).
5. Anderson, T. W., "An Introduction to Multivariate Statistical Analysis", John Wiley and Sons, 4th Edition, (2020).
6. Kreyszig, E., "Advanced Engineering Mathematics", Wiley, 10th Edition, (2015).

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7. Sharma J. K., “Operations Research”, Macmillan India Ltd, Delhi, 5th Edition, (2019).

Reference books/ Web Links

1. Freund John, E. and Miller, Irvin, “Probability and Statistics for Engineering”, Duxbury Press, 9th Edition, (2018).
2. Devore, J.L., “Probability and Statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, 9th Edition, (2021).
3. Freund, J.E., “Mathematical Statistics”, Prentice Hall of India, 7th Edition, (2017).
4. Gupta S.C. and Kapur J.N., “Fundamentals of Mathematical Statistics”, Sultan & Chand, Publishers, New Delhi, 11th Revised Edition, (2019).
5. Johnson, R. A., “Miller & Freund’s Probability and Statistics for Engineers”, 8th Edition, Pearson Education, (2017).
6. Spiegel, M.R. and Stephens, L.J., “Schaum’s Outlines: Statistics”, Tata McGraw-Hill, 5th Edition, (2020).
7. Taha, H.A., “Operations Research: An Introduction”, Pearson, 10th Edition, (2017).

Online Resources

1. MIT Open Course Ware – Introduction to Optimization - https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-251j-introduction-to-mathematical-programming-fall-2009/
2. NPTEL – Probability and Statistics - https://nptel.ac.in/courses/111105090
3. NPTEL – Optimization Techniques - https://nptel.ac.in/courses/112106134
4. edX – Fundamentals of Optimization - https://www.edx.org/course/fundamentals-of-optimization
5. Coursera – Data Analysis with R - https://www.coursera.org/learn/data-analysis-r
6. edX – Introduction to Probability - https://www.edx.org/course/introduction-to-probability
7. Stack Overflow – R Programming - https://stackoverflow.com/questions/tagged/r

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
1. Mr. Ramesh V.S., STEPS Knowledge Services Private Limited, Coimbatore. 2. Mr.Jayakumar Venkatesan, Valles Marineris International Private Limited- Chennai. 3. Mr. Imran Khan, GE Transportation Company, Bangalore.	1. Dr.T.Govindan, Government College of Engineering, Srirangam, Trichy. 2. Dr.C.Porkodi, PSG College of Technology, Coimbatore. 3. Dr.P.Paramanathan, Amrita Vishwa Vidyapeetham, Coimbatore.	Dr. Vijeta Iyer, Mathematics

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24DSI502	Research Methodology and Ethics	L	T	P	J	C
		3	0	2	0	4
BS		SDG	4			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	To understand the philosophy of science and ethics.
2	To understand the research integrity and publication ethics.
3	To prepare article and submit to the journal.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the concepts of research and formulate a research problem.	U
CO 2	Design and plan the research, collect data, interpret data and organize data.	Ap
CO 3	Demonstrate skill in writing research papers and prepare effective presentation.	Ap
CO 4	Understand the philosophy of science and ethics, research integrity and publication ethics.	U
CO 5	Understand the indexing and citation databases.	U
CO 6	Familiarize the types of open access publications and research metrics.	U

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3	2	3	2	2
2	2	3	2	3	
3	2	3			
4	2	2	1	1	3
5	1	2			2
6		2			2

Course Content

INTRODUCTION TO RESEARCH METHODS Definition and Objectives of Research - Scientific Methods, Various Steps in Scientific Research, Research planning - Selection of a Problem for Research, Formulation of the Selected Problems -Purpose of the Research, Formulation of research objectives - Formulation of research questions - Hypotheses Generation and Evaluation -Literature search, and review, Research abstract.	**9 Hours**
Practical Component Problem formulation. Formulate research questions for domain specific Problems.	**8 Hours**

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RESEARCH DESIGN/PLAN Types and Methods of Research - Classification of Research - Sampling Techniques, Methods of Collecting Primary Data, Use of Secondary Data, Experimentation - Design of Experiments, Survey Research and Construction of Questionnaires - Pilot Studies and Pre-tests - Data Collection methods, Processing of Data, Editing, Classification and Coding, Transcription, Tabulation, Validity and Reliability.	**9 Hours**
RESEARCH REPORTS/THESIS Structure and Components of Research Report/thesis, Types of Report, Planning of Report/thesis Writing, Research Report Format, Layout of Research Report, Presentation of data and Data Analysis Reporting, Mechanism of writing a research report, Principles of Writing, Writing of Report-Writing of thesis-Differences between thesis and research paper writing. **Practical Component** 1. Software tool to identify predatory publications 2. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	**9 Hours** **8 Hours**
PHILOSOPHY AND ETHICS Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions. Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data. **Practical Component** 1. Indexing database – Citation databases Scopus and Web of science. 2. Plagiarism software – Use of plagiarism checking software like Turnitin, Urkund and other open-source software tools.	**9 Hours** **8 Hours**
PUBLICATION ETHICS AND OPEN ACCESS PUBLISHING Publication ethics: definition, introduction and importance -Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals. **Practical Component** 1. Research Metrics: Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index. 2. Open access publications and initiatives. 3. Upload manuscript to a journal through editorial manager.	**9 Hours** **6 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**75**

Learning Resources

Textbooks

1. C.R. Kothari, Research Methodology Methods and Techniques, Fourth edition, New Age International Publishers, (2019).
2. Ranjit Kumar, Research Methodology, A Step-by-Step Guide for Beginners, 4th Edition, Sage Publishing, (2023).
3. R. Pannerselvam, Research Methodology, 2nd edition, Prentice Hall India, (2019).
4. C. Neal Stewart Jr., Research Ethics for Scientists: A Companion for Students, Wiley Publishing,(2011).

Reference books/ Web Links

1. Paul Oliver, The student's guide to research ethics, Open University Press, McGraw-Hill Education, McGraw-Hill House, second edition, (2010).

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Assessment (Embedded)
Research Assignment, Group Presentation, SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
		Dr. V. Manivel Muralidaran, Department of Mechanical Engineering	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24DSI503	Data Analysis and Visualization	L	T	P	J	C
		3	0	2	0	4
PC		SDG	3, 8, 9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Gain expertise in exploratory data analysis (EDA), statistical inference, and dimensionality reduction methods to effectively summarize, interpret, and reduce complex datasets.
2	Handle missing data, perform data imputation, normalize, and scale features to prepare datasets for accurate and meaningful analysis.
3	Design and implement effective visualizations using advanced plotting libraries and tools to communicate insights, identify patterns, and support decision-making processes.
4	Acquire skills in building dynamic and interactive dashboards using tools such as Tableau, Power BI, and Dash, including real-time data visualization to facilitate real-time decision-making and data exploration

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand advanced data analysis techniques and their application as tools for extracting meaningful insights from complex and large datasets.	U
CO 2	Identify appropriate visualization methods and tools to effectively represent data, ensuring clarity, accuracy, and impact in the communication of analytical results.	Ap
CO 3	Analyze the effectiveness of various visualization techniques by examining their ability to convey patterns, trends, and relationships within the data, while adhering to best practices in visual communication.	An
CO 4	Develop advanced data visualizations and interactive dashboards that integrate real-time data and custom visual components, facilitating dynamic and insightful data exploration.	Ap
CO 5	Apply advanced data analysis and visualization techniques to domain-specific challenges in business, healthcare, finance, and social media, demonstrating the ability to deliver actionable insights and informed decision-making.	Ap

Course Outcomes	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3	2	3		
2	2	2	3	2	2
3	2	2	3		
4	2	2	3	3	3
5	2	2	3	3	3

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Course Content

FOUNDATIONS OF DATA ANALYSIS Exploratory Data Analysis (EDA): Advanced techniques for summarizing data, identifying patterns, and outlier detection. Statistical Inference: Hypothesis testing, confidence intervals, and p-values in the context of large datasets.. Data Cleaning and Preprocessing: Handling missing data, data imputation, normalization, and feature scaling. Correlation and Causation: Techniques for identifying and quantifying relationships between variables. **Practical Component** Implement Exploratory Data Analysis , Dimensionality Reduction and Data Pre-processing.	**12 Hours** **8 Hours**
OVERVIEW OF DATA VISUALIZATION Visualization Principles: Understanding color theory, perceptual principles, and effective visual encoding. Plotting Libraries: Advanced usage of Matplotlib, Seaborn, Plotly, and Bokeh for static and interactive visualizations Geospatial Data Visualization: Techniques for visualizing spatial data, including maps, choropleths, and heatmaps using Folium and Geopandas. Time-Series Visualization: Techniques for visualizing temporal data, including line charts, candlestick charts, and horizon charts. Network Visualization: Visualization of complex networks, using tools like NetworkX, Gephi, and D3.js. Real-Time Data Visualization. **Practical Component** Creating complex visualizations using tools like Matplotlib, Seaborn, Plotly.	**12 Hours** **8 Hours**
ADVANCED VISUALIZATION AND DASHBOARDING Interactive Dashboards: Creating dynamic dashboards using tools like Tableau, Power BI, and Dash. Custom Visualizations: Building custom visualizations using D3.js - Techniques for visualizing streaming data, using Apache Kafka and real-time dashboards. Visualization Best Practices: Ethical considerations, avoiding misleading visualizations, and ensuring accessibility. **Practical Component** Creating interactive dashboards using Tableau and Power BI.	**12 Hours** **8 Hours**
APPLICATIONS AND CASE STUDIES Business Analytics: Applying data analysis and visualization techniques to business data for decision-making. Healthcare Data Visualization: Techniques for visualizing and analyzing complex healthcare datasets, including patient records and genomic data. Financial Data Analysis: Visualization and analysis of financial data, including stock prices, economic indicators, and portfolio performance. Social Media Analytics: Techniques for analyzing and visualizing social media data, including sentiment analysis and network graphs. **Practical Component** Working with large datasets from industries like finance, healthcare, and social media.	**9 Hours** **6 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 75

Learning Resources

Textbooks

1. McKinney, Wes. Python for Data Analysis. O'Reilly Media, Sebastopol (2022).
2. Dykes, Brent. Effective Data Storytelling: How to Drive Change with Data, Narrative and Visuals. Wiley, Hoboken (2020).
3. Wilke, Claus O. Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures. O'Reilly Media, Sebastopol (2019).
4. Healy, Kieran. Data Visualization: A Practical Introduction. Princeton University Press, Princeton (2018).
5. Glass, Russell, and Sean Callahan. The Big Data-Driven Business: How to Use Big Data to Win Customers, Beat Competitors, and Boost Profits. Wiley, Hoboken (2018).

Reference books/ Web Links

1. Johnson, David S. R., Data Cleaning and Preparation: A Practical Guide for Data Scientists., CRC Press, Boca Raton (2020).
2. VanderPlas, Jake., Python Data Science Handbook: Essential Tools for Working with Data., O'Reilly Media, Sebastopol (2016).

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3. Knaflic, Cole Nussbaumer., Storytelling with Data: A Data Visualization Guide for Business Professionals., Wiley, Hoboken (2015).
4. Hastie, Trevor, Tibshirani, Robert, Friedman, Jerome., The Elements of Statistical Learning: Data Mining, Inference, and Prediction., Springer, New York (2009).

Online Resources

1. https://www.coursera.org/learn/python-for-data-visualization
2. https://www.khanacademy.org/math/statistics-probability
3. https://www.datacamp.com/courses/dimensionality-reduction-in-python
4. https://www.udacity.com/course/data-visualization--ud1009
5. https://www.edx.org/micromasters/data-science

Assessment (Embedded)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
		Dr. S. Kavitha, Department of Information Technology	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24DSI504	Artificial Intelligence and Machine Learning	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4,9,12,17			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	To provide in-depth knowledge of advanced AI and machine learning techniques, enabling students to understand and apply sophisticated algorithms for solving complex problems in various domains.
2	Enable students to design and implement cutting-edge AI models using modern tools and frameworks.
3	Develop skills in optimizing and evaluating AI and ML models for enhanced performance and scalability.
4	Explore the use of reinforcement learning algorithms to solve problems on open platforms.
5	Address ethical, societal, and technical challenges in AI, preparing students for real-world applications with a broader perspective.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand and apply advanced machine learning algorithms and techniques to solve complex problems.	U
CO 2	Design, implement, and evaluate AI models using state-of-the-art tools and frameworks.	E
CO 3	Develop and deploy AI systems that address real-world challenges in various domains.	C
CO 4	Evaluate and optimize AI and ML models for performance, accuracy, and scalability.	E
CO 5	Apply reinforcement learning algorithms to solve problems using open platforms.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3		2		
2		3		2	
3	3			2	
4			2	3	
5	3				3

Course Content

MACHINE LEARNING TECHNIQUES Overview of AI and ML - Deep Leaning - Ensemble Learning Methods: Bagging, Boosting, Random Forests - Dimensionality Reduction Techniques: PCA, t-SNE, UMAP - Representation Learning: Auto encoders, Variational Auto encoders - Advanced Neural Network Architectures: Convolutional, Recurrent, Transformers.	**9 Hours**
Practical Component Implement ensemble methods and dimensionality reduction techniques. Use frameworks like scikit-learn.	**6 Hours**
FRONTIER TECHNIQUES IN DEEP NEURAL NETWOKS	**9 Hours**

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Convolutional Neural Networks (CNNs) and Applications - Transfer Learning and Fine-Tuning for Computer Vision Tasks - Generative Adversarial Networks (GANs) and Applications - Object Detection - Segmentation – Recognition. **Practical Component** Develop and fine-tune CNN models and GANs for computer vision tasks using TensorFlow or PyTorch.	 **6 Hours**
NATURAL LANGUAGE PROCESSING AND SPEECH RECOGNITION Sequence-to-Sequence Models: RNNs, LSTMs, Transformers - Language Models: BERT, GPT, ELMo, and Applications - Speech Recognition and Synthesis Using Deep Learning - Multimodal Learning and Applications. **Practical Component** Build and evaluate NLP models including language models and sequence-to-sequence models. Use libraries like Hugging Face Transformers.	**9 Hours** **6 Hours**
AI TECHNIQUES AND APPLICATIONS Meta-Learning and Few-Shot Learning - Neural Architecture Search (NAS) - Hyper parameter Optimization - Federated Learning and Edge AI - Advanced Reinforcement Learning: Actor-Critic Methods, Policy Gradient Methods, AI for Autonomous Systems and Robotics. **Practical Component** Apply reinforcement learning algorithms to solve problems using OpenAI Gym and RL libraries.	**9 Hours** **6 Hours**
ETHICAL, SOCIETAL, AND POLICY IMPLICATIONS OF AI Explainable AI (XAI) and Model Interpretability - Adversarial Machine Learning and Robustness - Privacy-Preserving Machine Learning Techniques (e.g., Differential Privacy) - AI Governance - Policy Frameworks – Regulation - Societal Impact of AI: Case Studies and Future Directions. **Practical Component** Analyse case studies and work on projects addressing ethical concerns and societal impacts of AI.	**9 Hours** **6 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 75

Learning Resources

Textbooks

1. Goodfellow, Ian, Bengio, Yoshua, and Courville, Aaron. Deep Learning. MIT Press, Cambridge (2016).
2. Sutton, Richard S., and Barto, Andrew G. Reinforcement Learning: An Introduction. MIT Press, Cambridge (2018).
3. Russell, Stuart, and Norvig, Peter. Artificial Intelligence: A Modern Approach. Pearson, London (2020).
4. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media, Sebastopol (2019).

