The Curriculum Book

Integrated Bachelor of Science (Hons. / Hons. with Research) - Master of Science

in

Computer Science (Artificial Intelligence and Data Science) 5 YEAR-PROGRAMME

(Scheme C)

Under Multiple Entry and Exit, Internship and

CBCS-LOCF as per NEP-2020

w.e.f. Session 2024-25

(for B.Sc. (Hons./ Hons. with Research) Computer Science (Artificial Intelligence and Data Science- Batch 2023-24)

(for Integ. B.Sc. (Hons./ Hons. with Research)-M.Sc. Computer Science (Artificial Intelligence and Data Science- Batch 2024-25)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE &

TECHNOLOGY HISAR-125001, HARYANA

(A+ NAAC Accredited State Govt. University)

Table 3: Curriculum and Credit Framework for Undergraduate Programmes (Single Major)

Semester	Discipline-Specific Courses (DSC)	Minor(MIC)/ Vocational (VOC)	Multidisciplinary courses (MDC)	Ability Enhancement courses (AEC)	Skill Enhancement Courses (SEC)/ Internship /Dissertation	Value-Addec Courses (VAC)	Total Credits
I	DSC - A1 @ 4 credits DSC – A2 @ 4 credits	MIC1 @ 4 credits	MDC1 @ 3 credits	AEC1 @ 2 credits	SEC1@ 3 credits	VAC1 @ 2 credits	22
II	DSC – A3 @ 4 credits DSC – A4 @ 4 credits	MIC2 @ 4 credits	MDC2 @ 3 credits	AEC2 @ 2 credits	SEC2@ 3 credits	VAC2 @ 2 credits	22
Students exiting the programme after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject							
III	DSC – A3 @ 4 credits DSC – A4 @ 4 credits	MIC3 @ 4 credits	MDC3 @ 3 credits	AEC3 @ 2 credits	SEC3@ 3 credits	VAC3 @ 2 credits	22
IV	DSC – A5 @ 4 credits DSC – A6 @ 4 credits DSC – A7 @ 4 credits DSC – A8 @ 4 credits	MIC4(VOC)@ 4 credits	----------	AEC4 @ 2 credits	----------	VAC4 @ 2 credits	24
Students exiting the programme after fourth semester and securing 94 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	DSC – A9 @ 4 credits DSC – A10 @ 4 credits DSC – A11 @ 4 credits DSC – A12 @ 4 credits	MIC5(VOC)@ 4 credits	----------	----------	Internship @ 4 credits#	----------	24
VI	DSC – A13 @ 4 credits DSC – A14 @ 4 credits DSC – A15 @ 4 credits DSC – A16 @ 4 credits	MIC6(VOC)@ 4 credits	----------	----------	SEC3@ 2 credits	----------	22
Students will be awarded 3-year UG Degree in relevant major Discipline/Subject upon securing 136 credits							
VII	DSC – H1 @ 4 credits DSC – H2 @ 4 credits DSC – H3 @ 4 credits DSC – H4 @ 4 credits DSC – H5 @ 4 credits	MIC7 @ 4 credits	----------	----------	----------	----------	24
VIII (4yr UG Hon.)	DSC – H5 @ 4 credits DSC – H7 @ 4 credits DSC – H8 @ 4 credits DSC – H9 @ 4 credits DSC – H10 @ 4 credits	MIC8 @ 4 credits	----------	----------	----------	----------	24
VIII (4yr UG Hon. with Research)	DSC – H6@ 4 credits DSC – H7@ 4 credits	MIC8 @ 4 credits	----------	----------	Research project/ Dissertation @ 12 credits	---------- TOTAL CREDITS	24 186

#Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programmes without taking exit option.

SEMESTER V

w.e.f

(for B.Sc. (Hons./ Hons. with Research) Computer Science (Artificial Intelligence and Data Science- Batch 2023-24)

(for Integ. B.Sc. (Hons./ Hons. with Research)-M.Sc. Computer Science (Artificial Intelligence and Data Science- Batch 2024-25)

Type of Course	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Discipline Specific Courses	24ADS0501T	Data Warehousing and Data Mining	3	3	20	50	70	2.5
	24ADS0501P	Data Warehousing and Data Mining Lab.	1	2	10	20	30	3
	24ADS0502T	Machine Learning	3	3	20	50	70	2.5
	24ADS0502P	Machine Learning Lab.	1	2	10	20	30	3
	24ADS0503T(i) OR 24ADS0503T(ii)	Computer Networks OR Graph Theory	4	4	30	70	100	3
	24ADS0504T(i) OR 24ADS0504T(ii)	Time Series, Forecasting and Index Numbers. OR Statistical Simulation and Data Analysis	4	4	30	70	100	3
Minor Course/Vocational Course		To be opted from the pool	2	2	15	35	50	2
			2	4	15	35	50	3
Skill Enhancement Course	24ADS0505I	Internship*	4	-	100	-	100	-
		TOTAL	24	24	250	350	600	

* The Internship of 4-6 weeks in domain of Computer Science (Artificial Intelligence and Data Science) carried out by the students at the end of fourth semester will be evaluated by the departmental committee constituted by the Chairperson of the department.

SEMESTER VI

w.e.f

(for B.Sc. (Hons./ Hons. with Research) Computer Science (Artificial Intelligence and Data Science- Batch 2023-24)

(for Integ. B.Sc. (Hons./ Hons. with Research)-M.Sc. Computer Science (Artificial Intelligence and Data Science- Batch 2024-25)

Type of Course	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Discipline Specific Courses	24ADS0601T	Neural Network and Deep Learning	3	3	20	50	70	2.5
	24ADS0601P	Neural Network and Deep Learning Lab.	1	2	10	20	30	3
	24ADS0602T	Big Data Analytics	3	3	20	50	70	2.5
	24ADS0602P	Big Data Analytics Lab.	1	2	10	20	30	3
	24ADS0603T(i) OR 24ADS0603T(ii)	Cloud Computing OR Information Retrieval Systems	4	4	30	70	100	3
	24ADS0604T(i) OR 24ADS0604T (ii)	Fundamental of Econometrics OR Internet of Things	4	4	30	70	100	3
Minor Course/Vocational Course		To be opted from the pool	2	2	15	35	50	2
			2	4	15	35	50	3
Skill Enhancement Course		To be opted from the pool	2	4	15	35	50	3
		TOTAL	22	28	165	385	550	

Data Warehousing and Data Mining

General Course Information

Course Code: 24ADS0501T Credits: 3 Hours /Week: 3 Course Type: Discipline Specific Course Category: Theory Mode: Lectures (L) Examination Duration: 2.5 Hours	Course Assessment Methods: Max. Marks: 70 (Internal: 20; External: 50) The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This course focuses on Data Mining and Warehousing, providing foundational and advanced knowledge of data preprocessing, storage, and pattern discovery. It covers essential techniques used to extract meaningful insights from large datasets and how data warehousing supports efficient analysis.

