ADVANCED DATABASE MANAGEMENT SYSTEM			
Course Code	**22SDS13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- Strong foundation in advanced database concepts from an industry perspective.
- The database management system contributes with advanced data modelling concepts like OOD Modelling and ORD Modelling.
- The advanced database system arranges query processing and transaction management concepts for object-relational database and distributed database.

Module-1	
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Object and Object-Relational Databases: Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-2	
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures. Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-3	
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. Big Data Technologies Based on MapReduce and Hadoop: What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-4	
Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases. Introduction to Information Retrieval and Web Search:Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-5

Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools. Overview of Data Warehousing and OLAP: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.

Teaching-Learning Process	Chalk and Talk/ PPT / Case Study: https://www.researchgate.net/publication/47393965_Data_warehousing_and_data_mining_A_case_study

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Fundamentals of Database Systems,Elmasri and Navathe, Pearson Education2013.
2. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill, 3rd Edition, 2013.
3. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 6th Edition, 2010.

Web links and Video Lectures (e-Resources):

1. https://link.springer.com/book/10.1007/978-3-7091-2704-9
2. https://www.youtube.com/watch?v=ywTn9qHyI9I
3. https://www.youtube.com/watch?v=_qbKMdqQS6E
4. https://www.youtube.com/watch?v=PqPkYmRSQ_w
5. https://www.researchgate.net/publication/47393965_Data_warehousing_and_data_mining_A_case_study

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Infer and represent the real-world data using object-oriented database	L2
CO2	Interpret rule set in the database to implement data warehousing of mining	L3
CO3	Discover and design database for recent applications database for better interoperability	L4

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	Po1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X	X									
CO2			X	X								
CO3		X	X									

PREDICTIVE ANALYTICS			
Course Code	**22SDS14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Develop theoretical understanding of modelling techniques in data science.
- Formulate complex decision-making problems with data for predictive analysis in business context.
- Analyze and evaluate predictive model outcomes for informing decision-making.

Module-1	
Linear Methods for Regression and Classification: Overview of supervised learning,Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection , Ridge regression, Lasso regression , Linear Discriminant Analysis , Logistic regression , Perceptron learning algorithm.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-2	
Model Assesment and Selection : Bias,Variance,and model complexity,Bias-variance trade off, Optimisim of the training error rate ,Esimate of In-sample prediction error,Effective number of parameters, Bayesian approach and BIC, Cross- validation ,Boot strap methods, conditional or expected test error.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-3	
.Additive Models,Trees,and Boosting: Generalized additive models, Regression and classification trees , Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting ,Examples (Spam data, California housing , New Zealand fish, Demographic data)	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-4	
Neural Networks(NN) , Support Vector Machines(SVM),and K-nearest Neighbour: Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest – Neighbour classifiers(Image Scene Classification)	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-5	
Unsupervised Learning and Random forests: Association rules, Cluster analysis, Principal Components, Random forests and analysis.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

.

Suggested Learning Resources:

Books

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman , The Elements of Statistical Learning-Data Mining, Inference, and Prediction ,Second Edition , Springer Verlag, 2009..
2. G.James,D.Witten,T.Hastie,R.Tibshirani-An introduction to statistical learning with applications in R,Springer,2013..
3. E.Alpaydin, Introduction to Machine Learning, Prentice Hall Of India,2010.
4. C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006.
5. L.Wasserman-All of statistics.

Web links and Video Lectures (e-Resources):

1. https://www.ibm.com/in-en/analytics/predictive-analytics
2. https://www.youtube.com/watch?v=Kd0C-8q0HkI

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Know the fundamentals of statistical methods and predictive strategies.	L3
CO2	Know how to validate models and analyse outcomes.	L4
CO3	Solving analytics difficulties by using systems and critical thinking.	L4

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X				X							
CO2		X	X									
CO3				X	X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7

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

FUNDAMENTALS OF MACHINE LEARNING			
Course Code	**22SDS13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Identifying which specific ML strategy (es) would be most suitable depends on where the problem at hand falls on the landscape of existing ML techniques.