Reference books/ Web Links

1. Burkov, Andriy. The Hundred-Page Machine Learning Book. Kindle Direct Publishing, Seattle (2019).
2. Foster, David. Generative Deep Learning. O'Reilly Media, Sebastopol (2019).

Online Resources

1. https://onlinecourses.nptel.ac.in/noc19_cs85/preview
2. https://nptel.ac.in/courses/106105077
3. https://www.coursera.org/specializations/deep-learning

Assessment (Embedded)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

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Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert**
			Mr. K. Manoj, Department of Computer Science and Engineering
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24DSI505	Data Security and Privacy	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4, 9, 16			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Comprehend the fundamental concepts of data security, including confidentiality, integrity, and availability.
2	Explore key data protection regulations and standards, such as GDPR, CCPA, HIPAA, and others.
3	Analyse the ethical considerations and societal impacts of data security and privacy decisions.
4	Develop skills to assess and manage risks associated with data security and privacy.
5	Apply theoretical knowledge to real-world scenarios through case studies and hands-on projects.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Apply encryption algorithms to ensure confidentiality and integrity in the data using a mathematical approach.	Ap
CO 2	Analyze network security protocols used for secure client-server data communication.	An
CO 3	Examine the threats of data repository and the security policies for secure data management.	An
CO 4	Identify the mitigation steps for the vulnerabilities in data breach.	Ap
CO 5	Relate the security breach with legal regulation to analyze the impact of minimal data security.	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3		3	3	2
2	2		2	3	2
3	-	2	3	3	3
4	-	3	3	2	2
5	2	3	3	2	3

Course Content

INTRODUCTION TO DATA SECURITY AND CRYPTOGRAPHIC DATA INTEGRITY APPROACH Data Security Concepts-Security Attacks-Security Services-Security Mechanisms-Model for Security-Classical Encryption Principles-Classical Encryption Techniques-Block Ciphers and Data Encryption Standards-Block Cipher Design Principles-Advanced Encryption Standard-Public Key Cryptography and RSA-Cryptographic Hash Functions-Message Authentication Codes.	**9 Hours**
Practical Component	**6 Hours**

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Demonstration of Classical Cryptographic algorithms. Analyse the algorithms in a simulator.	
NETWORK AND INTERNET SECURITY Network access control and cloud security-Data Protection in cloud-Transport Layer Security: Web security considerations-Transport Layer Security (TLS)-HTTPS-Secure Shell-Wireless Network Security-Electronic Mail Security-IP Security. **Practical Component** Demonstrate various Email attacks and Phishing related attack using Pen testing tools. Demonstrate the protection of sensitive data through encryption to ensure data privacy on HIPAA data.	**9 Hours** **6 Hours**
DATA PRIVACY PRINCIPLES AND DATA STORAGE SECURITY Data Privacy Principles -Personal Data vs. Sensitive Data-Data Collection, Processing, and Storage-Data Ownership and Control- Importance of Privacy Policies- Key Elements of a Privacy Policy- Data Protection Measures: Anonymization and Pseudonymization, Secure Data Storage and Transmission- Role-Based Access Control (RBAC)- Data Masking- Data Center Security-Data Segregation: Logical Segregation and Physical Segregation. **Practical Component** Apply data minimization principles by removing non-essential fields and ensuring that only necessary data is collected and stored. Configure access control mechanisms for a database or file storage system.	**9 Hours** **6 Hours**
DATA THREATS AND THREAT MANAGEMENT Cyberattacks- Data Breaches- Insider Threats- Physical Threats- Advanced Persistent Threats (APTs)- Social Engineering- Risk Assessment-Access control, Firewalls and Intrusion Detection Systems (IDS)- Data Backup and Recovery: Regular Backups, Disaster Recovery Planning-Monitoring and Incident Response - Compliance and Auditing -Case Studies: Cyber-attacks on data breach. **Practical Component** Demonstration of Social Engineering attacks.	**9 Hours** **6 Hours**
COMPLIANCE ASSESSMENT AND PRIVACY REGULATIONS Legal and Ethical Issues in Computer Security: Protecting Programs and Data, Information and the Law, Rights of Employees and employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security. Legal Regulation Act: General Data Protection Regulation (GDPR), California Consumer Privacy Act (CCPA), Personal Data Protection Act (PDPA). **Practical Component** Demonstration of various mechanism to ensure data is free from software and Hardware related attacks.	**9 Hours** **6 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 75

Learning Resources

Textbooks

1. William Stallings, Cryptography and Network Security : Pearson Education,7th edition,(2017).
2. Gurpreet Dhillon, John Wiley & Sons , Principles of Information Systems Security: Texts and Cases, By, 1st edition, (2006).

Reference books/ Web Links

1. David Salomon ,Data Privacy and Security, Springer Professional Computing, (2003).
2. Katharine Jarmul , Practical Data Privacy: Enhancing Privacy and Security in Data:,O'Reilly, (2023).
3. David Alexander, Amanda Finch, David Sutton, Information Security Management Principles, by Andy Taylor, 3rd edition, BCS, The Chartered Institute for IT Publishers, (2020).
4. David Sutton, Cyber Security: A practitioner's guide, BCS, The Chartered Institute for IT Publishers, (2017).

Online Resources

1. Data Security and Privacy Training | Udemy.
2. Data, Security, and Privacy | Coursera.
3. Cyber Security and Privacy - Course (nptel.ac.in)

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Assessment (Embedded)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
		Dr. A. Roshini, Department of Computer Science and Engineering	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24DSP506	Exploratory Research and Ideation	L	T	P	J	C
		0	0	4	0	2
HSS		SDG	4,8,9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	To understand the role of exploratory research in innovation and problem-solving across various disciplines.
2	To apply structured and unstructured research methodologies for gathering and analyzing data relevant to complex challenges**.**
3	To develop proficiency in ideation techniques such as brainstorming, mind mapping, and the SCAMPER method for creative problem-solving.
4	To evaluate and refine innovative ideas using criteria such as feasibility, impact, and potential for innovation.
5	To effectively communicate research insights and ideation outcomes through written reports and oral presentations.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand and apply various exploratory research methods to gather and analyse information.	U
CO 2	Employ ideation techniques to generate creative solutions to complex problems.	Ap
CO 3	Develop skills in brainstorming, mind mapping, and other creative processes.	Ap
CO 4	Evaluate and refine ideas to ensure feasibility and innovation potential.	E
CO 5	Present research findings and ideas effectively in both written and oral formats.	C

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
COS	1	2	3	4	5
1	3	1	2		
2	3	2	3		
3	2	2	2		
4	3	2	3		
5	1	3	2		

Course Content

INTRODUCTION TO EXPLORATORY RESEARCH AND IDEATION Importance of exploratory research in innovation-Differences between exploratory and confirmatory research-Overview of the ideation process -When to use exploratory research-Exploratory research questions-Exploratory vs. explanatory research-Advantages and disadvantages of exploratory research. **Activity**: Explore the differences between exploratory and confirmatory research. **Task**: Conduct a literature review on a selected topic, summarize findings, and present in groups. **Tool/Method**: Secondary research, peer discussions, and presentation tools.	**12 Hours**
EXPLORATORY RESEARCH TECHNIQUES	**12 Hours**

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Literature review and secondary research-Qualitative research methods: interviews, focus groups, and ethnographic studies-Quantitative methods: surveys and data analysis-Tools for organizing and analysing research findings. **Activity1**: Hands-on practice with qualitative research methods (interviews, focus groups, ethnographic studies). **Task**: Conduct an interview or focus group related to a specific problem. Document and analyse results. **Tool/Method**: Audio/video recording tools, transcription, thematic analysis. **Activity2:** Practice survey design and data analysis for exploratory research. **Task**: Design a survey for a selected research topic, collect data from peers, and analyse the results using basic statistical methods. **Tool/Method**: Google Forms/SurveyMonkey, Excel/SPSS for data analysis.	
IDEATION TECHNIQUES Brainstorming: methods and best practices-Mind mapping and concept mapping-SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse) technique-Role-playing and scenario analysis-Use of digital tools for ideation. **Activity**: Ideation exercises using brainstorming and mind mapping. **Task**: Choose a complex problem, conduct a brainstorming session, and map out ideas using digital or manual mind mapping techniques. Tool/Method: Mind mapping software (e.g., MindMeister, XMind), SCAMPER technique	**12 Hours**
EVALUATING AND REFINING IDEAS Criteria for evaluating ideas: feasibility, impact, and innovation-Iterative design and prototyping-Feedback loops and collaborative refinement-Techniques for overcoming creative blocks. **Activity**: Criteria-based evaluation of ideas generated in previous sessions**.** **Task:** Refine ideas based on feasibility, impact, and innovation potential using feedback loops and peer reviews**.** **Tool/Method:** Iterative prototyping tools (e.g., Sketch, Figma), peer feedback.	**12 Hours**
APPLICATION IN VARIOUS CONTEXTS Case studies in technology, product design, and academic research-Cross-disciplinary applications of research and ideation techniques- Exploratory research data collection-Step-by-step example of exploratory research. **Activity:** Develop and present a comprehensive research project, incorporating all stages of exploratory research and ideation**.** **Task:** Choose a real-world problem, conduct exploratory research, apply ideation techniques, and present findings**.** **Tool/Method:** Presentation tools (e.g., PowerPoint, Prezi), report writing**.**	**12 Hours**

Theory Hours:	**0**	**Tutorial Hours:**	**0**	**Practical Hours:**	**60**	**Project Hours: 0**	**Total Hours:**	**60**

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Learning Resources

Textbooks

1. Michael Lewrick, Patrick Link, and Larry Leife," "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems",(2020)
2. Nigel Cross," "Design Thinking: Understanding How Designers Think and Work",(2019).

Reference books/ Web Links

1. Tim Brown ," "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation",(2019).
2. Jeff Gothelf and Josh Seiden," "Lean UX: Designing Great Products with Agile Teams",(2021).
3. Hasso Plattner, Christoph Meinel, and Larry Leifer ,"Design Thinking Research: Building Innovators" edited by, Springer,(2016).
4. Tom Kelley and David Kelley, "Creative Confidence: Unleashing the Creative Potential Within Us All" , Crown Business, (2013).
5. Tom Kelley and Jonathan Littman ,"The Art of Innovation" by, Crown Business,(2001).