Course Outcomes:

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

CO1. Understand the fundamental concepts, functionalities, and challenges of data mining.

CO2. Apply data preprocessing techniques for improving data quality.

CO3. Analyze and design data warehouse architectures and OLAP operations.

CO4. Implement and evaluate frequent pattern mining techniques, including Apriori and pattern growth approaches.

Course Content

Unit I

Introduction to Data Mining: Kind of data to be mined, Data Mining Functionalities, Technologies used in Data Mining, Applications of data Mining, Major Issues in Data Mining. Data Pre-Processing: Need for preprocessing, Data Objects and Attribute types, Statistical description of data, Data Visualization, Measuring similarity and dissimilarity of data, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

Unit II

Data Warehouse: Introduction, Data Warehouse and Database Systems, Data Warehouse Architecture, Data Warehouse Models, Data Cube and OLAP, Multidimensional data Model, Concept Hierarchies, OLAP operations, Data Warehouse Implementation

Unit III

Mining Associations and Correlations: Mining Frequent Patterns, Associations and Correlations, Frequent Itemset Mining using Apriori Algorithm, Generating Association Rules from Frequent Itemsets. Improving efficiency of Apriori, Pattern Growth Approach for Mining Frequent Itemsets, Pattern evaluation Methods. Advanced Pattern Mining: Pattern Mining in Multilevel and Multidimensional Space, Constraint-Based Frequent Pattern Mining.

Text and Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufmann Publishers, Third Edition, July 2011.
2. Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw Hill, 2004.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2014.
4. K. P. Soman, Shyam Diwakar and V. Ajay, Insight into Data Mining Theory and Practice, Easter
5. Economy Edition, Prentice Hall of India, 2009.
6. G. K. Gupta, Introduction to Data Mining with Case Studies, Prentice Hall of India, 2006.
7. Daniel T. Larose, Data Mining Methods and Models, Wiley, 2006.
8. W. H. Inman, Building the Data Warehouse, Wiley India, 2005.

Data Warehousing and Data Mining Lab.

General Course Information

Course Code: 24ADS0501P Credit: 1 Hours/Week: 2 Course Type: Discipline Specific course Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 30 (Internal: 10; External: 20) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This hands-on lab course is designed to complement theoretical knowledge of data mining concepts with practical skills. It provides students with an opportunity to work with real datasets and apply data mining algorithms to extract meaningful patterns, make predictions, and evaluate model performance. The lab emphasizes the application of various data mining techniques using popular tools and programming languages.

Course Outcomes:

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

CO1. Implement and experiment with data mining algorithms using Python, R, or Weka, and analyze their performance.

CO2. Preprocess real-world datasets by applying data cleaning, transformation, and reduction techniques.

CO3. Evaluate and compare the effectiveness of different data mining algorithms based on performance metrics.

CO4. Apply and analyze advanced data mining techniques such as pattern mining, clustering, and anomaly detection.

Practical Lab based on subject 24ADS0501T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Machine Learning

General Course Information

Course Code: 24ADS0502T Credits: 3 Hours /Week: 3 Course Type: Discipline Specific course Category: Theory Mode: Lectures (L) Examination Duration: 2.5 Hours	Course Assessment Methods: Max. Marks: 70 (Internal: 20; External: 50) The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This course provides a comprehensive introduction to the core concepts and techniques of Machine Learning (ML), including both supervised and unsupervised learning approaches. Students will learn to design, analyze, and implement machine learning algorithms, with a focus on understanding the underlying principles and mathematics.

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

CO1: Understand and design learning systems by defining well-posed learning problems and implementing machine learning models.

CO2: Apply supervised learning algorithms such as linear regression, logistic regression, decision trees, and SVM for predictive tasks.

CO3: Implement unsupervised learning techniques, including k-means, k-medoids, and DBSCAN for clustering and pattern discovery.

CO4: Analyze and evaluate model performance using appropriate evaluation metrics for regression and classification tasks.

Course Content

Unit I

Introduction: Well posed learning problems, designing a learning system, Issues in machine learning, the concept learning task, Concept learning as search, Finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidateeliminations, Inductive bias.

Unit II

Supervised Learning: Introduction to linear regression, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression, Logistic regression, basic decision tree learning (ID3) algorithm, Support Vector Machine (SVM)

Unit III

Unsupervised Learning: About clustering, type of data in clustering analysis, k-means and k-medoids, DBSCAN density-based clustering method, Performance analysis of clustering algorithms, Bayesian Learning: Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least- squared error hypotheses, Naïve Bayes Classifier.

Text and Reference Books:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1997.
2. Bishop Christopher, Pattern Recognition and Machine Learning, Springer Verlag, 2006.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction, Springer, 2nd edition, 2009..J. Han and M. Kamber, Data Mining Concepts and Techniques, 3rd Edition, Elsevier, 2012.
4. S. Rajeshkaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI, 2003.

Machine Learning Lab.

General Course Information

Course Code: 24ADS0502P Credit: 1 Hours/Week: 2 Course Type: Discipline Specific course Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 30 (Internal: 10; External: 20) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

The Machine Learning Lab is a hands-on course designed to complement the theory learned in the Machine Learning course. In this lab, students will implement various machine learning algorithms, apply them to real-world datasets, and evaluate their performance. The lab emphasizes practical experience with both supervised and unsupervised learning techniques, fostering problem-solving and analytical skills in the context of machine learning.

Course Outcomes:

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

CO1: Implement machine learning algorithms using Python and libraries like scikit-learn for both supervised and unsupervised learning.
CO2: Preprocess and explore datasets by handling missing values, outliers, and feature scaling for effective model training.
CO3: Evaluate machine learning models using appropriate performance metrics and cross-validation techniques.
CO4: Apply machine learning techniques to real-world datasets to solve practical problems.

Practical Lab based on subject 24ADS0502T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Computer Networks

General Course Information

Course Code: 24ADS0503T(i) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

The Computer Networks course provides an in-depth understanding of the principles and protocols that govern communication across computer networks. It covers everything from data communication fundamentals to advanced concepts in networking, with a focus on the OSI and TCP/IP models, and hands-on experience with various networking devices, protocols, and technologies.

Course Outcomes:

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

CO1: Understand network models and protocols, including OSI and TCP/IP models, and key protocols such as IP, TCP, UDP, DNS, and HTTP.