Module-1

Fundamentals of Machine Learning: The introduction basic machine learning concepts, tasks, and workflow using an example classification problem based on the K-nearest neighbors method, and implemented using the scikit-learn library.

Teaching-Learning Process	Chalk and Talk/ PPT

Module-2

Supervised Machine Learning: supervised learning methods for both classification and regression, learning about the connection between model complexity and generalization performance, the importance of proper feature scaling, and how to control model complexity by applying techniques like regularization to avoid overfitting.

Teaching-Learning Process	Chalk and Talk/ PPT

Module-3

k-nearest neighbors, this week covers linear regression (least-squares, ridge, lasso, and polynomial regression), logistic regression, support vector machines, the use of cross-validation for model evaluation, and decision trees.

Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-4

Evaluation: Evaluation and model selection methods to understand and optimize the performance of your machine learning models.

Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-5

Supervised Machine Learning - Part 2

Advanced supervised learning methods that include ensembles of trees (random forests, gradient boosted trees),

and neural networks (with an optional summary on deep learning). You will also learn about the critical problem of data leakage in machine learning and how to detect and avoid it.

Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

.

Suggested Learning Resources:

Books

1. Kevin Murphy. Machine Learning: A Probabilistic Perspective. The MIT Press. 2012.
2. Shai Shalev-Shwartz and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press. 2014.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition. Springer. 2009..
4. Christopher Bishop. Pattern Recognition and Machine Learning. Springer. 2007.
5. Ian Goodfellow, YoshuaBengio and Aaron Courville. Deep Learning. The MIT Press. 2016.

Web links and Video Lectures (e-Resources):

1. https://bloomberg.github.io/foml/#lectures.
2. https://www.coursera.org/learn/machine-learning/
3. https://www.youtube.com/watch?v=I6RBgXAWXdE

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the features of machine learning to apply on real world problems	L1
CO2	Characterize the machine learning algorithms as supervised learning and unsupervised learning and Apply and analyse the various algorithms of supervised and unsupervised learning	L3,L4
CO3	Analyze the concept of neural networks for learning linear and non-linear activation functions	L4

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X											
CO2		X	X									
CO3		X	X									

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5

6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

Common to all M tech programs in CSE board

Research Methodology and IPR

Course Code	**22RMI16**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To introduce various technologies of conducting research.
- To choose an approptiate rsearch design for the choosen problem.
- Choose appropriate tool for the conduction of research.
- To explain the art of interpretation and the art of writing research reports.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment
- To discuss leading International Instruments concerning Intellectual Property Rights.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. **Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration

Teaching-Learning Process	Chalk and talk/PPT/case study

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Teaching-Learning Process	Chalk and talk/PPT/case study/web content

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **Measurement and Scaling:** Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. **Data Collection:** Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	
Teaching-Learning Process	Chalk and talk/PPT/case study/web content
Module-4	
Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. **Chi-square Test:** Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests	
Teaching-Learning Process	Chalk and talk/PPT/case study/web content
Module-5	
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. **Intellectual Property:** The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.	
Teaching-Learning Process	Chalk and talk/PPT

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Text Books:

1. *Research Methodology: Methods and Techniques*, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture," PHI, 6th Edition

2. *Research Methodology a step-by-step guide for beginners.* (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.

Reference Books:

1. *Research Methods: the concise knowledge base,* Trochim, Atomic Dog Publishing, 2005.

2. *Conducting Research Literature Reviews: From the Internet to Paper,* Fink A, Sage Publications, 2009.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=A7oioOJ4g0Y&list=PLVf5enqoJ-yVQ2RXUl6mCfLPf3J_JUfoc

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Conduct research independently	L2
CO2	Choose research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	L2
CO3	Statistically interpret the data and draw inferences	L2

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		x		x								x
CO2		x	x									x
CO3				x	x							x

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4

5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

DATA SCIENCE AND ANALYTICS LABORATORY			
Course Code	**22SDSL17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	2	Exam Hours	04

Course objectives:

- Recognize how to programme in R.
- Exposure to data science problem solving.
- Recognize the regression and classification models.
- To develop new algorithms and software tools for data management and mining, and to use them for social good.