Online Resources

1. https://www.designkit.org/
2. https://www.interaction-design.org/
3. https://dschool.stanford.edu/resources

Assessment
Assignments/Reports, Oral Presentation, Project Reviews

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Dr. S. Sathyavathi, Department of Information Technology

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

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24DSI507	Big Data Technologies	L	T	P	J	C
		3	0	2	0	4
PC		SDG	3, 9,11			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Evaluate Big Data platforms for scalability and data governance challenges.
2	Master Hadoop architecture and advanced MapReduce techniques for distributed computing.
3	Design optimized Big Data workflows using Python/Scala and Apache Spark for real-time analytics.
4	Engineer advanced NoSQL solutions for key-value, document, columnar, and graph databases in real-world cases.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Outline scalable data processing systems by exploring the Hadoop and Spark ecosystems.	U
CO 2	Practice NoSQL databases and optimize queries for efficient data handling.	Ap
CO 3	Analyze machine learning models to large datasets to achieve predictive analytics.	An
CO 4	Utilize cloud platforms to effectively manage, store, and perform analytics on big data.	Ap
CO 5	Integrate real-time data processing systems using stream-processing frameworks.	An

Course Outcomes	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	2		3	3	2
2	2		3	3	3
3	3	2	3	3	3
4	2		3	3	3
5	3	2	3	3	3

Course Content

BIG DATA Definition, characteristics (Volume, Velocity, Variety, Veracity, Value) - Big Data vs Traditional Data - Data generation sources (IoT, social media, Transactions) - Data storage types: Structured, Semi-Structured, Unstructured - Data storage, Processing and Scalability - Security and Privacy concerns - Data Quality and Governance - Overview of Big Data platforms. **Practical Component** Hands-on with Hadoop, MapReduce.	**8 Hours** **4 Hours**

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HADOOP History and evolution of Hadoop - Hadoop ecosystem and components -Hadoop distributions - Hadoop Architecture: Hadoop cluster architecture - Role of NameNode, DataNode, and Secondary NameNode - HDFS (Hadoop Distributed File System): HDFS architecture and components - HDFS design and goals - HDFS blocks, replication, and fault tolerance - Setting Up a Hadoop Cluster: Single-node and multi-node cluster setup - Configuration files - Managing and monitoring Hadoop clusters - Introduction to MapReduce: MapReduce programming model - Phases of MapReduce - Combiner and Partitioner in MapReduce - Advanced MapReduce concepts (Joins, Counters, Distributed Cache). **Practical Component** Big Data analytics using cloud services.	**10 Hours** **4 Hours**
BIG DATA PROGRAMMING PARADIGMS Functional Programming, Parallel Programming - Introduction to Python/Scala for Big Data - Data Processing with Pig and Hive - Introduction to Apache Spark: RDDs, DataFrames, Spark SQL - Real-time processing with Spark Streaming - Working with GraphX and MLib - **Case Study:** Analyzing customer behavior. **Practical Component** Data processing using Hive and Pig. Real-time data processing with Apache Spark. Data analysis using machine learning algorithms in Spark.	**9 Hours** **10 Hours**
ADVANCED DATABASE SYSTEMS NoSQL Databases: Key-Value Stores (Redis, Riak) - Document Stores (MongoDB, CouchDB) - Column Stores (HBase, Cassandra) - Graph Databases (Neo4j) - SQL vs NoSQL: ACID vs BASE properties - Query optimization, indexing in NoSQL - Case Study: Healthcare data analytics. **Practical Component** Data ingestion and ETL using Apache Flume, Sqoop.	**9 Hours** **4 Hours**
REAL-TIME DATA PROCESSING Stream Processing: Introduction to real-time data and event-driven architecture - Frameworks: Apache Storm, Flink, Kafka Streams - Case Studies: Real-time monitoring, Fraud detection - Lambda and Kappa Architectures: Combining batch and stream processing -Design and implementation for low-latency data processing. **Practical Component** Building real-time data pipelines using Kafka and Flume. Stream processing with Apache Storm, Flink.	**9 Hours** **8 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 75

Learning Resources

Textbooks

1. White, Tom. Hadoop: The Definitive Guide. O'Reilly Media, Sebastopol (2023).
2. Holmes, Alex. Hadoop in Practice (2nd Edition). Manning Publications, Shelter Island (2023).
3. Alapati, Sam. Expert Hadoop Administration: Managing, Tuning, and Securing Spark, YARN, and HDFS. Addison-Wesley, Boston (2023).
4. Aven, Jeffrey. Hadoop in 24 Hours, Sams Teach Yourself. Sams Publishing, Indianapolis (2023).

Reference books/ Web Links

1. Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. Learning Spark: Lightning-Fast Data Analytics. O'Reilly Media, 2nd Edition, (2020).
2. Bradshaw, Shannon, Eoin Brazil, and Kristina Chodorow. MongoDB: The Definitive Guide. O'Reilly Media, 3rd Edition (2019).
3. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media, 2nd Edition, (2019).
4. Narkhede, Neha, Gwen Shapira, and Todd Palino. Kafka: The Definitive Guide. O'Reilly Media, (2017).

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Online Resources
1. https://www.coursera.org/specializations/big-data 2. https://www.coursera.org/specializations/cloudera-big-data-analysis-sql 3. https://www.coursera.org/learn/introduction-to-big-data-with-spark-hadoop

Assessment (Embedded)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
		Mr. S. Kanagaraj, Department of Information Technology	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24DSI508	Natural Language Processing Techniques	L	T	P	J	C
		3	0	2	0	4
PC		SDG	4, 9, 16			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Enable learning of the basics of linguistics, probability, and statistics relevant to NLP, including tokenization, morphology, language models, and sequence labelling.
2	Implement foundational NLP tasks such as text classification, part-of-speech tagging, and morphological analysis using Python libraries.
3	Develop and evaluate parsers for syntactic structures, experiment with word sense disambiguation, and explore dialogue systems and question-answering models for real-world applications.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the basics of linguistics, probability, and statistics as they relate to Natural Language Processing (NLP) and apply these concepts to NLP tasks.	U
CO 2	Implement a Part-of-Speech (POS) Tagger using rule-based, statistical, and machine learning approaches, and evaluate its performance.	Ap
CO 3	Design and implement a sequence labelling solution for a given domain, focusing on tasks like Named Entity Recognition (NER) or Chunking.	Ap
CO 4	Develop and implement semantic processing tasks and a document indexing and searching system, utilizing NLP concepts to enhance information retrieval.	Ap
CO 5	Create a simple chatbot using dialogue system principles, including intent recognition and response generation, with practical implementation using NLP tools.	C

COS	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	2				
2	3		2		
3	3			3	
4		2		3	3
5		2		3	3

Course Content

INTRODUCTION Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata.	**8 Hours**
Practical Component Implement foundational NLP tasks such as tokenization and morphological analysis using Python libraries.	**6 Hours**

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STATISTICAL NLP AND SEQUENCE LABELLING N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier – Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labelling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging. **Practical Component** Implement text classification using Python libraries.	**10 Hours** **6 Hours**
CONTEXTUAL EMBEDDING Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm- Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing - Transition Based - Graph Based. **Practical Component** Develop and evaluate language models, sequence labelling techniques, and parsers for syntactic and dependency structures.	**9 Hours** **6 Hours**
COMPUTATIONAL SEMANTICS Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labelling – Proposition Bank- FrameNet- Selectional Restrictions - Information Extraction - Template Filling. **Practical Component** Explore semantic role labelling and word sense disambiguation for creation of dialogue systems.	**9 Hours** **6 Hours**
DISCOURSE ANALYSIS AND SPEECH PROCESSING Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture. **Practical Component** Explore discourse analysis by creating dialogue systems and basic question-answering models.	**9 Hours** **6 Hours**

Theory	Tutorial	Practical	Project	Total
Hours: 45	Hours: 0	Hours: 30	Hours: 0	Hours: 75

Learning Resources

Textbook

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" , Prentice Hall Series in Artificial Intelligence (2020).
2. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK". Paperback (2019).

Reference books/ Web Links

1. Jacob Eisenstein. "Natural Language Processing ", MIT Press (2019).
2. Nitin Indurkhya,Fred J. Damerau, "Handbook of Natural Language Processing", Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover (2010).
3. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press (2009).

Online Resources

1. Natural Language Processing | Coursera
2. https://www.mltut.com/best-natural-language-processing-courses-online-to-become-expert/#2-become-a-natural-language-processing-expert-udacity
3. https://www.mltut.com/best-natural-language-processing-courses-online-to-become-expert/#7-applied-text-mining-in-python-coursera

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert**
			Dr.S.Rajini , Department of Information Technology
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24DSJ601	PROJECT PHASE I	L	T	P	J	C
		0	0	0	20	10
PRJ		SDG	4,9,11			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:

The purpose of taking this course is to:

1	To identify and define a research problem in the data science domain with societal or industrial relevance.
2	To conduct a comprehensive literature survey and gap analysis.
3	To formulate a clear research methodology and plan of execution.
4	To document the project idea with a structured interim report

Course Outcomes:

After successful completion of this course, the students shall be able to		Bloom's Taxonomy Level (BTL)
CO 1	Identify a relevant research problem in data science and formulate research objectives.	An
CO 2	Conduct a critical review of existing literature and summarize research gaps.	An
CO 3	Design a suitable methodology or solution framework for the selected problem.	Ap
CO 4	Present the problem statement, methodology and expected outcomes in a structured technical report.	Ap
CO5	Demonstrate initial prototype development or simulation results aligned with the research plan.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3				3
2	3		3		
3		3			
4		3			
			3		3

Signature of the BOS Chairman

Assessment
Rubrics based Evaluation, Faculty and Panel review, Viva voce, Report Submission

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
-	-	Dr. N.Rajathi , Department of Information Technology	
Recommended by BoS on	09.05.2025		
Academic Council Approval	No:28	**Date**	26.06.2025

Signature of the BOS Chairman

24DSJ602	PROJECT PHASE II	L	T	P	J	C
		0	0	0	40	20
PRJ		SDG	4,9,11			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:

The purpose of taking this course is to:

1	To implement and evaluate the proposed solution using appropriate data science tools and techniques.
2	To interpret and analyze experimental results using relevant metrics.
3	To demonstrate innovation, ethical practices, and technical mastery in project execution.
4	To document and present the research outcomes in a professional manner.

Course Outcomes:

After successful completion of this course, the students shall be able to		Bloom's Taxonomy Level (BTL)
CO 1	Develop a complete solution or application based on the proposed methodology.	C
CO 2	Analyze and interpret results using appropriate performance metrics and visualization techniques.	An
CO 3	Demonstrate innovation, ethical responsibility, and domain mastery in solving the problem.	Ap
CO 4	Prepare a well-structured, technically sound project report with proper citations and documentation.	Ap
CO5	Present and defend the project outcomes to a technical audience with clarity and confidence.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3			3	
2			3	3	
3			3	3	3
4		3			
5		3	3		

Signature of the BOS Chairman

Assessment
Rubrics based Evaluation, Faculty and Panel review, Viva voce, Report Submission

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
-	-	Dr. N. Rajathi, Department of Information Technology	
Recommended by BoS on	09.05.2025		
Academic Council Approval	No:28	**Date**	26.06.2025

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PROFESSIONAL ELECTIVES

Signature of the BOS Chairman

24DSE001	Internet of Things	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9, 11, 12			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Understand the fundamental concepts, technologies, and architecture of IoT systems.
2	Explore IoT devices, protocols, data management techniques, and analytics of IoT data.
3	Design, implement, and analyze IoT systems in real-world applications through hands-on projects and labs.
4	Address security, privacy, and ethical considerations in IoT deployments.

Course outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the architecture, components, and evolution of IoT.	U
CO 2	Design IoT applications using sensors, actuators, and microcontrollers.	Ap
CO 3	Apply IoT protocols and networking technologies, ensuring secure and efficient data transmission.	Ap
CO 4	Analyze data collected from IoT devices and implement data management strategies.	An
CO 5	Understand the security, privacy, and ethical considerations in IoT deployments.	U
CO 6	Develop solutions for real-world problems using IoT technologies and tools.	C

COS	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	2		3	3	2
2	3		2	3	2
3	3			2	2
4	3	1		3	3
5	3			2	1
6	3	2	3	3	3

Course Content

FUNDAMENTALS OF IOT Overview of IoT: Concepts, terminologies, characteristics and Evolution-IoT ecosystem and standards - IoT architecture -types-design considerations- Applications and challenges **IoT Hardware Platform:** IoT Devices-Sensors-Behavior, Selection, Circuits -Actuators – embedded system and Microcontrollers, Battery Issue and Energy Management- IoT hardware platforms (Arduino, Raspberry Pi- NVIDIA Jetson). **Practical Component** Set up an IoT development board (e.g., Arduino, Raspberry Pi) and connect various sensors (temperature, humidity, motion etc.,).	**6 Hours** **6 Hours**
IOT PROTOCOLS	**6 Hours**

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Application Layer Protocols-MQTT, CoAP, HTTP, AMQP- Network Layer Protocols: 6LoWPAN, RPL, IPv6, Zigbee, LoRaWAN, BLE, GSM/GPS- Edge and Fog Computing: Concepts and Architectures- Connectivity Challenges in IoT. **Practical Component** Write a basic script to read data from sensors and display it on a local console.	**4 Hours**
DATA STORAGE AND MANAGEMENT FOR IOT IoT cloud Storage -IoT Core Services-IoT Registry-IoT Rules-IoT Shadows- MQTT/HTTP/Web sockets- Computing on the Edge - IoT Greengrass-Deeplens-Time-series databases (InfluxDB, TimescaleDB)-IoT data streaming and real-time databases- Security and privacy issues in IoT data storage. **Practical Component** Collect and store IoT data using cloud and local storage solutions.	**6 Hours** **8 Hours**
IOT ANALYTICS IoT Analytics- Types of Analytics- Descriptive Analytics -Predictive Analytics-Prescriptive Analytics and Decision Making-Time Series Analysis- IoT Analytics Platforms- Open-Source Tools for IoT Analytics. **Practical Component** Process and analyze IoT data in real-time.	**6 Hours** **6 Hours**
IOT SECURITY Security Threats and Vulnerabilities-Security Mechanisms: Authentication, authorization, and encryption techniques-Secure firmware updates and device management-Privacy Considerations: Data privacy regulations (GDPR, CCPA)-Privacy-preserving techniques and data anonymization. **Case Studies:** Industries such as smart agriculture, smart transportation, healthcare, and environment. **Practical Component** Build IoT application with sensors (temperature, motion, and lighting etc.,) integrating with cloud services.	**6 Hours** **6 Hours**

Theory Hours: 30	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 60

Learning Resources

Textbooks

1. Andrew Minteer, Analytics for Internet of Things, Packt Publications Mumbai (2017).
2. Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann. Internet of Things: Principles and Paradigms, Elsevier (2016).