CO2: Design and implement network architectures by configuring network topologies and devices like routers, switches, and hubs.

CO3: Analyze data link and network layers by solving problems related to error detection, flow control, and routing algorithms.

CO4: Manage transport layer services by implementing TCP/UDP protocols and handling error control, flow control, and congestion management.

Course content

Unit I

Data communication: Components, Data representation and Data flow; Network: Uses, Topologies, Network Services, OSI and TCP/IP Reference Models; Network categories: LAN, MAN, WAN; Guided Transmission Media, Wireless Transmission Media, Switching Techniques: Circuit

Switching, Packet Switching, Message Switching, Networking Devices: Hubs, Repeaters, Bridges, Modems, Switches, Routers, and Gateways.

Unit II

Data Link Layer-design issues, Framing & Error Handling: Framing Protocols, Error detection and correction mechanisms; Flow Control Protocols: Stop-and-wait, Sliding Window protocols: Go-backN and Selective Repeat; Medium Access sub layer: Channel allocation methods, Multiple Access Communication: Random Access-ALOHA, Slotted-ALOHA, CSMA, CSMA-CD, LAN Standards:
Ethernet, Fast Ethernet & Gigabit Ethernet.

Unit III

Network Layer-Design issues, store and forward packet switching connection less and connection oriented networks, Routing algorithms: optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Hierarchical Routing, Congestion control algorithms, admission control.

Internetworking: IPV4 and IPV6, IP Addressing (Classful Addressing, Private IP Addresses, Classless Addressing, Sub-netting), ARP, RARP, ICMP, Internet Routing Protocol.

Unit IV

Transport Layer: Transport layer Services: Addressing, Multiplexing, Flow control, Buffering and Error control. Internet Transport Protocols: UDP, TCP, TCP Segment, TCP Connection.

Application Layer: Introduction to DNS, FTP, TELNET, HTTP, SMTP, Electronic Mail, WWW and Multimedia.

Text and Reference Books:

1. Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson publications, 2010.
2. Forouzan, Data Communication and networking ,5th Edition, Tata McGrawHill, 2012.
3. William Stalling, Data & Computer Communication 6th edition, LPE Pearson Education, 2013.
4. Todd Lammle, CCNA Study Guide, 6th Edition, 2013.
5. RFCs and Internet Drafts available from Internet Engineering Task Force.

Graph Theory

General Course Information

Course Code: 24ADS0503T(ii) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

This course provides an in-depth exploration of graph theory, covering the fundamental concepts, types of graphs, properties, and advanced topics such as network flows, graph coloring, and matrix representations. It also emphasizes real-world applications of graphs in fields such as computer science, engineering, and mathematics.

Course Outcomes:

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

CO1: Classify and analyze different types of graphs and their properties.

CO2: Solve graph-related problems, including Euler paths, Hamiltonian circuits, and spanning trees.

CO3: Utilize algebraic structures such as modular arithmetic and vector spaces to represent and analyze graphs.

CO4: Apply graph coloring techniques to solve real-world problems in scheduling and optimization.

Course Content

Unit I

Introduction to graphs, Types of graphs -Regular, Complete, Bipartite, Isomorphic, Connected, Applications, Operations on Graphs, Walks, Path, Circuits, Euler Graphs, Hamiltonian Path and Circuits, Trees, Properties of Trees, Spanning Trees (Standard Results with proofs based on all mentioned topic).

Unit II

Cut-Sets, Properties of Cut-Set, All Cut-Sets in a graph, Fundamental Circuits and Cut-Sets, Connectivity and Separability, Network Flows, 1-Isomorphism, 2- Isomorphism, Planar Graphs, Kuratowski's Two Graphs (Standard Results with proofs).

Unit III

Sets with one operation, Sets with two operations, Modular Arithmetic and Galois Fields, Vector and Vector Spaces, Vector Space associated with a graph, Basic Vectors of a graph, Circuits and Cut-Set Subspaces, Orthogonal Vectors and Spaces, Intersection and Join of W and Ws.

Unit IV

Matrix representation of graphs, Incidence Matrix, Submatrices, Circuit Matrix, Fundamental Circuit Matrix and Rank, Coloring of graphs: Chromatic Number, Vertex Coloring of graphs, Edge Coloring of graphs, Coloring of Planar Graphs.

Text and Reference Books:

1. V. K. Balakrishnan, Graph Theory, Tata McGraw Hill, 1st Edition, 2004.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall of India, Reprint, 2004.
3. Frank Harary, Graph Theory, Narosa/Addison Wesley, Indian Student Edition, 1988.
4. Bollobas, Bela, Modern Graph Theory, Springer Verlag New York, 1st Edition, 1998.
5. R. Diestel, Graph Theory, Springer, 2nd Edition, 2000.
6. Douglas B. West, Introduction to Graph Theory, Prentice Hall of India, 2nd Edition, 2002.

Time Series, Forecasting and Index Numbers

General Course Information

Course Code: 24ADS0504T(i) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

This course introduces the methods used in the construction and analysis of index numbers, time series, and forecasting models. Students will gain knowledge on measuring price levels, quantities, and trends over time, with practical applications in economics and business forecasting.

Course Outcomes:

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

CO1: Construct and interpret index numbers by understanding and calculating different types using various methods.

CO2: Analyze time series data by decomposing and studying components like trends and seasonal variations.

CO3: Apply time series models such as Autoregressive (AR), Moving Average (MA), and ARIMA for forecasting.

CO4: Perform data adjustments using techniques like base shifting and deflating for accurate analysis.

Course Content

Unit I

Index Number: Definition, problems involved in the construction of index numbers, calculation of index numbers-simple aggregate method, weighted aggregates method, simple average of price relatives, weighted average of price relatives, link relatives, chain indices, value index numbers, price and quantity index numbers.

Unit II

Laspeyre's, Paasche's, Marshall-Edgeworth and Fisher's index numbers, time and factor reversal tests of index numbers, consumer price index number and its uses. Base shifting, splicing and deflating of index numbers.

Unit III

Time Series Analysis: Definition, components of time series-trend, seasonal variations, cyclic variations, irregular component, additive and multiplicative models. Determination of trend: graphic method, method of curve fitting by principle of least squares, moving average method. Analysis of seasonal fluctuations, construction of seasonal indices using method of simple averages, ratio to trend method and ratio to moving average method.

Unit IV

Autocorrelation and Partial autocorrelation functions, Correlogram and periodogram analysis. Autoregressive, Moving average and Mixed processes. Autoregressive integrated moving average processes. Model identification, Objectives, Model estimation and forecasting. Seasonal and nonseasonal ARIMA models.