Sl.NO	Experiments
1	R AS CALCULATOR APPLICATION: a. Using with and without R objects on console b. Using mathematical functions on console c. Write an R script, to create R objects for calculator application and save in a specified location in disk.
2	DESCRIPTIVE STATISTICS IN R: a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets. b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset
3	Iris dataset: Load the Iris dataset as a list of lists (each of the 150 lists should have 5 elements). Compute and print the mean and the standard deviation for each of the 4 measurement columns (i.e. sepal length and width, petal length and width). Compute and print the mean and the standard deviation for each of the 4 measurement columns, separately for each of the three Iris species (Versicolor, Virginica and Setose). Which measurement would you consider “best”, if you were to guess the Iris species based only on those four values?
4	Citybik.es dataset: Load the Citybik.es dataset as a Python dictionary. Use of the json module. Count and print the number of active stations (a station is active if its extra.status field is "online"). Count and print the total number of bikes available (field free_bikes) and the number of free docks (field empty_slots) throughout all stations. Given the coordinates (latitude, longitude) of a point (e.g. 45.074512, 7.694419), identify the closest bike station to it that has available bikes. For computing the distance among two points (given their coordinates), you can use the function distance_coords() defined in the code snippet below (which is an implementation of the great-circle distance): from math import cos, acos, sin defdistance_coords(lat1, lng1, lat2, lng2): """Compute the distance among two points.""" deg2rad = lambda x: x * 3.141592 / 180 lat1, lng1, lat2, lng2 = map(deg2rad, [lat1, lng1, lat2, lng2]) R = 6378100 # Radius of the Earth, in meters return R * acos(sin(lat1) * sin(lat2) + cos(lat1) * cos(lat2) * cos(lng1 - lng2))
5	MNIST dataset: Load the MNIST dataset. Create a function that, given a position $1 \le k \le 10,000$, prints the kthdigit of the dataset (i.e. thekthrow of the csv file) as a grid of 28 × 28 characters. More specifically, you should map each range of pixel values to the following characters: *0, 64) → " " *64, 128) → "." *128, 192) → "*" [192, 256) → "#" Compute the Euclidean distance between each pair of the 784-dimensional vectors of the digits at the following positions: 26th, 30th, 32nd, 35th. Based on the distances computed in the previous step and knowing that the digits listed are 7, 0, 1, 1, can you assign the correct label to each of the digits?
6	Tips dataset: Read the dataset “Tips.csv” as a dataframe “Data”. Extract the columns in the following sequence - Time, TotalBill, Tips. Plot a histogram for the variable ‘TotalBill’ to check which range has the highest frequency. Draw bar chart for the variable “Day”. Identify the category with the maximum count. Demonstrate the data distributions using box, scatter plot, histogram, and bar chart on iris dataset. Demonstrate the correlation plot on iris dataset and perform exploratory visualization giving an overview ofrelationships among data with covariance analysis.

7	Split the Iris dataset into two the datasets - IrisTest_TrainData.csv, IrisTest_TestData.csv. Read them as two separate data frames named Train_Data and Test_Data respectively. Answer the following questions: a) How many missing values are there in Train_Data? b) What is the proportion of Setosa types in the Test_Data? c) What is the accuracy score of the K-Nearest Neighbor model (model_1) with 2/3 neighbors using Train_Data and Test_Data? d) Identify the list of indices of misclassified samples from the 'model_1'. e) Build a logistic regression model (model_2) keeping the modelling steps constant. Find the accuracy of the model_2
8	Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining
	Demonstration Experiments (For CIE) if any
9	For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable „mpg" (Miles per gallon)
10	Train a regularized logistic regression classifier on the iris dataset (https://archive.ics.uci.edu/ml/machine- learning-databases/iris/ or the inbuilt iris dataset) using sklearn. Train the model with the following hyper parameter C = 1e4 and report the best classification accuracy.
11	Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBF-kernel, gamma=0.5, onevs-rest classifier, no-feature-normalization. Also try C=0.01,1,10 C=0.01,1,10. For the above set of hyperparameters, find the best classification accuracy along with total number of support vectors on the test data.
12	Consider the dataset spiral.txt (https://bit.ly/2Lm75Ly). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods: K – means Clustering Single – link Hierarchical Clustering Complete link hierarchical clustering. Also visualize the dataset and which algorithm will be able to recover the true clusters.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Demonstrate proficiency with statistical analysis of data.
- Illustrate the ability to build and assess data-based models.
- Optimize the data using Classifiers.
- Apply clustering algorithms and logistic regressions on data sets.
- Apply kernel techniques on datasets.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is 50 Marks.