Reference books/ Web Links

1. Rachael Tatman, Data Science for the Internet of Things, O'Reilly Media (2021).
2. David Hanes, Gonzalo Salgueiro, and Patrick Grossetete, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press (2017).
3. K. K. R. Choo, R. H. J. A. S. M. G. A. Singh, Architecting the Internet of Things: State of the Art, Springer (2016).
4. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, VPT Universities Press (2015).
5. Olivier Hersent, David Boswarthick, and Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley publication (2012).

Online Resources

1. Introduction to the Internet of Things and Embedded Systems | Coursera
2. IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies | Coursera
3. IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies | Coursera
4. IoT Communications | Coursera

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Assessment (Embedded)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
		Ms. G. Shobana, Department of Information Technology	
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24DSE002	Cloud and Data Engineering	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4,9,12			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to
1	Understand the key concepts of cloud computing and evaluate different cloud platforms for data engineering needs.
2	Learn to manage and optimize cloud-based resources, including storage, computing, and databases for large-scale data processing.
3	Implement cloud security best practices, focusing on identity management, data protection, and regulatory compliance.
4	Design and deploy scalable, resilient cloud applications, leveraging advanced services for real-time analytics and big data processing.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the Fundamental Concepts of Cloud Computing and Compare Services Across different clouds.	U
CO 2	Efficiently manage and optimize essential cloud services, including computing resources, storage solutions, and databases.	Ap
CO 3	Implement Security Best Practices in Cloud Environments Using Identity Management and Compliance Tools.	Ap
CO 4	Utilize Advanced Cloud Services for Data Processing, Analytics, and Serverless Computing.	An
CO 5	Design and Manage Scalable and Resilient Cloud-Based Applications Using Appropriate Cloud Architectures.	An

COS	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	1	2	3	-	-
2		2		3	3
3				2	3
4				3	2
5	3			2	3
6	1	2	3		

Course Content

INTRODUCTION TO CLOUD COMPUTING FOR DATA ENGINEERING Overview of Cloud Computing: Evolution of modern IT and the role of cloud computing in transforming data engineering and IT practices. Major Cloud Service Providers: An introduction to leading cloud platforms, focusing on their key services and capabilities related to data engineering. Cloud Deployment Models: Understand the differences between Public, Private, and Hybrid Cloud models, and how each affects data storage, processing, and scalability. Service Models: IAAS, PAAS, SAAS and their applications in data engineering workflows.	**5 Hours**

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Practical Component: Account Setup and Dashboard Exploration of different clouds, deploy a virtual machine using IaaS.	**6 Hours**
CORE CLOUD SERVICES Introduction to Cloud Services: Essential cloud services used for data storage, processing, and analytics. Features, scalability, and key use cases for data storage and building data lakes. Explore ETL (Extract, Transform, Load) processes and the creation of data pipelines. Big data processing and analytics using popular frameworks like Hadoop and Spark. Data warehousing solutions for large-scale data analysis. Serverless computing for efficient and scalable data processing tasks. Techniques for migrating databases Cloud solutions for big data processing. Orchestrate data pipelines using cloud orchestration service. **Practical Component:** Cloud Services for Extraction, Transform and Load.	**7 Hours** **6 Hours**
ADVANCED CLOUD DATA MANAGEMENT AND PROCESSING Build and manage data lakes for centralized data storage and processing, ensuring efficient data governance and security. configuration and usage of VMs for scalable data processing tasks, Relational database services: MySQL, MariaDB, PostgreSQL, Oracle, and Microsoft SQL Server. Managing identity and access control - secure handling and protection of data within cloud environments. Integration of big data and data warehousing capabilities for advanced analytics, enabling comprehensive insights and data-driven decision-making. **Practical Component:** Run a sample data processing job, such as a word count or data aggregation task in cloud, Infrastructure and Database Deployment.	**6 Hours** **6 Hours**
CLOUD STORAGE AND IDENTITY MANAGEMENT Cloud Storage Solutions: Scalable data storage options using different cloud Storage and focusing on best practices for data management. Identity and Access Management (IAM): Manage users, groups, roles, and policies to ensure secure data access and maintain compliance within cloud environments. Data Modelling and Schema Design: Concepts of data modelling and schema design, and how they influence data engineering workflows and efficiency. **Practical Component:** Upload, manage, and access different types of data (e.g., CSV, JSON). Implement versioning and lifecycle policies. Compare scalability and performance.	**6 Hours** **6 Hours**
CLOUD SECURITY AND BEST PRACTICES Security in Cloud Computing: Strategies to ensure data protection, privacy, and compliance within cloud environments. Comprehensive security management and threat protection offered by Cloud. Compliance and Governance: Implementing data encryption, key management, and regulatory compliance to secure cloud-based data and meet governance requirements. Disaster Recovery and Business Continuity Planning (BCP): Develop strategies to ensure data availability, resilience, and continuity in the face of potential disruptions, critical for data engineering contexts. **Practical Component:** Create IAM users, groups, roles, and policies. Implement least privilege access for cloud resources and test access controls.	**6 Hours** **6 Hours**

Theory Hours:	**30**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**60**

Learning Resources

Text Books:

1. Thomas Erl, Zaigham Mahmood, & Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, (2013).
2. Paul Crickard, Data Engineering with Python: Work with Massive Datasets to Design Data Models and Automate Data Pipelines Using Python, (2020).
3. Ronald L. Krutz & Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, (2010).

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4. Michael J. Kavis, Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), (2014).
5. Martin Kleppmann, Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, (2017).

Reference books/ Web Links

1. Nishant Neeraj, Cloud Data Engineering: Building Modern Data Platforms, (2022).
2. Vlad Riscutia, Data Engineering on Azure: A Guide to Designing and Building Scalable Data Solutions, (2021).
3. Martin Kleppmann, Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, (2017).
4. Thomas Erl, Robert Cope, & Amin Naserpour, Cloud Computing Design Patterns, (2015).
5. Nathan Marz & James Warren, Big Data: Principles and Best Practices of Scalable Real-Time Data Systems, (2015).
6. Liang Zhao, Cloud Data Management, (2014).

Online Resources

1. https://learn.microsoft.com/en-us/training/
2. https://aws.amazon.com/training/
3. https://www.coursera.org/specializations/gcp-data-machine-learning
4. https://cloudsecurityalliance.org/

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Mr .C. Jeganathan, Department of Information Technology

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24DSC003	Generative AI	L	T	P	J	C
		2	0	2	0	3
PE		SDG	4, 9, 12			

Pre-requisite courses	24DSI504 / Artificial Intelligence and Machine learning	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	Provide a comprehensive understanding of Generative AI, focusing on foundational theories and hands-on practices.
2	Explore the architecture and significance of Transformers in language and text generation tasks.
3	Equip students with techniques like prompt engineering and fine-tuning to effectively guide Large Language Models.
4	Study advanced model optimization methods, including Parameter Efficient Fine-Tuning and Reinforcement Learning with Human Feedback.
5	Design and develop applications powered by LLMs for text and image generation.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Understand the architecture of Transformers and their role in language generation and text processing.	U
CO 2	Apply prompt engineering techniques and instruction fine-tuning to guide Large Language Models for desired outputs.	Ap
CO 3	Evaluate and implement Parameter Efficient Fine-Tuning and Reinforcement Learning with Human Feedback to optimize LLM performance.	Ap
CO 4	Develop and deploy LLM-powered applications for text and image generation.	An
CO 5	Analyse ethical considerations and biases in Generative AI and apply responsible AI practices in real-world applications.	An

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
COS	1	2	3	4	5
1	2	2	3		
2			2		
3					
4	3	3	3	3	3
5	2			3	3

Course Content

INTRODUCTION TO GENERATIVE AI Introduction to Generative AI, History and Evolution of Generative AI, Natural Language Processing, Tokenization, Word Embedding, Word2Vec, Learnable Word Embeddings, Probabilistic Models in Generative AI, Sequential Models, Recurrent Neural Networks, Long Short-Term Memory Cell, Gated Recurrent Unit, Text Generation Using Sequential Models. **Practical Component** Build classification and regression models using Neural Networks.	**6 Hours** **6 Hours**
LARGE LANGUAGE MODELS	**6 Hours**

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Encoder-Decoder models, Bidirectional RNN, Attention Mechanism, Self-Attention, Multi Head Attention, Positional Encoding, Normalization, Transformer Architecture, Pre-training and Fine-tuning, Architectural Variants of transformers, Tokenization techniques, Evaluation metrics, Vison Transformer, Applications of LLM. **Practical Component** Making text generation models using RNN.	**6 Hours**
PROMPT ENGINEERING AND FINE-TUNING TECHNIQUES Introduction to Prompt Engineering, Role of Prompts in Generative AI, Structure of Prompts, Prompt Templates and Patterns, Prompt Optimization Strategies, Feedback to Improve Prompts, Instruction Fine-Tuning, Supervised Fine-Tuning, Parameter Efficient Fine-Tuning, Reinforcement Learning with Human Feedback. **Practical Component** Apply prompt engineering and fine-tuning techniques on text generation model.	**6 Hours** **6 Hours**
ADVANCED GENERATIVE MODELS Generative Adversarial Networks (GANs), Deep Convolutional GANs, Conditional GANs, Wasserstein GANs, Progressive Growing GANs, Variational Autoencoders (VAEs), Conditional VAEs, Diffusion Models, Autoregressive Models, Transformers for Image Generation, BERT and Variants, Hybrid Models. **Practical Component** Image Generation using GANs.	**6 Hours** **6 Hours**
DEVELOPING AND DEPLOYING LLM-POWERED APPLICATIONS Applications of LLMs: Text and Image Generation, Contrastive Language-Image Pre-Training, Building Custom Applications and Pipelines, Deployment Strategies, Best Practices for LLM Training and Deployment, Model Optimization Techniques. Ethical Considerations and Responsible AI Practices **Practical Component** Building and deploying Text to Speech and Speech to Text models.	**6 Hours** **6 Hours**

Theory Hours: 30	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 60

Learning Resources

Textbooks

1. James Phoenix, Mike Taylor, Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs, (2024).
2. Charu C Aggarwal, Neural Networks and Deep Learning: A Textbook, (2023).

Reference books/ Web Links

1. Lewis Tunstall, Leandro von Werra, Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, (2022).
2. Chip Huyen, Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications, (2022).
3. David Foster, Generative Deep Learning-Teaching Machines to Paint, Write, Compose, and Play, (2019).

Online Resources

1. https://www.nvidia.com/en-us/glossary/generative-ai/
2. https://aws.amazon.com/what-is/generative-ai/
3. https://www.ibm.com/topics/generative-ai

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert**
			Mr. Abhijith C Prakash, Department of Information Technology
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24DSE004	Computer Vision	L	T	P	J	C
		3	0	0	0	3
PE		SDG	3, 9, 11			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:	The purpose of taking this course is to:
1	This course delves into advanced computer vision techniques with deep learning, from image formation to feature detection and object segmentation.
2	Students will learn to apply CNNs for real-world tasks such as object localization, 3D reconstruction, and motion estimation.
3	The Advanced Computer Vision and Deep Learning course delves into cutting-edge techniques for analysing and interpreting visual data.
4	It covers advanced neural network architectures, such as convolutional and generative models, for tasks like image recognition and synthesis.
5	Students will explore state-of-the-art methodologies in object detection, segmentation, and visual reasoning. The course aims to equip learners with the skills to tackle complex vision problems and innovate in the field.

Course Outcomes:	After successful completion of this course, the students shall be able to	Bloom's Taxonomy Level (BTL)
CO 1	Evaluate the impact of geometric and photometric factors on image formation using different camera models.	E
CO 2	Implement and assess feature detection and image processing techniques using OpenCV and Pillow.	An
CO 3	Apply and critique advanced object detection and segmentation algorithms to solve real-world problems.	An
CO 4	Integrate 3D vision techniques to reconstruct scenes and estimate motion from image sequences.	An
CO 5	Develop and optimize deep learning models for tasks such as face recognition and neural style transfer.	An

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
COS	1	2	3		
1	3	2	3	3	3
2	3	2	3	3	3
3	3	2	3	3	3
4	3	2	3	3	3
5	3	2	3	3	3

Course Content

INTRODUCTION TO COMPUTER VISION AND IMAGE FORMATION Introduction to Computer Vision: Definition, scope, and real-world applications, Image Formation and Representation: Geometric transformations (2D and 3D), Camera models and projections (pinhole model, lens distortions), Photometric Image Formation: Lighting models,	**9 Hours**

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reflectance, and shading, Image Representation and Capture: Sampling, quantization, and color theory, Linear Filtering: Convolution, correlation, and edge detection techniques.	
FEATURE DETECTION AND IMAGE PROCESSING Feature Detection: Corners, blobs, edges, and lines (e.g., Harris, SIFT, SURF), Scale-space and scale selection, Image Processing Techniques with OpenCV and Pillow: Manipulating Images, Pixel Transformations, Geometric Operations, Spatial Operations in Image Processing.	**9 Hours**
OBJECT DETECTION AND SEGMENTATION Object Detection: Landmark detection, sliding window techniques, bounding box predictions, Intersection over Union (IoU), non-max suppression, anchor boxes, Object Detection Algorithms: YOLO algorithm, Faster R-CNN, Semantic Segmentation: U-Net architecture, segmentation techniques.	**9 Hours**
3D VISION, RECONSTRUCTION, AND MOTION ESTIMATION 3D Vision: Two-view geometry, epipolar constraints, structure from motion (SfM), Multi-view stereo, shape from shading, 3D Reconstruction Techniques: Depth estimation, stereo correspondence, Motion Estimation: Optical flow, dense motion estimation.	**9 Hours**
DEEP LEARNING IN COMPUTER VISION Face Recognition: One-shot learning, Siamese networks, triplet loss, Neural Style Transfer: Style and content cost functions, advanced neural transformations, Convolutional Neural Networks (CNNs): Architectures like ResNet, VGG, and transfer learning, Generative Models: Generative Adversarial Networks (GANs), Reinforcement Learning in Vision: Applications in robotics and autonomous systems.	**9 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 45

Learning Resources

Textbooks

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition, Springer (2022).
2. Vaibhav Verdhan, Computer Vision Using Deep Learning: Neural Network Architectures with Python and Keras, 1st Edition, Apress (2021).