Text and Reference Books:

1. Box GEP, Jenkins GM & Reinsel GC.. Time Series Analysis: Forecasting and Control. 3rd Ed. Pearson Edu, 2007.
2. Brockwell PJ & Davis RA, Introduction to Time Series and Forecasting. 2nd Ed. Springer, 2002 3. Chatterjee S, Hadi A & Price B. Regression Analysis by Examples. John Wiley. Draper NR & Smith H.

   1998. Applied Regression Analysis. 3rd Ed. John Wiley, 1999
4. Gupta, S.C. and Kapoor, V.K., Fundamentals of applied statistics. Sultan Chand & Sons, 2019.
5. Johnston J. Econometric Methods. McGraw Hill, 1984
6. Judge GG, Hill RC, Griffiths WE, Lutkepohl H & Lee TC.. Introduction to the Theory and Practice of Econometrics. 2nd Ed. John Wiley, 1988.
7. Montgomery DC & Johnson LA. Forecasting and Time Series Analysis. McGraw Hill, 1976
8. Pankratz, A. Forecasting with univariate Box-Jenkins models: Concepts and cases (Vol. 224). John Wiley & Sons, ., 2009
9. Shumway RH & Stoffer DS. Time Series Analysis and its Applications: with R Examples. 2nd Ed. Springer, . 2006

Statistical Simulation and Data Analysis

General Course Information

Course Code: 24ADS0504T(ii) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

This course focuses on the principles and techniques of statistical simulation, which plays a crucial role in analyzing complex systems and data that are difficult to solve analytically. Students will learn to simulate random variables, probability models, and stochastic processes to solve real-world problems in various domains.

Course Outcomes:

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

CO1. Understand the principles and applications of statistical simulation techniques.
CO2. Generate random numbers and simulate random variables using appropriate methods.
CO3. Implement advanced simulation techniques such as variance reduction and resampling methods like jackknife, bootstrap, and cross-validation.
CO4. Apply Markov Chain Monte Carlo (MCMC) methods and density estimation techniques for simulating complex data.

Course Content

Unit I

Introduction and need of statistics simulation, general principles, advantages and disadvantages of simulation, Review of simulation methods, Simulation of random variable from discrete, continuous, multivariate distributions and stochastic processes, Types of models, Steps in simulation study, Model development life cycle, Areas of application.

Unit II

Random Number generation: Generation of Pseudo-Random numbers, Random Number generation methods, Properties of Random Numbers, Test for random numbers, Generating discrete distribution, Inversion, Rejection sampling.

Unit III

Variance reduction techniques. Implementation of simulation methods - for various probability models, and resampling methods: theory and application of the jack-knife, bootstrap and cross validation, Simulating multivariate distributions.

Unit IV

Univariate density estimation, kernel smoothing multivariate density estimation. Markov Chain Monte Carlo methods: Markov chains, Gibbs sampling, Hastings Metropolis algorithms, critical slowingdown and remedies, auxiliary variables. Practical Simulation from various probability models.

Text and Reference Books:

1. Law, A. M., Kelton, W.D., & Kelton, W. D, Simulation, Modeling and Analysis, New York: McGrawHill, 2000.
2. Balakrishnan, N., Melas,V. B., & Ermakov, S., Advances in Stochastic Simulation Methods, Springer Science & Business Media,2012.
3. Banks, J, Handbook of Simulation: Principles, Methodology, Advances, Applications and Practice, John Wiley & Sons,1998
4. Bratley, P., Fox, B. L., & Schrage, L. E., A Guide to Simulation, Springer Science & Business Media,2011

Internship

General Course Information

Course Code: 24ADS0505I Credit: 4 Course Type: Skill Enhancement Course Category: Industrial Training / Internship	Course Assessment Methods (100 Marks) An internal evaluation is done by the departmental committee constituted by the Chairperson of the department. Significance and originality of the problem addressed and the solution provided: 20 Knowledge of the problem domain and tool used (VIVAVOCE):25 Report Writing: 20 Judgement of the skill learnt and system developed: 20 Level of ethics followed: 15

About the Internship:

Students do an Industrial Training / Internship of 4 to 6 weeks after fourth semester. They are expected to learn novel skills and develop some application in the domain of Computer Science (AI and Data Science) during the this period.

After doing Internship students will be able to:

CO1. review the existing systems for their strengths and weaknesses.
CO2. address novel problems in an original and innovative manner.
CO3. select and apply modern AI tools.
CO4. evaluate the system developed critically with respect to the requirement analysis and other similar systems.
CO5. prepare internship report by organising ideas in an effective manner.
CO6. follow ethical practices while doing the training /internship and writing report.

Guidelines for Preparing Internship Report

All the students are required to follow these guidelines for preparing their industrial training / internship report.

General Guidelines

1. The industrial training/ internship report must include a declaration by the student that he/she has followed ethical practices while doing the industrial training / internship work. Any violation of ethical practices will lead to rejection of the industrial training/ internship report. For instance, a plagiarized report or a readymade report purchased from market will be rejected straight away.
2. Industrial training / internship work carried out in groups of two students must include the individual contribution of the students.
3. The industrial training / internship report must be submitted to the committee in soft binding at least 7 days before the final submission so that committee can suggest changes.

Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	No. of pages	Minimum 20 and maximum 40
2.	Paper size	A4
3.	Font Type	Times New Roman
4.	Normal text size	12
5.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers
6.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
7.	References/Bibliography	IEEE format
8.	Binding	soft and hard binding of good quality

Contents of the Industrial Training Report

The contents of the industrial training report should be organised as described below.

1. Declaration that the students has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the industrial training / internship report through references and citations.
2. Acknowledgement
3. List of figures
4. List of Tables
5. List of Abbreviations
6. Contents

Contents in the Body of the industrial training report

The report must be written in English. The ideas must be organised in a clear and concise fashion.

S. No	Content	Tentative No. of pages
1.	Profile of the Company	At most 2 pages
2.	Introduction	2-4 pages
3.	Description of skills learned	4-6 pages
4.	Application developed (if any) based on skills learnt	10-18 pages
5.	Scope of the training/ internship/ application developed	1 paragraph

The industrial training /internship report should not no way exceed 40 pages and should be submitted in soft and hard binding of good quality.

Format of the title page

The format of the title page is given is given on next page.