Reference books/ Web Links

1. Benjamin Planche & Eliot Andres, Hands-On Computer Vision with TensorFlow 2: Leverage Deep Learning to Create Powerful Image Processing Apps with TensorFlow 2.0 and Keras, 1st Edition, Packt Publishing Limited (2019).
2. Rajalingappaa Shanmugamani, Deep Learning for Computer Vision: Expert Techniques to Train Advanced Neural Networks Using TensorFlow and Keras, 1st Edition, Packt Publishing Limited (2018).
3. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, & Mohammed Bennamoun, A Guide to Convolutional Neural Networks for Computer Vision, 1st Edition, Morgan & Claypool Publishers (2018).

Online Resources

1. https://www.coursera.org/learn/advanced-computer-vision-with-tensorflow?msockid=0b25de636016615406b8cdaf61006069
2. https://www.coursera.org/learn/advanced-deep-learning-techniques-computer-vision?msockid=0b25de636016615406b8cdaf61006069

Assessment (Theory)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

Signature of the BOS Chairman

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert**
			Dr. S. Sangeetha, Department of AI&DS
Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24DSC005	BLOCKCHAIN TECHNOLOGIES AND DAPP DEVELOPMENT	L	T	P	J	C
		2	0	0	2	3
PE		SDG	9			

Pre-requisite courses	Nil	Data Book / Codes / Standards (If any)	NA

Course Objectives:

The purpose of taking this course is to:

1	Understand and differentiate blockchain architectures, consensus mechanisms, and decentralized storage systems.
2	Equip learners with skills to develop smart contracts using Solidity and connect them to Web3 frontends.
3	Explore decentralized storage protocols, indexing tools, and their integration in DApps.
4	Examine data-driven blockchain applications, including identity, privacy, and DAO frameworks.

Course Outcomes:

After successful completion of this course, the students shall be able to		Bloom's Taxonomy Level (BTL)
CO 1	Apply appropriate blockchain architecture and consensus mechanism to demonstrate decentralized network deployment	Ap
CO 2	Analyze smart contract logic to develop interactive Web3 DApps	An
CO 3	Analyze storage and indexing methods to ensure efficient data handling in DApps	An
CO 4	Evaluate identity and privacy models to design secured blockchain systems.	E

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	2			2	2
2	2			3	2
3	2			3	2
4	2			2	3

Course Content

BLOCKCHAIN AND DECENTRALIZATION FUNDAMENTALS Blockchain architectures (public, private, consortium) - Decentralized storage concepts and IPFS basics - Cryptographic primitives: Hashing, Merkle Trees, Digital Signatures - Consensus mechanisms: PoW, PoS, PBFT, DPoS - Blockchain scaling challenges: Layer 1 vs Layer 2 solutions - Blockchain interoperability: Polkadot, Cosmos	**7 Hours**
Practical Component Setup blockchain environment with Node.js, Ganache, and MetaMask - Simulate basic transactions in a local blockchain (Ganache + MetaMask) - Demonstrate cryptographic primitives (Hashing, Merkle Trees) using simple JS or Python scripts.	**4 Hours**

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SMART CONTRACTS AND DAPPS Smart Contract Basics -Solidity programming essentials: data types, control structures - Smart contract deployment: Hardhat and Truffle workflows - JSON-RPC model and provider mechanisms - Connecting smart contracts to frontend: Web3.js vs Ethers.js - Handling transactions and events from frontend - Introduction to wallet SDKs: MetaMask, WalletConnect **Practical Component** Write and deploy smart contracts using Solidity on Hardhat - Use Remix IDE for initial testing and debugging - Connect contract to frontend using Web3.js or Ethers.js, and handle wallet-based interactions (MetaMask).	**7 Hours** **4 Hours**
DECENTRALIZED STORAGE AND INDEXING Using IPFS: node setup, pinning, gateways - Filecoin basics and decentralized storage economics - Uploading and fetching metadata with Web3.Storage - Cross-chain data retrieval techniques - Challenges in decentralized data storage: Privacy, Redundancy, Speed **Practical Component** Upload and retrieve data using IPFS via Pinata or Web3.Storage - Display retrieved metadata on a simple frontend (HTML/JS) - Intro demo of indexing with The Graph (hosted playground; no deployment).	**8 Hours** **4 Hours**
DATA-DRIVEN BLOCKCHAIN APPLICATIONS Blockchain for Data Privacy: zk-SNARKs, zk-STARKs basics - Introduction to Decentralized Identity Systems (DID, SSI models) - Use of NFTs for asset tokenization in data marketplaces - Decentralized Autonomous Organizations (DAOs) for collaborative analytics - Legal and ethical considerations in blockchain-based data solutions - Real-world case studies: Healthcare, Finance, Supply Chain, Education **Mini-Project Options:** 1. **NFT Marketplace** - with smart contracts, file storage (IPFS), frontend (React/Web3.js), MetaMask login 2. **Decentralized Voting App** - with privacy logic (zk-SNARKs concept), basic UI, and event recording 3. **DID Demo** - setup identity (using tools like Ceramic or open-source SDKs) and access control 4. **Token-gated Learning App** - restrict content access using NFT/token verification **Tool Options:** Solidity, Hardhat, IPFS/Web3.Storage, MetaMask, React, Web3.js/Ethers.js, OpenZeppelin libraries, zk-demo kits	**8 Hours** **18 Hours**

Theory Hours:	30	Tutorial Hours:	0	Practical Hours:	0	Project Hours:	30	Total Hours:	60

Learning Resources

Text books:

1. Imran Bashir. *Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications*. 3rd Edition, Packt Publishing (2020).
2. Pethuru Raj, Anupama C. Raman, Blockchain Technology and Applications,, Springer(2019).
3. Arshdeep Bahga, Vijay Madisetti,Blockchain Applications: A Hands-On Approach, , Publisher: VPT (Vijay P. Madisetti & Arshdeep Bahga), (2017).

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Reference books:
2. Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners,Chris Dannen, Apress (Springer) ISBN: 978-1484225349 3. Wattenhofer, R. P, Distributed Ledger Technology: The Science of the Blockchain (Inverted Forest Publishing), 2017, 2nd Edition, CreateSpace Independent Pub, Scotts Valley, California, US. 4. Bashir, I. (2020). Mastering Blockchain: A Deep Dive into Distributed Ledgers, Consensus Protocols, Smart Contracts, DApps, Cryptocurrencies, Ethereum, and More Third Edition. United Kingdom: Packt Publishing.
Online Resources (Weblinks)
1. https://ethereum.org/en/developers/ 2. https://web3.storage/docs/ 3. https://www.weforum.org/reports/blockchain-beyond-the-hype 4. https://www.investopedia.com/terms/b/blockchain.asp 5. https://www.debutinfotech.com/blockchain-technology 6. https://www.coursera.org/specializations/blockchain 7. https://nptel.ac.in/courses/106105184/

Assessment (Embedded)
SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
-	-	Dr. J.Cynthia , Department of Computer Science and Engineering	
Recommended by BoS on	09.05.2025		
Academic Council Approval	No:28	**Date**	26.06.2025

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24DSC006	NETWORK SCIENCE AND SOCIAL ANALYTICS	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9, 10,16			

Pre-requisite courses	24MAI505 Mathematics for Data Science	Data Book / Code book (If any)	NA

Course Objectives:

The purpose of taking this course is to:

1	Acquire knowledge of fundamental graph theory concepts, network data types, and key metrics used in social network analysis.
2	Develop practical skills in collecting, processing, analyzing, and visualizing network data using standard Python libraries and visualization tools.
3	Gain competency in interpreting network structures, identifying key actors and communities, and understanding basic network dynamics.
4	Understand the application of SNA techniques in various domains, particularly social media and organizational contexts, while considering ethical implications.
5	Develop the ability to critically evaluate network analysis results and communicate findings effectively through visualizations.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Design and implement advanced graph-based models to analyze and predict social network structures and dynamics.	Ap
CO2	Evaluate network properties and patterns using sophisticated statistical and machine learning techniques.	An
CO3	Develop scalable solutions for community detection, link prediction, and influence modeling in large networks.	Ap
CO4	Critically assess the ethical, societal, and methodological limitations of SNA applications in diverse domains.	E
CO5	Communicate complex SNA findings effectively through advanced visualizations and research-oriented presentations.	Ap

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1		3	2	2	3
2					3
3		2	3		
4		2	3		
5	3			2	

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Course Content	
Foundations of Social Network Analysis SNA Overview - Advanced applications in social media, epidemiology, organizational networks - Graph Theory - Directed/undirected graphs, weighted graphs, multiplex networks, temporal networks - Network Data - Multi-modal data, big data challenges, API-based data collection -Twitter, LinkedIn - Ethical Frameworks - Privacy, bias, fairness in network data analysis. **Practical Component:** Create/analyze multiplex and temporal graphs using NetworkX - Collect network data using Twitter/LinkedIn APIs -Tweepy, python-linkedin - Model a multi-layer social media network.	**6 Hours** **6 Hours**
Network Metrics and Statistical Analysis Centrality Measures - Katz centrality, PageRank, hub/authority scores - Statistical Properties - Homophily, assortativity, modularity, network autocorrelation Moran's I, Geary's C - P1/P* Models - Predicting dyadic relations using Exponential Random Graph Models (ERGMs) - Tools - Python NetworkX, igraph, R-statnet, sna. **Practical Component:** Compute Katz centrality and PageRank using NetworkX/igraph - Implement ERGMs using R statnet to model network ties - Analyze homophily in an organizational network.	**6 Hours** **6 Hours**
Community Detection and Network Clustering Advanced Community Detection - Spectral clustering, stochastic block models, overlapping communities - Modularity Optimization - Louvain, Infomap, hierarchical clustering - Evaluation Metrics - Normalized mutual information, adjusted Rand index - Visualization - Advanced Gephi layouts- Force Atlas 2, OpenOrd, Python - Matplotlib, Seaborn. **Practical Component:** Apply spectral clustering and evaluate with normalized mutual information - Detect communities in a social media dataset - Visualize communities using Gephi and Python.	**6 Hours** **6 Hours**
Dynamic Networks and Machine Learning Network Dynamics - Temporal network models, preferential attachment, network evolution - Diffusion Models - Epidemic models -SIR, SEIR-, information cascades, threshold models - Machine Learning - Graph Neural Networks (GNNs), node embedding -Node2Vec, DeepWalk - Link Prediction - Graph convolutional networks, temporal link prediction. **Practical Component:** Model/visualize temporal networks using Python -teneto - Simulate SIR diffusion on networks using NetworkX - Implement Node2Vec for node embeddings - Build a GNN for node classification using PyTorch Geometric.	**6 Hours** **6 Hours**

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Module 5: Applications, Ethics, and Research Communication Advanced Applications - Social media analytics, organizational influence, epidemiological modeling - Ethical Considerations - Bias in algorithms, data privacy, societal impact - Research Communication - Designing research papers, advanced visualizations, stakeholder presentations - Case Studies - Misinformation spread, supply chain networks. **Practical Component:** Analyze misinformation spread in a social media network - Evaluate ethical implications of SNA in a dataset - Create interactive visualizations using Gephi with temporal/multiplex data - Draft a research paper and deliver a visualized presentation.	**6 Hours** **6 Hours**

Theory Hours: 30	**Tutorial Hours: 0**	**Practical Hours: 30**	**Project Hours: 0**	**Total Hours: 60**

Learning Resources

Text books:

1. Barabási, A.-L. (2016). *Network Science*. Cambridge University Press. (http://networksciencebook.com/)
2. Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2018). *Analyzing Social Networks* (2nd ed.). SAGE Publications.

Reference books:

1. Hanneman, R. A., & Riddle, M., Introduction to Social Network Methods. University of California, Riverside.(2005).
2. Easley, D., & Kleinberg, J., Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press(2010).
3. Wasserman, S., & Faust, K. , Social Network Analysis: Methods and Applications,Cambridge University Press(1994).
4. Newman, M. E. J. Networks: An Introduction. Oxford University Press, (2010).

Online Resources (Weblinks)

1. https://networkx.org/documentation/stable/
2. https://gephi.org/users/
3. http://web.stanford.edu/class/cs224w/
4. https://www.coursera.org/learn/social- network-analysis
5. https://pytorch-geometric.readthedocs.io/

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

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Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert**	
-	-	Dr. P.C.Thirumal Department of Information Technology	
Recommended by BoS on	09.05.2025		
Academic Council Approval	No:28	**Date**	26.06.2025

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24DSC007	BUSINESS INTELLIGENCE AND STRATEGIC DECISION ANALYTICS	L	T	P	J	C
		2	0	2	0	3
PE		SDG	8,9			
Pre-requisite courses	24DSI503 Data Analysis and Visualization	Data Book / Code book (If any)	NA			

Course Objectives:	
The purpose of taking this course is to:	
1	Acquire an in-depth understanding of advanced business analytics frameworks, statistical learning, and decision science approaches.
2	Develop skills in handling complex and unstructured data for business modelling and data-driven insights.
3	Apply machine learning and deep learning techniques for predictive and prescriptive analytics in varied business domains.
4	Master the use of advanced tools for dynamic visualization and decision support systems.
5	Integrate domain expertise to drive innovative, ethical, and sustainable business strategies using analytics.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Formulate and evaluate complex business problems using advanced analytics models and tools.	C
CO 2	Design machine learning and optimization models for predictive and prescriptive business analytics.	C
CO 3	Integrate unstructured and structured data sources to build decision support systems.	Ap
CO 4	Perform analytics in domains like finance, HR, marketing, and operations using cutting-edge techniques.	An
CO 5	Research and develop innovative and ethical analytics solutions addressing industrial or societal challenges.	E

Course Outcomes	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research & Development	Technical Reporting	Domain Mastery	Data Science Applications	Ethical Analytics Solutions
1	3			2	
2		2	3		
3				3	2
4	2	3			
5	3				2

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Course Content	
Advanced Foundations of Business Analytics Business analytics lifecycle – CRISP-DM – SEMMA – Hypothesis formulation in business context-Causal inference – A/B testing – Bayesian inference for decision- making – Experimental design for analytics **Practical Component:** Develop a CRISP-DM based business workflow – Perform hypothesis and A/B testing using Python or R	**6 Hours** **6 Hours**
Predictive and Prescriptive Analytics Supervised learning – Forecasting – Classification – Regression – Decision trees – Random Forest – XGBoost-Optimization techniques – Linear, Nonlinear, Integer programming – Simulation – What-if scenario analysis **Practical Component:** Build ensemble models using Python – Perform demand forecasting and prescriptive modeling using Tableau/Power BI	**6 Hours** **6 Hours**
Unstructured Data Analytics Text mining – Sentiment analysis – Web and social media analytics – NLP techniques – Named Entity Recognition-Topic modeling using LDA – Deep learning for customer insights – Transformers – BERT for unstructured text **Practical Component:** Analyze Twitter or Facebook data – Apply LDA and BERT for topic extraction and feedback interpretation	**6 Hours** **6 Hours**
Industry-Specific Analytics Applications Financial analytics – Credit scoring – Fraud detection – HR analytics – Attrition prediction – Workforce analysis-Marketing analytics – Churn prediction – Customer lifetime value – Operations and supply chain analytics **Practical Component**: Create industry-specific dashboards – Build ML models for fraud and churn prediction	**6 Hours** **6 Hours**
Ethical, Sustainable and Innovative Analytics Bias – Fairness – Privacy – Responsible AI – LIME – SHAP – Transparency and model explainability-Analytics for social impact – Sustainability – Healthcare – Education – Smart cities – Responsible innovation **Practical Component:** Build interpretable models using SHAP and LIME – Mini-project on analytics for social good	**6 Hours** **6 Hours**

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Theory Hours: 30	Tutorial Hours: 0	Practical Hours: 0	Project Hours:30	Total Hours: 60

Learning Resources

Text books:

1. J. R. Evans, Business Analytics, 3rd ed., Boston, MA, USA: Pearson(2021).
2. B. Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, 2nd ed., Hoboken, NJ, USA: Wiley,(2021).
3. F. Provost and T. Fawcett, Data Science for Business: What You Need to Know About Data Mining and Data- Analytic Thinking, 2nd ed., Sebastopol, CA, USA: O'Reilly Media(2023).
4. M. Kuhn and K. Johnson, Applied Predictive Modeling, New York, NY, USA: Springer,(2013)
5. S. Sharda, D. Delen, and E. Turban, Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 5th ed., Upper Saddle River, NJ, USA: Pearson(2023)

Reference books:

1. D. Jurafsky and J. H. Martin, Speech and Language Processing, 3rd ed. Stanford, CA: Pearson (2023).
2. B. Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and Its Applications, 2nd ed., Hoboken, NJ: Wiley(2021).
3. C. O'Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, New York, NY: Broadway Books(2017).
4. G. Miner, J. Elder IV, T. Hill, R. Nisbet, D. Delen and A. Fast, Practical Text Mining and Statistical Analysis for Non-structured Text Data Applications, Amsterdam: Academic Press (2012)
5. W. L. Winston, Operations Research: Applications and Algorithms, 4th ed., Boston, MA: Cengage Learning, (2021).

Online Resources (Weblinks)

1. https://www.coursera.org/specializations/business-analytics
2. https://www.coursera.org/learn/machine-learning-with-python
3. https://www.coursera.org/learn/python-text-mining
4. https://www.coursera.org/learn/wharton-people-analytics
5. https://www.edx.org/learn/ethics/international-compliance-association-ethics-and-ai

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

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Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
-	-	Ms. G. Preethi G, Department of Artificial Intelligence & Data Science

Recommended by BoS on	09.05.2025		
Academic Council Approval	No:28	**Date**	26.06.2025

Signature of the BOS Chairman

24DSC008	ADVANCED GEOSPATIAL DATA SCIENCE	L	T	P	J	C
		2	0	2	0	3
PE		SDG	9, 11,13,15			

Pre-requisite courses	24DSI504 Artificial Intelligence and Machine Learning	Data Book / Code book (If any)	NA

Course Objectives:	
The purpose of taking this course is to:	
1	Master advanced geospatial concepts, data structures, spatial statistics, and geostatistical methods necessary for complex analysis.
2	Develop expertise in processing, analyzing, and modeling complex geospatial data using advanced Python libraries, spatial databases, and GIS integrations.
3	Critically evaluate and apply sophisticated spatial analysis, machine learning, and deep learning techniques to address complex, real-world geospatial problems and research questions.
4	Design, implement, and rigorously evaluate robust and innovative geospatial data science workflows, considering scalability, efficiency, uncertainty, and ethical implications.
5	Independently investigate geospatial problems and effectively communicate advanced analytical findings and solution designs through substantial technical reports and visualizations.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO1	Apply advanced geospatial data processing and management techniques for complex vector, raster, and spatio-temporal datasets using specialized libraries and spatial databases.	Ap
CO2	Apply advanced spatial statistical and geostatistical methods to model complex spatial dependencies and perform robust interpolation/ prediction.	Ap
CO3	Analyze integrated geospatial data science workflows by examining the incorporation of advanced GIS functionalities, spatial feature engineering, and the selection of appropriate ML/DL model architectures for specific problem contexts.	An
CO4	Analyze the performance, limitations, spatial considerations, and uncertainty of advanced ML/DL models when applied to complex geospatial problems	An
CO5	Analyze the effectiveness, ethical considerations, and potential for innovation in geospatial solutions by examining complex case studies and assessing communication through technical reports	An

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Course Outcomes	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)				
	1	2	3	4	5
	Research Competence	Technical Communication	Domain Mastery	Data Science Applications	Ethical Innovation
1			3	2	
2	2		3	2	
3	2		2	3	2
4	3		3	2	
5	3	2			

Course Content

Advanced Geospatial Data Foundations Review of Core Concepts Vector/Raster, CRS- Advanced Projection Theory & Transformations - Spatial Data Structures -Quadtrees, R-Trees, Grids - Topology Rules and Validation - Spatial Databases (PostGIS/SpatiaLite): Architecture, Data Types, Indexing - GiST, SP-GiST - Handling Large Geospatial Datasets -Chunking, Parallel I/O concepts. **Practical Component:** Setting up and querying spatial databases (PostGIS)-Implementing advanced geometric operations and topology checks using libraries like Shapely/GEOS- Working with spatial indexes in PostGIS. Processing moderately large vector datasets.	**6 Hours** **6 Hours**
Advanced Spatial Analysis & Geostatistics Advanced Point Pattern Analysis -Ripley's K, G-function - Spatial Autocorrelation Deep Dive -LISA, Geary's C, Moran Scatterplot - Geographically Weighted Regression (GWR) - Spatio-temporal Data Structures and Analysis Concepts - Geostatistics: Variogram Modeling (Advanced), Kriging Variants -Universal, Co- Kriging, Indicator Kriging, Introduction to Bayesian Geostatistics. **Practical Component:** Compute and interpret Local Moran's I -LISA-using PySAL or similar. Implement Geographically Weighted Regression (GWR) using relevant libraries. Perform advanced Kriging interpolation and compare results with basic methods. Analyze simple spatio-temporal patterns.	**6 Hours** **6 Hours**

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Geospatial Machine Learning Handling Spatial Autocorrelation in ML Models -Spatial Lag/Error Models - SAR, SEM - Advanced Spatial Feature Engineering -Network-based features, Complex landscape metrics, multi-scale features - Applying ML to Geospatial Tasks -Land Use Classification, Object Detection from imagery - using standard ML. Introduction to Spatial Cross-Validation Techniques. Addressing scale and Modifiable Areal Unit Problem (MAUP). **Practical Component:** Implement spatial feature engineering techniques-Apply spatial regression models to account for spatial dependence-Perform spatial cross-validation and compare results with standard CV.	**6 Hours** **6 Hours**
Geospatial Deep Learning CNNs for Geospatial Raster Data: Applications -Semantic Segmentation, Object Detection, Architectures -U-Net variants-, Transfer Learning with Geo-referenced imagery. RNNs/LSTMs/Transformers for Spatio-temporal Prediction -Graph Neural Networks (GNNs) for Geospatial Networks: Applications, Basic GNN architectures. Evaluating Geospatial DL Models: Spatial metrics, Handling class imbalance in spatial data. Model interpretability.	**6 Hours**
Practical Component: Apply a pre-trained CNN model -U-Net for land cover segmentation on satellite imagery using libraries like Rasterio and TensorFlow/PyTorch/fastai.-Use libraries like pytorch_geometric or dgl to apply a basic GNN to a geospatial network dataset -Evaluate model performance using appropriate spatial metrics.	**6 Hours**
Advanced Geovisualization, Evaluation & Research Context Advanced Visualization Techniques: 3D Visualization, Spatio-temporal animations, Visualizing Uncertainty, Web mapping libraries- Evaluating Complex Geospatial Solutions: Frameworks for assessment, Uncertainty analysis, Scalability and performance testing. Ethical Considerations Revisited: Fairness, Accountability, Transparency in Geospatial AI -FATE-GeoAI. Locational privacy techniques - aggregation, obfuscation. Research Frontiers and Case Studies: Analyzing current research papers, Critiquing existing solutions, Identifying open problems. Technical report structure for geospatial analysis. **Practical Component** Create advanced interactive web maps visualizing complex spatial or spatio- temporal data.-Implement methods to visualize uncertainty associated with spatial predictions-Critically analyze and present findings from recent geospatial data science research paper-Develop a proposal/report outline for tackling a complex geospatial problem discussed in case studies.	**6 Hours** **6 Hours**

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Theory Hours: 30	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 60

Learning Resources

Text books:

1. Lovelace, Robin, Jakub Nowosad, and Jannes Muenchow. Geocomputation with R. CRC Press, 2019. (Excellent concepts, R focus but transferable).
2. Obe, Regina O., and Leo S. Hsu. PostGIS in Action. 3rd Edition, Manning Publications, 2021. (Spatial Databases).
3. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016. http://www.deeplearningbook.org

Reference books:

1. Brunsdon, Chris, and Lex Comber. An Introduction to R for Spatial Analysis and Mapping. 2nd Edition, Sage Publications, 2018. (Concepts applicable).
2. Hengl, Tomislav, and Robert A. MacMillan (Eds.). Geomorphometry: Concepts, Software, Applications. Vol. 33. Elsevier, 2009. (Advanced raster analysis).
3. PySAL Documentation: https://pysal.org/docs/ (Core library for spatial stats).
4. GeoPandas, Rasterio, Shapely Documentation (as per UG syllabus).
5. PostGIS Documentation: https://postgis.net/documentation/
6. Relevant Deep Learning library docs (PyTorch Geometric, DGL, TensorFlow Geo).
7. Key academic journals: Transactions in GIS, International Journal of Geographical Information Science, Computers, Environment and Urban Systems, Remote Sensing, IEEE TGRS.