TITLE OF THE INTERNSHIP REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Training /Internship report submitted to
Guru Jambheshwar University of Science and Technology, Hisar for
the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 4 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 1 lines gap with 12 font size from the text above in three lines)

Bachelor of Science (Hons. /Hons. with Research) in

Computer Science (Artificial Intelligence and Data Science)

(Write in Times New Roman, 14-point size, Bold, Centred style after "of" after 1 line gap with

12 font size)

By

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 1 line gap with 12 font size)

Your Name

(Enrolment Number)

(Write in Times New Roman, 14-point size font, Bold, Centred style after1 line gap with 12

font from "By")

Department of Artificial Intelligence and Data Science

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centred style, after 2 lines gap from logo)

Declaration to be submitted for training report

DECLARATION

I, Your Name, Your Roll No., certify that the work contained in this industrial training/ internship report is original and has been carried by me in the ---------- company name. This work has not been submitted to any other institute for the award of any degree and I have followed the ethical practices and other guidelines provided by the Department of Artificial Intelligence and Data Science in preparing the industrial training /internship report.

Signature

Name of Student

Registration Number

Department of Artificial Intelligence and Data Science

Guru Jambheshwar University of Science and Technology, Hisar

Neural Network and Deep Learning

General Course Information

Course Code: 24ADS0601T Credits: 3 Hours /Week: 3 Course Type: Discipline Specific Course Category: Theory Mode: Lectures (L) Examination Duration: 2.5 Hours	Course Assessment Methods: Max. Marks: 70 (Internal: 20; External: 50) The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This course introduces fundamental concepts of Artificial Neural Networks (ANN) and deep learning architectures. It will cover perceptrons, backpropagation, convolutional networks, and sequence modeling, providing hands-on knowledge of modern neural network techniques.

Course Outcomes:

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

CO1. Understand the fundamental concepts of artificial neural networks, including perceptrons and the backpropagation algorithm.

CO2. Apply deep learning techniques such as convolutional neural networks (CNNs) and transfer learning for image recognition tasks.

CO3. Analyze and model sequential data using recurrent neural networks (RNNs), long short-term memory (LSTM) networks, and sequence-to-sequence models for time-series and natural language processing (NLP) applications.

CO4. Optimize model performance by addressing issues such as overfitting, underfitting, and longterm dependencies in deep learning models.

Course Content

Unit I

Introduction to Artificial Neural Network, Neural Network Representation, Perceptron: Representational Power of Perceptrons, Limitations of the Perceptron – Model. XOR problem,

Gradient Descent Algorithm and delta learning rule, Multilayer Networks and Backpropagation Algorithm, Over fitting and Under fitting.

Unit II

Convolutional Networks and Transfer Learning Convolution Operation - Motivation - Pooling - Structured Outputs - Data Types - Popular CNN Architectures - LeNet, AlexNet, VGG - Transfer Learning - DenseNet.

Unit III

Sequence Modelling: Recurrent and Recursive Nets Unfolding Computational Graphs , Long ShortTerm Memory and Gated RNNs Optimization for Long-Term Dependencies, - Bidirectional RNNs Encoder-Decoder Sequence-to-Sequence Architectures.

Text and Reference Books:

1. lan Goodfellow, Yoshua Bengio and Aaron Courville, Deep learning, 2016, MIT Press.
2. Dipanjan Sarkar, Raghav Bali, Tamoghna Ghosh, Hands-On Transfer Learning with Python, 2018, First edition, Packt Publishing.
3. John D. Kellcher, Deep Learning, 2019, First edition, The MIT Press
4. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, 2018, First edition, Springer.

Neural Network and Deep Learning Lab.

General Course Information

Course Code: 24ADS0601P Credit: 1 Hours/Week: 2 Course Type: Discipline Specific course Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 30 (Internal: 10; External: 20) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This lab course provides hands-on experience in designing, training, and optimizing artificial neural networks and deep learning models. Students will implement various neural network architectures, including perceptrons, convolutional networks, and recurrent networks, using modern deep learning frameworks.

Course Outcomes:

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

CO1. Implement fundamental neural networks such as perceptrons, multi-layer networks, and backpropagation for basic learning tasks.
CO2. Develop and optimize deep learning models, including CNNs and RNNs, for applications such as image and sequence processing.
CO3. Apply transfer learning and hyperparameter tuning techniques to improve model performance and generalization.
CO4. Analyze and interpret deep learning models using performance metrics and optimization techniques for real-world AI applications.

Practical Lab based on subject 24ADS0601T Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Big Data Analytics

General Course Information

Course Code: 24ADS0602T Credits: 3 Hours /Week: 3 Course Type: Discipline Specific Course Category: Theory Mode: Lectures (L) Examination Duration: 2.5 Hours	Course Assessment Methods: Max. Marks: 70 (Internal: 20; External: 50) The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 5 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 50 marks. The examiner is required to set seven questions in all. The first question will be compulsory consisting of consisting of five short questions covering the entire syllabus consisting of 2.5 marks each. In addition to that six more questions will be set, two questions from each unit. The students shall be required to attempt four questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 12.5 marks.

About the Course:

This course introduces the fundamental concepts, tools, and techniques used in big data analytics. Students will explore the data science process, analytics lifecycle, and challenges associated with traditional systems. Emphasis will be placed on statistical methods, data mining, real-time analytics, and distributed computing frameworks such as Hadoop and NoSQL databases.

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

CO1. Understand big data concepts, the analytics lifecycle, and challenges in handling large datasets with statistical and machine learning techniques.
CO2. Implement stream data processing techniques like sampling, filtering, and real-time analytics to extract insights from continuous data.
CO3. Apply clustering algorithms and frequent itemset mining techniques to analyze large datasets.
CO4. Use big data frameworks (Hadoop, MapReduce, Hive, NoSQL) and visualization tools for largescale data processing and representation.

Course Content

Unit I

Introduction: Overviews of Big Data, State of the Practice in Analytics, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle Challenges of Conventional Systems, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error, Regression Modelling.

Unit II

Mining Data Streams: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics, Platform (RTAP) Applications, Frequent Itemset and Clustering: Mining Frequent Itemsets, Market Based Model: Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent Itemsets in a Stream.

Unit III

Clustering based Techniques: Hierarchical, K-Means etc., Clustering High Dimensional Data, CLIQUE And PROCLUS, Frequent Pattern based Clustering Methods, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism, Frameworks and Visualization: Overview of MapReduce, Hadoop, Hive, MapR, Sharding, NoSQL Databases, S3, HADOOP, Distributed File System (HDFS), Visualizations: Visual Data Analysis Techniques, Interaction Technique and Applications.

Text and Reference Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. A. Rajaraman, J.D. Ullman, Mining of Massive Datasets, Cambridge University Press, 2012. 3. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
4. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007
5. Pete Warden, Big Data Glossary, O'Reilly, 2011.

Big Data Analytics Lab.

General Course Information

Course Code: 24ADS0602P Credit: 1 Hours/Week: 2 Course Type: Discipline Specific course Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 30 (Internal: 10; External: 20) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course aims to equip students with the necessary skills to extract valuable insights from big data and apply them to real-world scenarios.