Online Resources (Weblinks)

1. https://postgis.net/workshops/postgis-intro/
2. https://pysal.org/notebooks/
3. https://wvview.org/geospatdl.html
4. https://nptel.ac.in/courses/130106115
5. https://guide.wisc.edu/nondegree/capstone/advanced-gis-capstone-certificate/

Assessment (Embedded)

SA I, SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
-	-	Ms. Rupashini P R, Department of Artificial Intelligence and Data Science

Recommended by BoS on	09.05.2025		
Academic Council Approval	No: 28	**Date**	26.06.2025

Signature of the BOS Chairman

OPEN ELECTIVES

Signature of the BOS Chairman

24MEO001	SUSTAINABLE INNOVATIONS AND PRACTICES	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

Faculty Name:	**Mr. M. Sathish**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/sathish-mathiyazhagan-2a63b65b/**

Course Objectives:	**The purpose of taking this course is to:**
1	Gain a deep understanding of sustainability principles.
2	Learn how to design and implement sustainable solutions.
3	Enhance knowledge of sustainable business practices.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the fundamental principles of sustainability and sustainable development.	U
CO 2	Analyse the impact of human activities on the environment and society.	An
CO 3	Assess and design sustainable solutions for various sectors.	An
CO 4	Evaluate the role of policy, technology, and global cooperation in achieving sustainability goals.	E

MODULE	**Hours**
INTRODUCTION TO SUSTAINABILITY Introduction- Definition and history of sustainability-The three pillars: environmental, social, and economic sustainability-The Anthropocene: Human impact on the Earth-Sustainable Development Goals (SDGs) overview-Systems Thinking and Global Challenges-Systems thinking in sustainability-Global environmental challenges: Climate change, deforestation, pollution-Introduction to ecological footprints and planetary boundaries.	**9**
ENVIRONMENTAL SUSTAINABILITY Climate Change and Energy-Science of climate change and global warming-Renewable energy: Solar, wind, and other alternatives-Transitioning to a low-carbon economy-Biodiversity and Ecosystems-The importance of biodiversity and ecosystems-Threats to biodiversity: Habitat loss, pollution, and overexploitation-Conservation strategies and sustainable resource management.	**8**

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SOCIAL SUSTAINABILITY Poverty, Inequality, and Development-The relationship between poverty, inequality, and sustainability-Sustainable development in low-income countries-Social justice and equity in the context of sustainable development-Sustainable Cities and Communities-Urbanization and its impact on sustainability-Designing sustainable cities: Smart cities, green infrastructure-Case studies of sustainable urban planning.	**8**
ECONOMIC SUSTAINABILITY The Economics of Sustainability-Economic growth and sustainability: The concept of decoupling-The circular economy and sustainable business models-Sustainable finance and green investing-Corporate Responsibility and Policy-The role of businesses in sustainability-Corporate social responsibility (CSR) and ethical practices-Government policies and international agreements-Paris Agreement.	**10**
GLOBAL COOPERATION AND FUTURE DIRECTIONS Global Cooperation for Sustainable Development-The role of international organizations - UN, World Bank in sustainability-Global partnerships and collaborative efforts to achieve the SDGs-Case studies of successful global sustainability initiatives-Innovations and Future Trends-Technological innovations driving sustainability clean tech, AI-Future scenarios and challenges in sustainability. Case Study: Developing a comprehensive sustainability plan for a real-world challenge.	**10**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Reference books/ Web Links

1. Tom Theis and Jonathan Tomkin, *Sustainability: A Comprehensive Foundation*, OpenStax CNX (2018).
2. Ken Webster, The Circular Economy: A Wealth of Flows, 2nd Edition Ellen MacArthur Foundation Publishing, Cowes, UK, (2017).
3. Jeffrey D. Sachs, The Age of Sustainable Development, Columbia University Press (2015).
4. Mark Maslin, Climate Change: A Very Short Introduction, Oxford University Press (2014).

Online Resources

1. “Introduction to Sustainability " https://www.coursera.org/learn/sustainability
2. “The Age of Sustainable Development" https://www.coursera.org/learn/sustainable-development

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Mr. M. Sathish, Department of Computer Science and Engineering

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24MEO002	Electric and Autonomous Mobility	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

Faculty Name:	**Mr. V. Senthilkumar**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/senthil-kumar-v-5498aa60/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand the design and evolution of electric vehicles and their market trends.
2	Analyse electric mobility ecosystems and emerging business models.
3	Apply deep learning techniques to enhance computer vision and sensor fusion in autonomous vehicles.
4	Implement object detection and tracking methods using advanced computer vision and sensor fusion techniques.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO1	Understand the design and evolution of electric vehicles and their market trends.	U
CO2	Evaluate EV components, charging technologies, and infrastructure challenges.	U
CO3	Analyse electric mobility ecosystems and emerging business models.	An
CO4	Apply deep learning techniques to enhance computer vision and sensor fusion in autonomous vehicles.	Ap
CO5	Implement object detection and tracking methods using advanced computer vision and sensor fusion techniques.	E

Module	**Hours**
INTRODUCTION TO ELECTRIC VEHICLES (EVS) Overview of Electric Vehicles: Historical development and evolution of EVs, Components and Architecture of EVs: Key components of EVs: Electric motors, batteries, power electronics, and control systems. EV Market and Trends: Current global and regional market trends, Government policies, incentives, and regulations supporting EV adoption.	**6**
EV CHARGING INFRASTRUCTURE AND TECHNOLOGY EV Charging Basics: Types of EV charging (AC, DC, wireless), levels of charging (Level 1, Level 2, Level 3) and their differences. Charging Infrastructure Deployment: Planning and implementation of public and private charging stations., Role of smart grids and Vehicle-to-Grid (V2G) technology. Challenges and Solutions in Charging Infrastructure: Addressing range anxiety and charging time issues, Infrastructure challenges in urban and rural areas.	**9**
ELECTRIC MOBILITY ECOSYSTEM AND BUSINESS MODELS Electric Mobility and Urban Planning: Impact of EVs on urban transportation systems, Role of EVs in reducing urban pollution and congestion, Integration of EVs with public transportation and shared	**10**

Signature of the BOS Chairman

mobility services. Business Models for Electric Mobility: Emerging business models: Mobility-as-a-Service (MaaS), Car-as-a-Service (CaaS),EV fleet management for businesses and public transportation, Economic and environmental benefits of electric mobility.Case Studies in Electric Mobility: Successful case studies of electric mobility implementations in different regions.	
ADVANCED DEEP LEARNING TECHNIQUES FOR AUTONOMOUS VEHICLES Advanced Computer Vision Techniques: Convolutional Neural Networks (CNNs): Used for detecting and classifying objects. Semantic Segmentation, Instance Segmentation: Identifies and distinguishes objects in complex environments. Deep Learning for Sensor Fusion: Sensor Integration, Ulti-Modal Learning, Data Handling, Reinforcement Learning for Autonomous Driving: Basics of Reinforcement Learning, Application in Driving, Simulations Safety and Reliability in Deep Learning Systems: Ensuring Safety, Testing and Validation.	**10**
ADVANCED COMPUTER VISION TECHNIQUES FOR AUTONOMOUS VEHICLES Object Detection and Tracking: YOLO (You Only Look Once),SSD (Single Shot MultiBox Detector),Kalman Filters, Semantic and Instance Segmentation: Semantic Segmentation, Instance Segmentation Sensor Fusion for Enhanced Perception: Integration of Camera and LiDAR Data, Multi-Modal Fusion Techniques, Noise Reduction and Data Synchronization.	**10**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Reference books/ Web Links

1. Tom Denton, Electric and Hybrid Vehicles, Routledge, (2020).
2. Shai Shalev-Shwartz and Shaked Shammah, Deep Learning for Autonomous Vehicles, Springer, (2021).
3. James Larminie and John Lowry, Electric Vehicle Technology Explained, Wiley, (2012).

Online Resources

1. https://www.coursera.org/learn/electric-vehicles-mobility
2. https://www.coursera.org/learn/introduction-deep-learning-computer-vision?specialization=deep-learning-computer-vision
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/advanced-deep-learning-techniques-computer-vision?specialization=deep-learning-computer-vision

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Mr. V. Senthilkumar, Department of Computer Science and Engineering

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24IEO074	Modern Financial Strategies and Innovations	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 9			

Pre-requisite: Nil

Faculty Name:	**Mayuri P T**
Designation:	**Assistant Professor 1**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/mayuri-palanisamy**

Course Objectives:	**The purpose of taking this course is to:**
1	This course covers essential financial principles and concepts useful for both personal and corporate finance.
2	This course provides an in-depth introduction to the ideas, methods, and institutions that help manage risks and foster enterprise in financial markets.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understanding the financial principles and concept of Finance	U
CO 2	Equip learners with the financial decision-making skills.	Ap
CO 3	Evaluate company performance using profitability, efficiency, leverage, and other ratios.	E
CO 4	Assess the working capital needs of the business.	An
CO 5	Manage risks and foster enterprise in financial markets.	Ap

MODULE	**Hours**
FINANCIAL STATEMENTS AND CASHFLOWS Introduction to Finance- Balance sheet - Assets, Liabilities, and Stockholders & Equity-Income Statement- Profit & loss- Cash flows -Sources and use of cashflows- Liquidity Leverage Ratios- Turnover Ratios- Profitability Ratios-Financial Ratios: Market Value Ratios- Financial Forecasting.	**9**
TIME VALUE OF MONEY Introduction to Time Value of Money-Present Value (PV) and Future Value (FV)- difference between the quoted interest rate and effective annual rate- Annual Percentage Rate (APR) -Effective Annual Interest Rate (EAR)-Annuity and perpetuity- Applications of time value of money.	**9**
VALUATION AND CAPITAL BUDGETING Basic terms of bonds-Interest Rates-Zero Coupon bonds- Types of Bonds- Bond Ratings- structure of bond market- Basic Concepts of Stock- Parameter Estimation- Growth Opportunities- P/E ratio- Stock Markets- Tax salvage value - Opportunity Costs- Sunk Costs- Side Effects- Capital Budgeting with Example.	**9**
RISK AND RETURN	**9**

Signature of the BOS Chairman

24IEO075	Sports Analytics and Emerging Technologies	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 8			

Historical record of return and risk- Trade-off between risk and return-Calculate return and risk- Systematic risk and unsystematic risk- Beta Coefficient- Valuation & Risk Estimation- The Capital Asset Pricing Model.	
FINANCIAL MARKETS Financial Markets Introduction- Distribution and Outliers- Insurance Fundamentals-Forecasting--Introduction to Behavioural Finance- Prospect Theory- Leverage- Shares and Dividends- Investment Banks Introduction- Importance of Financial Theory.	**9**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 45

Learning Resources

Reference books/ Web Links

1. Introduction to Finance by Lawrence J. Gitman, Jeff Madura
2. The Financial Times Guide to Investing: The definitive companion to investment and the financial markets by Glen Arnold

Online Resources

1. https://www.coursera.org/learn/introduction-to-finance-the-basics
2. https://www.coursera.org/learn/financial-markets-global
3. https://www.coursera.org/learn/introduction-to-finance-the-role-of-financial-markets

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Ms. Mayuri P T, MBA-IEV

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

Pre-requisite: Nil

	**Faculty Name:**	**Asmitha Shree R**
	Designation:	**Assistant Professor 1**
	Concern/industry/Institution:	**KCT**
	LinkedIn profile	**https://www.linkedin.com/in/asmitha-shree**

Course Objectives:	**The purpose of taking this course is to:**
1	To provide a foundational understanding on the relation between sports and society.
2	To enable students to apply core marketing principles in the context of sports.
3	To develop analytical skills for comparing sports marketing with other sectors.
4	To foster an understanding of the influence of data-driven decision-making in sports.
5	To develop critical thinking and problem-solving skills in sports management.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the social dynamics, cultural identity, and globalization's impacts on the sports world.	U
CO 2	Understand the Evolution and Commercialization of Sports.	U
CO 3	Apply Marketing Principles to Sports.	Ap
CO 4	Analyse and differentiate between sports marketing and other marketing industries.	An
CO 5	Understanding Machine Learning Workflow in sports analytics.	U
CO 6	Apply regression analysis and machine learning models to predict sports outcomes.	Ap

Module	**Hours**
THE SOCIAL DYNAMICS OF SPORTS Exploring the concepts of games, play, and sports - Analyzing the impact of globalization, nationalism, and politics in sports - Understanding race, cultural identity, and their influence on the sports world.	**8**
THE EVOLUTION AND COMMERCIALIZATION OF SPORTS Examining the rise of women's sports, gender, and sexuality - Investigating why sports captivate global audiences - Understanding the mega business of sports- outdoor sports-extreme sports, and the search for adventure.	**8**
INTRODUCTION TO THE SPORTS MARKETING Introduction to the Sports Marketing- Sports Marketing Challenges- Marketing Basics Applied to Sports Marketing- The Traditional 4 P's: A Meaningful Update for Sports- Fan Marketing- Influence Marketing: Sports- Service vs. Product Marketing in Sports- Sports Marketing versus other Marketing Industries- Event Marketing & Management.	**9**
ENTERTAINMENT MARKETING Entertainment Marketing -Business Marketing- Creating Creative Content-Virtual Reality and Over the Top TV, Entertainment Branding (Placement) -Digital Viral Marketing- Dangers of Viral Marketing- Personal Entertainment Experience- Virtual Reality.	**10**
PREDICTION MODELS WITH SPORTS Machine Learning-The Machine Learning Workflow- Model: NHL Game Outcomes-Introduction to Regression Analysis -Building the Logistic Regression Model-Interpreting Regression Results -	**10**

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Considerations in Deploying The Model-Case Study: Regression Analysis - Batsman's performance and salary , Regression Analysis - Batsman's performance and salary ,Regression Analysis with Cricket Data.	

Theory Hours:	45	Tutorial Hours:	0	Practical Hours:	0	Project Hours:	0	Total Hours:	45

Learning Resources

Textbooks

1. Grant Jarvie., Sport, Culture and Society: An Introduction., Taylor & Francis, (4th Edition, 2021).
2. Matthew D. Shank and Mark R. Lyberger., Sports Marketing: A Strategic Perspective., Routledge, (6th Edition, 2021).
3. Thomas W. Miller Machine Learning and Data Mining for Sports Analytics, Pearson Education, Inc, (2017).

Reference books/ Web Links

1. Richard Giulianotti, The Globalization of Sport: The Politics, Economics, and Culture of Sports", (2005)
2. Manfred Bruhn, Peter Rohlmann , “Sports Marketing: Fundamentals - Strategies – ,Springer, Instruments”, (2022).