Course Outcomes:

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

CO1. Understand the fundamental concepts, challenges, and applications of big data across various industries.

CO2. Implement techniques for real-time data mining and stream processing to analyze continuous data streams.

CO3. Apply clustering algorithms (e.g., K-Means) and frequent itemset mining algorithms (e.g., Apriori) to extract insights from large datasets.

CO4. Gain hands-on experience with tools like Hadoop, Spark, and NoSQL databases, and visualize results using Tableau or Power BI.Practical Lab based on subject 24ADS0602T

Practical Lab based on subject 24ADS0602T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Cloud Computing

General Course Information

Course Code: 24ADS0603T(i) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

The Cloud Computing course explores the fundamental concepts and technologies behind cloud-based systems. It covers topics such as distributed computing, virtualization, cloud platforms, deployment models, and cloud security. The course also dives into major cloud service providers like Amazon Web Services (AWS), Google App Engine, and Microsoft Azure. Students will learn about the core services provided by these platforms and their applications across industries. This course will provide students with the knowledge to understand cloud architecture, services, and deployment models while also applying these concepts to real-world scenarios.

Course Outcomes:

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

CO1: Understand the fundamental concepts of distributed, cluster, grid, and cloud computing, and describe the various cloud service and deployment models.

CO2: Analyze the benefits and architecture of cloud computing and evaluate service models such as IaaS, PaaS, and SaaS.

CO3: Examine and work with various cloud platforms like Amazon Web Services, Google App Engine, and Microsoft Azure for industry-specific applications.

CO4: Identify and assess the use of cloud applications in different domains such as scientific, business, and consumer applications, and understand security concerns in cloud computing.

Course Content

Unit I

Introduction: Distributed Computing, Cluster Computing, Grid Computing, Overview of Cloud Computing, History of Cloud Computing, Defining a Cloud, Benefits of Cloud Computing, Cloud Computing Architecture, Services Models (XaaS), Infrastructure as a Service, Platform as a Service, Software as a Service.

Unit II

Deployment Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Dynamic Provisioning and Resource Management, Virtualization: Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Pros and Cons of Virtualization, Xen, VMware, Hyper-V.

Unit III

Cloud Platform in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services, Additional Services, Google App Engine- Architecture and Core Concepts, Application Life Cycle, Cost Model, Microsoft Azure – Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance.

Unit IV

Cloud Application: Scientific Applications- ECG Analysis in cloud, Protein Structure Prediction, Gene Expression data analysis for Cancer Diagnosis, Satellite Image Processing, Business and Consumer Applications-CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online gaming. Cloud Security.

Text and Reference Books:

1. Rajkumar Buyya, Christian Vecchiola and S ThamaraiSelvi, Mastering Cloud Computing, Tata McGraw Hill Education Pvt. Ltd., 2013.
2. Kai Hwang, Geofferyu C. Fox and Jack J. Dongarra, Distributed and Cloud Computing, Elsevier, 2012.
3. John W. Ritting and James F. Ransome, Cloud Computing: Implementation Management and Security, CRC press, 2012.

Information Retrieval Systems

Course Code: 24ADS0603T(ii) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

The Information Retrieval Systems course introduces students to the foundational concepts and techniques used in searching and retrieving information from large datasets. It covers the design, development, and evaluation of information retrieval systems, including how they relate to databases, digital libraries, and data warehouses. Students will gain a deep understanding of indexing, search techniques, text retrieval, multimedia retrieval, and information visualization. The course also delves into advanced topics like automatic indexing, clustering, and user search techniques.

Course Outcomes:

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

CO1: Understand the core concepts, objectives, and components of Information Retrieval Systems, including their relationship to DBMS, digital libraries, and data warehouses.
CO2: Gain knowledge of indexing processes, including automatic indexing, and apply clustering techniques for organizing documents and terms.
CO3: Develop an understanding of search strategies, similarity measures, relevance feedback, and advanced search methods like weighted searches and Boolean systems.
CO4: Learn how to retrieve and process multimedia content (audio, video, imagery) and apply information visualization techniques for presenting search results effectively.

Course content

Unit I

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management

Systems, Digital Libraries and Data Warehouses. Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities.

Unit II

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction. Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models.

Unit III

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages. Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext.

Unit IV

Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies.

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems. Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval.

Text and References Books:

1. Kowalski & Maybury, Information storage and retrieval systems: theory and implementation (Vol. 8). Springer Science & Business Media, 2002.
2. Frakes & Baeza-Yates (Eds)., Information retrieval: data structures and algorithms. Prentice-Hall, Inc., 1992.
3. Korfhage, Information Retrieval and Storage, John Wiley & Sons, 1997
4. Baeza-Yates & Ribeiro-Neto (1999), Modern information retrieval (Vol. 463), New York: ACM press, 1999.

Fundamental of Econometrics

Course Code: 24ADS0604T(i) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

The Econometrics course introduces students to the statistical techniques used to analyze economic data. The course focuses on regression analysis, which forms the backbone of econometric modeling, and covers the assumptions and methodology necessary for building and estimating economic models. Through this course, students will learn how to estimate, interpret, and evaluate econometric models, ensuring they can apply these skills to a variety of economic and business contexts.

Course Outcomes:

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

CO1. Understand the basic concepts, assumptions, and application of Ordinary Least Squares (OLS) in regression models.
CO2. Apply Classical Normal Linear Regression Model and Maximum Likelihood Estimation to realworld datasets.
CO3. Identify and handle issues like multicollinearity and heteroscedasticity, using techniques like Generalized Least Squares (GLS).
CO4. Detect and address autocorrelation in time series data using tests such as Durbin-Watson and apply Best Linear Unbiased Estimator (BLUE).

Course content

Unit I

Introduction to econometrics; Nature, scope, objectives and methodology of econometrics, Types of econometrics, Nature of the regression analysis, Basic assumptions, Simple Linear Regression Model: Two Variable Case, Estimation of model by method of ordinary least squares, properties of estimators, goodness of fit, Gauss-Markov theorem.

Unit II

Classical Normal Linear Regression Model, Normality Assumption for Disturbances, Properties of ordinary least squares, Estimators under the Normality Assumption, Method of Maximum Likelihood, Multiple regression analysis: Three variable case, ordinary least squares and Maximum Likelihood Estimation of the Partial Regression Coefficients, Multiple Coefficient of Determination, Multiple Coefficient of Correlation.