Online Resources

1. https://www.coursera.org/learn/international-entertainment-sports-marketing
2. https://www.coursera.org/learn/sports-marketing
3. https://www.coursera.org/learn/prediction-models-sports-data#modules
4. https://www.coursera.org/learn/machine-learning-sports-analytics
5. https://www.coursera.org/learn/foundations-sports-analytics#modules

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Ms. Asmitha Shree, Department of Computer Science and Engineering

Recommended by BoS on	16.08.2024		
Academic Council Approval	No: 27	**Date**	24.08.2024

Signature of the BOS Chairman

24IEO076	Healthcare Innovation and Technology	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

Faculty Name:	**G. Shobana**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**www.linkedin.com/in/shobana-g-0425b348/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand Healthcare Systems and their Challenges.
2	Explore Ethical and AI-driven Approaches in Healthcare.
3	Investigation of Healthcare Marketplace Dynamics.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the structure and functions of healthcare systems, along with the associated ethical and technological frameworks.	U
CO 2	Understand the implementation and challenges of electronic health records (EHR) and eHealth models.	U
CO 3	Analyse Healthcare Market Dynamics over time.	An
CO 4	Examine Insurance and Medical Technology Markets and the impact of technological advancements on healthcare delivery and policy.	An
CO 5	Understand the global medical innovations, their impact, and the trends shaping the healthcare industry.	U

Module	**Hours**
INTRODUCTION TO HEALTHCARE SYSTEMS Overview of healthcare systems-Issue in healthcare – patients-Intermediaries -providers-challenges in healthcare access and delivery- Characteristics of Physician Practices -healthcare organizations and functions- Procedure Codes and Diagnosis Codes- Payment Systems- EMRs, EHRs, and PHRs-Stereotypical Plan Design- Public and Private Plans- Ethical frameworks - AI in health care delivery and payment structure.	**6**
EHR MANAGEMENT SYSTEM eHealth -model -challenges- Future scope- Collecting the data- Clinical use of personal health data-Mobile apps -social media apps -design of eHealth solutions-Evaluating health apps- Data and digital health records- Anatomy-Predictive and precision medicine- Privacy and security- performance-Interacting with healthcare professional – Advantages -Telehealth- personalize healthcare-EHR applications- patient journey -Features- Login, Authentication, Credentialing- Clinical Decision Support-types- CDS Committees-Introduction to Databases-Components of a SQL Server-EHR Interfaces- Training- Communications- Change Management.	**12**
HEALTHCARE MARKETPLACE	**10**

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Marketplace Overview, Healthcare Spending Drivers, Quality Trends, Market Evolution-Health Cost Growth- Issues -Effects of Health Behaviours. **Physician and hospital Service Market: Provider** Market Overview-Price Discrimination- Physician Market Evolution-Physician Sites of Care- Physician-Hospital Market Evolution: Hospital Features-Scale and Scope, Hospital Issues, Quality and Safety- Hospital Future Trends, Policy Impact on Hospitals.	
INSURANCE AND MEDICAL TECHNOLOGY MARKET Risky Business, Utility of Wealth- working of Insurance model- Moral Hazard and Adverse Selection-Early Public Health Insurance- Healthcare Laws and Regulations (HIPAA, FDA, etc.) Quality and Safety Standards in Healthcare-Role of Policy -Future Health Reform. **Medical Technology Market**: Device- Drug-Medical Device Evolution-Medical Devices -Vision -New Technology Make Money-Measuring Medical Technology Value -FDA Approval for Pharmaceuticals- FDA Approval for Medical Devices- Drive Towards Cost-Effectiveness-preparing a Global Health Technology -Pharma & Device Convergence-Medical Technology Market.	**10**
GLOBAL MEDICAL INNOVATION Globalization of the Medical Industry, Medical Tourism Evolution & Growth, Medical Tourism in India, Key Issues, Health Bads and Their Consequences-Goals of Health Information Technology-Value of Health Information Technology- Insurer Information Technology- Provider Information Technology-Integrated Health Care Delivery-Key Questions for an Innovation Valuation-Technology-Secure- Return Investment on Technology.	**7**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Reference books/ Web Links

1. Robert E. Hoyt, Ann K. Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Lulu.com (2019).
2. Peter M. Ginter, Linda E. Swayne, and Robert J. Duncan, Healthcare Systems: An Introduction, Health Administration Press (2018).
3. Sharon B. Buchbinder, Nancy H. Shanks, Introduction to Healthcare Management, Jones & Bartlett Learning (2017).
4. Richard Gartee, Electronic Health Records: Understanding and Using Computerized Medical Records, Pearson (2014).
5. Peter R. Kongstvedt, Healthcare Economics and Policy, Jones & Bartlett Learning (2013).

Online Resources

1. https://www.coursera.org/learn/intro-to-healthcare
2. https://www.coursera.org/learn/health-it-fundamentals
3. https://www.coursera.org/learn/ehealth
4. https://www.coursera.org/specializations/healthcare-marketplace

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Ms.G.Shobana , Department of Information Technology

Signature of the BOS Chairman

24IEO077	Corporate Strategy and Innovation	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 9			

Pre-requisite : Nil

Faculty Name:	**Ms. P. T Mayuri**
Designation:	**Assistant Professor 1**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/mayuri-palanisamy**

Course Objectives:	**The purpose of taking this course is to:**
1	This course is designed to help learners develop structured approaches to making sound strategic decisions in multi-business firms.
2	This focuses on modern practices in product management, especially for digital products.
3	It covers essential skills for product managers, emphasizing the need to understand customer needs, use actionable analytics, and apply agile methodologies.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Develop structured, decision-based frameworks for making key corporate strategy decisions.	Ap
CO 2	Understand how to make informed decisions about business diversification and entering new markets or industries.	U
CO 3	Learn how to design corporate headquarters that add value across business units.	Ap
CO 4	Develop the ability to leverage actionable analytics and user data to drive product decisions.	E
CO 5	Understand how to iterate and enhance digital products continuously, using feedback and analytics.	An

Module	**Hours**
CORPORATE ADVANTAGE Introduction to Corporate strategy- Understanding Differences: Number of Businesses, Corporate Advantage, Competition- Sum-of-the-parts Analysis- Corporate Strategy Decisions- value multi-business firms.	**9**
DIVERSIFICATION AND DIVESTITURE Understanding the Basic Modes of Diversification- Diversification Test -Five-step Approach- Understanding the Basic Modes of Divestiture- Divestiture Test- Three-step Approach to the Divestiture Decision.	**9**

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CORPORATE HEADQUARTERS Example of Corporate Headquarters- Controls of Corporate Headquarters- HQ Influence Models- Financial Perspective- Uncertainty Perspective- Synergy Perspective- Social Perspective- Synergistic Portfolio Framework.	**9**
FOCUS AND PRODUCT INNOVATING METHODS Introduction to Product Management Journey- Creating, Testing and Facilitating- Product Owner- Team Collaboration- Qualitative Analytics- Quantitative Analytics- Managing Habits- Customer Collaboration- Funnel Focus- Managing Product.	**9**
EXPLORING AND AMPLIFYING PRODUCTS Introduction to Exploring a new Product Idea- Building for learning- Horizons of growth- Corporate Innovation Pipeline- Business Model Design- Introduction to Amplifying an existing products- Business model types- Actionable analytics- Data science- Chanel - Modality- Roadmap.	**9**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 45

Learning Resources

Reference books/ Web Links

1. Competitive Strategy: Techniques for Analyzing Industries and Competitors, Michael E. Porter
2. User Experience Is Brand Experience: The Psychology Behind Successful Digital Products and Services by Felix Van De Sand, Anna-Katharina Frison, Pamela Zotz
3. Corporate Strategy and Product Innovation by Robert R. Rothberg

Online Resources

1. https://www.coursera.org/learn/corporatestrategy
2. https://www.coursera.org/learn/uva-darden-digital-product-management

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Ms. Mayuri P T, MBA-IEV

Signature of the BOS Chairman

24IEO078	Gamification and Gaming	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3, 4, 9			

Pre-requisite: Nil

Faculty Name:	**Dr. K. Saranya**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**Kumaraguru college of Technology**
LinkedIn profile	**https://www.linkedin.com/in/dr-saranya-k-b3a93313a/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand the core differences between Gamification and Games.
2	Explore how gamification drives innovation in business.
3	Analyse the effectiveness of gamification in Advocacy, Media, Politics, and Education.
4	Identify the risks and future trends in gamification.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Acquire in-depth knowledge of gamification principles and identify specific applications across various contexts.	U
CO 2	Develop a comprehensive conceptual framework for gamification tailored to different sectors.	C
CO 3	Critically analyse and evaluate the benefits and risks associated with gamification.	E
CO 4	Analyse the role of motivation in gamification and how it drives innovation in the game market.	An

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Module	Hours
GAMIFICATION Core concepts, distinctions between gamification and games, Motivation in Gamification, Gamification drive Innovation, Game Market.	**9**
GAMIFICATION IN BUSINESS Business sector adopts gamification techniques -Case studies, features of gamification in business, marketing strategies.	**8**
GAMIFICATION FOR ADVOCACY AND MEDIA Applications in civil society, differences from business gamification, effectiveness in raising awareness, media outlets adopt gamification techniques, features of gamification in media, journalism and communication benefiting from gamification.	**10**
GAMIFICATION IN POLITICS AND EDUCATION Political gamification, effectiveness for political campaigns, differences from other sectors, gamification effective for policymaking. Educational applications, effectiveness in teaching and learning.	**10**
RISKS AND FUTURE IN GAMIFICATION Gamification desirability, Social and mental sickness, features of gamification in social networks, need of gamers-Future with games.	**8**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 0	Project Hours: 0	Total Hours: 45

Learning Resources

Reference books/ Web Links

1. Yu-Kai Chou," Actionable Gamification: Beyond Points, Badges, and Leaderboards", Fremont (CA), 2014.
2. B. Burke, "Gamify: How Gamification Motivates People to Do Extraordinary Things", Bibliomotion, 2014.
3. J. Lerner, "Making Democracy Fun: How Game Design Can Empower Citizens and Transform Politics", Boston (MA), 2014.

Online Resources

1. https://www.coursera.org/specializations/esports
2. https://www.coursera.org/learn/gamification

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Dr. K. Saranya, Department of Computer Science and Engineering

Signature of the BOS Chairman

24IEO079	Environmental Innovations and Management	L	T	P	J	C
		3	0	0	0	3
OE		SDG	6, 15			

Pre-requisite: Nil

Faculty Name:	**Dr. N. Rajathi**
Designation:	**Professor**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/dr-rajathi-natarajan-7748758b/**

Course Objectives:	**The purpose of taking this course is to:**
1	Explore urbanization, climate change, sustainability, and circular economy principles in managing environmental challenges.
2	Understand integrated water resource management and pollution control in relation to environmental hazards and public health.
3	Investigate population dynamics, agriculture's impact on the environment, and ethical approaches to solving complex environmental issues.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Analyse and address the environmental challenges associated with global trends.	An
CO 2	Evaluate and apply integrated water resource management principles to address complex water-related challenges,	Ap
CO 3	Explain the impact of environmental hazards.	U
CO 4	Explain the relationship between global population dynamics, agriculture, and soil resources.	U
CO 5	Identify and apply environmental ethics and management principles to complex issues.	Ap

Module	**Hours**
GLOBAL TRENDS AND ENVIRONMENT MANAGEMENT Sustainability and the SDGs-Demographic Trends-Global urbanization-Environment Management -Cities and the rising sea level-Climate Change and Water-Circular Thinking in Waste Management-Plastic as Part of the Circular Economy-Stakeholder and Social Sustainability Analysis-–Utility Management -Environmental Management in Rural Areas-Phases in Solid Waste Management -Regulation -Outdoor and Indoor air pollution –Technologies for the environment built .	**9**
WATER RESOURCE MANAGEMENT AND POLICY The rules of resource, uses and their circumvention- Integrated water resource management to water-food-energy –Integrated Water shed management –water as source of conflict and cooperation.	**9**

Signature of the BOS Chairman

ENVIRONMENTAL HAZARDS AND GLOBAL PUBLIC HEALTH Air and water pollution –key concepts – controlling air pollution –key concepts in water pollution-controlling water pollution –physical hazards and soil waste - Solid Waste Disposal Methods-Hazardous Waste Disposal Methods-Population pressure –Build environment.	**9**
POPULATION, FOOD, AND SOIL Population the world- population changes-Global population – Global population dynamics - Agriculture and Environment – Agriculture and Human Nutrition- Modern Agriculture Effects and Alternatives -Soil and Environment –Soil resource and Profile.	**9**
ENVIRONMENTAL MANAGEMENT & ETHICS Introduction – Environmental Ethics- Environmental management of tame and wicked problems-Decision support tools-Environmental regulation and principles.	**9**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Reference books/ Web Links

1. Circular Economy for the Management of Operations. United States, CRC Press, (2020).
2. Pangare, Vasudha. Global Perspectives on Integrated Water Resources Management. India, Academic Foundation, (2006).
3. Hutchinson, Emma, and Kovats, Sari. Environment, Health and Sustainable Development. United Kingdom, McGraw-Hill Education, (2017).
4. Wild, Alan. Soils, Land and Food: Managing the Land during the Twenty-First Century. United Kingdom, Cambridge University Press, (2003).
5. Krishnamoorthy, Bala. Environmental Management: Text and Cases. India, Prentice Hall India Pvt., Limited, (2017).
6. Politics and Policies for Water Resources Management in India. United Kingdom, Taylor & Francis,(2020).

Online Resources

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://www.coursera.org/learn/global-environmental-management
3. https://www.coursera.org/learn/water-management
4. https://www.coursera.org/learn/environmental-hazards-and-global-public-health
5. https://www.coursera.org/learn/population-food-and-soil
6. https://www.coursera.org/learn/environmental-management-ethics

Assessment (Theory)

SA-I, SA-II, Activity and Learning Task(s), Case Study, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert
		Dr.N.Rajathi , Department of Information Technology

Signature of the BOS Chairman