Unit III

Nature of Dummy Variables and Multicollinearity, Estimation in the Presence of Perfect Multicollinearity, Estimation in the Presence of "High" but "Imperfect" Multicollinearity, Detection of Multicollinearity, Heteroscedasticity: OLS Estimation in the Presence of Heteroscedasticity, Method of Generalized Least Squares, Detection of Heteroscedasticity.

Unit IV

Nature of the Autocorrelation: OLS Estimation in the Presence of Autocorrelation, BLUE Estimator in the Presence of Autocorrelation, Detecting Autocorrelation, Graphical Method, Runs Test, Durbin–Watson Test, Breusch–Godfrey Test.

Text and References Books:

1. Gujarati D.N., Basic Econometrics, McGraw Hill.,2003
2. Gujarati D.N. and Porter D.C.,Essentials of Econometrics, McGraw Hill, 4th edition,2009
3. Koop G., Introduction to Econometrics, John Wiley,2007
4. Maddala GS., Introduction to Econometrics, MacMillan,1992 5. Maddala GS., Econometrics, McGraw Hill,1997

Internet of Things

Course Code: 24ADS0604T(ii) Credits: 4 Hours/Week: 4 Course Type: Discipline Specific Elective Course Category: Theory Mode: Lectures (L) Examination Duration: 3 Hours	Course Assessment Methods: Max. Marks: 100 (Internal: 30; External: 70) The department will conduct one minor test worth 15 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks) and 10 marks for assignments, seminars, presentations, or quizzes. Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 70 marks. The examiner is required to set nine questions in all. The first question will be compulsory consisting of consisting of seven short questions covering the entire syllabus consisting of 2 marks each. In addition to that eight more questions will be set, two question from each unit. The students shall be required to attempt five questions in all selecting one question from each unit in addition to compulsory Question No. 01. All question shall carry equal marks i.e. 14 marks.

About the Course:

The Internet of Things (IoT) course provides an in-depth exploration of the IoT ecosystem, from its foundational concepts and technologies to real-world applications. The course covers the history, architecture, and components of IoT, as well as the identification of IoT objects and services. Students will learn about IoT technologies, including sensor technology, RFID, communication protocols, and security issues.

Course Outcomes:

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

CO1. Understand the basic concepts, architecture, and applications of the Internet of Things (IoT).
CO2. Identify IoT objects and services, addressing key challenges such as scalability, interoperability, and security.
CO3. Analyze and apply IoT access technologies, including communication protocols and optimization techniques for constrained networks.
CO4. Explore business models, value creation, and real-world IoT applications in sectors like smart metering, healthcare, and home automation.

Course content

Unit I

What is the Internet of Things: History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Basics Of Microcontroller, Microprocessor Vs Microcontroller, Types of Sensor, Actuators and their Applications.

Unit II

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology-Introduction, Principle of RFID, Components of an RFID system, Issues, Satellite Technology.

Unit III

IoT Access Technologies: Physical and MAC layers, Topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

Unit IV

Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Applications: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Smart Transportation and Smart Shopping.

Text and Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 1st Edition, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things – Key applications and Protocols, Wiley, 2nd Edition, 2012.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, 1st Edition, Springer, 2011.
4. Michael Margolis, Arduino Cookbook, “Recipes to Begin, Expand, and Enhance Your Projects”, 2nd Edition, O'Reilly Media, 2011.
5. Arshdeep Bahga, Vijay Madisetti, Internet of Things – A hands-on approach, 1st Edition, Universities Press, 2015.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Details of the courses offered by the department in 5th and 6th semesters to students from other departments as per NEP-2020 are categorized as shown in the table below.

Type of Course	Sem.	Course Code	Nomenclature of Paper/Course	Credit(s)	Contact Hours	Internal Marks	External Marks	Total	Duration of Exam (Hrs.)
Minor / Vocational Courses	5th	24VOC0517T	R Programming	2 (Th)	2	15	35	50	2
		24VOC0517P	R Programming Lab.	2(Pr)	4	10	15	25	3
	6th	24VOC0617T	Python Programming	2 (Th)	2	15	35	50	2
		24VOC0617P	Python Programming Lab.	2(Pr)	4	10	15	25	3
Skill Enhancement Courses	6th	24SEC0603P	Data Visualization Lab.	2 (Pr)	4	15	35	50	3

Chairman

R Programming

General Course Information

Course Code: 24VOC0517T Credits: 2 Hours/Week: 2 Course Type: Minor / Vocational Courses Category: Theory Mode: Lectures (L) Examination Duration: 2 Hours	Course Assessment Methods: Max. Marks: 50 (Internal: 15; External: 35) The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

This course is to learn the fundamentals of R and covers how to use different functions in R for data analysis.

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

CO1. Understand the significance of R as a programming language, and its advantages over others, and navigate R Studio effectively and manage packages, input, and output operations in R.
CO2. Manipulate R data types (vectors, lists, matrices, etc.) through operations like accessing, modifying, and merging data.
CO3. Implement decision-making constructs and looping mechanisms, including user-defined functions, to control program flow in R.
CO4. Load and analyze datasets in R, summarize data, perform statistical calculations, and manipulate text data for effective data analysis.

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Course Content

Unit I

Introduction to R: What is R?, Why R? , Advantages of R over Other Programming Languages, R Studio: R command Prompt, R script file, Handling Packages in R: Installing a R Package, Input and Output: Entering Data from keyboard, Printing fewer digits or more digits, Special Values functions: NA, Inf and –inf, R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame,R Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables. R Operators:
Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators. R Decision Making: if statement, if – else statement, if – else if statement, switch statement.R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.R Function: function definition, Built in functions: mean (), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values. R-Strings: Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower().

Unit II

R Vectors: Sequence vector, rep function, vector access, vector names, vector math, vector element sorting.R List: Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector.R Matrices: Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements

R Factors: creating factors, generating factor levels gl().Data Frames : Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions , Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast(). Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir().R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File , R -Excel File – Reading the Excel file.

Text and Reference Books:

1. S. D. Ratnoo and H. S. Ratnoo, Essentials of R for Data Analytics, Wiley, January 2021.
2. S. Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017.
3. S. Acharya, Data Analytics using R, McGraw Hill Education (India), 2018.
4. A. de Vries and J. Meys, R for Dummies, 2nd Edition, John Wiley and Sons, Inc, 2015.

R Programming Lab.

General Course Information

Course Code: 24VOC0517P Credit: 2 Hours/Week: 4 Course Type: Minor / Vocational Courses Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 25 (Internal: 10; External: 15) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

This course provides practical study related to the fundamentals of R and covers how to use different functions in R for data analysis.

Course Outcomes:

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

CO1. Apply practical knowledge of R programming by writing and executing scripts that demonstrate data manipulation, statistical analysis, and visualization techniques.

CO2. Effectively use R to clean and preprocess datasets, including handling missing values, transforming variables, and reshaping data structures for analysis.

CO3. Create various data visualizations using R libraries like ggplot2 to communicate findings through graphical representations, including bar charts, histograms, scatter plots, and boxplots.

CO4. Design and implement a mini-project that encompasses the entire data science process in R, from data acquisition and cleaning to analysis and visualization.

Practical Lab based on subject : 24VOC0517T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Python Programming

General Course Information

Course Code: 24VOC0617T Credits: 2 Hours/Week: 2 Course Type: Minor / Vocational Courses Category: Theory Mode: Lectures (L) Examination Duration: 2 Hours	Course Assessment Methods: Max. Marks: 50 (Internal: 15; External: 35) The department will conduct one minor test worth 10 marks. The Course Coordinator will decide whether to hold a second minor test at their level, and there will be no date sheet for it. Class performance includes attendance (5 marks). Internal marks will be the total of the minor test score and the class performance marks earned by the student. Note: The end semester examination will be of 35 marks. The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to that four more questions will be set with two questions from each unit. The students shall be required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1 consisting of marks 15.

About the Course:

Python is a popular open-source programming language used for both standalone programs and scripting applications in a wide variety of domains. It is free, portable, and powerful and is both relatively easy and remarkably fun to use. In today's era Python has found great applicability in machine learning, data analytics and many other data science applications. This is introductory course and covers most of the basic concepts required for basic python programming.

Course Outcomes:

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

CO1. Understand the Python programming fundamentals, including data types, control structures, and functions, enabling the development of effective scripts and algorithms.

CO2. Efficiently use and manipulate Python's built-in data structures, such as lists, tuples, and dictionaries, to solve programming problems and organize data effectively.

CO3. Apply object-oriented programming principles in Python, including the creation of classes and objects, to design modular and reusable code.

CO4. Manipulate strings and handle file operations in Python, showcasing the ability to process and manage text data and files effectively.

Course Content

Unit I

Introduction to Python, History of Python, Features of Python, Python Identifiers, Python Character Set, Keywords and Indentation, Comments, Command Line Arguments, Assignment Operator, Operators and Expressions, print() Function, input() Function, eval() Function, Python Data Types: int, float, complex, Variables, Mutable vs Immutable variables, Decision Statements: Boolean Type, Boolean Operators, if statement, else statement, Nested Conditionals Statements, Multi-way Decision Statements (elif statement), Loop Control Statements: While loop, range() Function, For Loop, Nested Loops, Infinite Loop, Break Statement, Continue Statement, Pass Statement, Introduction to Strings, String Operations: Indexing and Slicing.

Unit II

Lists: Operations on List: Slicing, Inbuilt Functions for Lists, List Processing: Searching and Sorting, Tuples, Dictionaries: Need of Dictionary, Operations on Directories: Creation, Addition, Retrieving Values, Deletion; Tuples, operations on Tuples, Inbuilt Functions for Tuples, Python Functions, Inbuilt functions, Main function, User Defined functions, Defining and Calling Function, Parameter Passing, Actual and Formal Parameters, Default Parameters, Global and Local Variables, Recursion, Passing Functions as Data, Lamda Function, Modules, Importing Own Module. Python Object Oriented: Overview of OOP, Classes and objects, Accessing attributes, Built- In Class Attributes, Methods, Class and Instance Variables, Destroying Objects, Polymorphism, Class Inheritance.

Text and Reference Books:

1. R. Nageswara Rao, Core Python Programming, dreamtech Press, 2019.
2. Ashok Namdev Kamthane, Programming and Problem Solving with Python, Mc Graw Hill Education Publication, 2018.
3. Lutz, M., Learning Python: Powerful Object-Oriented Programming, O'Reilly Media, Inc., 2013.
4. John Guttag, Introduction to Computation and Programming using Python, Springer, Revised and Expanded version (Referred by MIT), 2013.
5. Michael T Goodrich and Robertto. Thamassia, Micheal S Goldwasser, Data Structures and Algorithms in Python, Wiley, 2016.
6. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2013.
7. Reema Thareja, Python Programming Using Problem Solving Approach, Oxford Publications, 2017.
8. Allen B. Downey Think Python, O'Reilly Media,2012.
9. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning, 2011.

Python Programming Lab.

General Course Information

Course Code: 24VOC0617P Credit: 2 Hours/Week: 4 Course Type: Minor / Vocational Courses Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 25 (Internal: 10; External: 15) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

Python is a scripting programming language known for both its simplicity and wide breadth of applications. For this reason, it is considered one of the best languages for beginners. Used for everything from web development to scientific computing Python is referred to as a general-purpose language by the greater programming community. The major objective of Python language is to make the students solve real word problem efficiently using python.

Course Outcomes:

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

CO1. Implement Python Programming Concepts, including data types, control structures, and functions to solve programming problems.
CO2. Design, code, and debug Python programs that utilize lists, tuples, dictionaries, and objectoriented programming principles to create structured and reusable code.
CO3. Effectively use Python libraries and modules to enhance functionality and efficiency in coding, including importing and leveraging third-party libraries for specific tasks.
CO4. Apply Python programming skills to perform data analysis and visualization using relevant libraries, enabling the interpretation and presentation of data effectively. Practical Lab based on subject 24VOC0617T

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

Data Visualization Lab.

General Course Information

Course Code: 24SEC0603P Credit: 2 Hours/Week: 4 Course Type: Skill Enhancement Course Category: Practical Mode: Lab Practice and Assignments	Course Assessment Methods: Total Marks: 50 (Internal: 15; External: 35) The internal and external assessment is based on the level of participation in lab sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA VOCE, the quality of lab file and ethical practices followed. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

About the Course:

The Data Visualization Lab is designed to provide students with practical experience in transforming complex datasets into meaningful visual representations. This lab complements theoretical concepts with hands-on sessions that develop the skills needed to interpret, analyze, and communicate data insights effectively. Through this lab, students will explore a range of visualization tools and libraries such as Tableau, Microsoft Power BI, Python (Matplotlib, Seaborn, Plotly), and R (ggplot2). Emphasis will be placed on storytelling with data, creating dashboards, and applying principles of design and perception to build interactive and insightful visualizations.

Course Outcomes:

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

CO1: Understand and apply core principles of data visualization to represent datasets effectively using various tools and libraries.
CO2: Develop interactive and static visualizations using tools such as Tableau, Power BI, and Python/R-based libraries.
CO3: Analyze and interpret visual data representations to derive meaningful insights for real-world datasets and business problems.
CO4: Design and present data-driven stories through dashboards and visual reports adhering to best practices in visual perception and ethics.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.