The split-up of CIE marks for record/ journal and test are in the ratio 60:40.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

- https://www.dataquest.io/data-science-resources/

DEEP LEARNING			
Course Code	**22SDS21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Neural network models operated to accurately recognize, classify, and describe objects within the data.
- The unstructured data was analysed by deep learning algorithms and the results were accurately predicted.

Module-1	
Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.	
Teaching-Learning Process	Chalk and Talk /PPT

Module-2	
Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.	
Teaching-Learning Process	Chalk and Talk /PPT

Module-3	
Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges inNeural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features	
Teaching-Learning Process	Chalk and Talk /PPT

Module-4	
Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory.	
Teaching-Learning Process	Chalk and Talk /PPT

Module-5	
Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to GatherMore Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision, NLP, Speech.	
Teaching-Learning	Chalk and Talk /PPT

Process	

Assessment Details (both CIE and SEE)

The weight age of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Text Books

1. "Deep Learning", Lan Good fellow, MIT Press, 2016

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=VyWAvY2CF9c
2. https://www.youtube.com/watch?v=aircAruvnKk

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Identify the deep learning algorithms which are more appropriate for various types of learningtasks in various domains.	L2
CO2	Implement deep learning algorithms and solve real-world problems.	L3, L4
CO3	Execute performance metrics of Deep Learning Techniques.	L5

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	Po1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X										
CO2			X		X							
CO3				X	X							

DATA VISUALIZATION			
Course Code	**22SDS22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10 hours Lab	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- Develop skills to both design and review visualizations.
- Recognize the elements that go into visualising design.
- Recognize how the type of visualisation is impacted by the type of data.

MODULE-1	
What Is Visualization?, History of Visualization, Relationship between Visualization and Other Fields, The Visualization Process, Types of Data, Structure within and between Records, Data Preprocessing, Perception in Visualization, Metrics, The Visualization Process in Detail, Semiology of Graphical Symbols, The Eight Visual Variables, Taxonomies.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.shiksha.com/it-software/data-visualization-chp

MODULE-2	
Visualization Techniques for Spatial Data, Visualization Techniques for Geospatial Data, Visualization Techniques for Multivariate Data.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.shiksha.com/it-software/data-visualization-chp

MODULE-3	
Visualization Techniques for Time-Oriented Data, Visualization Techniques for Trees, Graphs, and Networks, Text and Document Visualization.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: http://www.ifs.tuwien.ac.at/~silvia/wien/vu-infovis/articles/Chapter8_VisualizationTechniquesForTreesGraphsAndNetworks_271-290.pdf

MODULE-4	
Interaction Concepts: Interaction Operators, Interaction Operands and Spaces, A Unified Framework, Interaction Techniques: Screen Space, Object Space (3D Surfaces), Data Space (Multivariate Data Values), Attribute Space (Properties of Graphical Entities), Data Structure Space (Components of Data Organization), Visualization Structure Space (Components of the Data Visualization), Animating Transformations, Designing Effective Visualizations: Steps in Designing Visualizations, Problems in Designing Effective Visualizations.	
Teaching-Learning	Chalk and Talk/ PPT

Process	
MODULE-5	
Comparing and Evaluating Visualization Techniques, Visualization Systems, Research Directions in Visualization	
Teaching-Learning Process	Chalk and Talk/ PPT / Web Resources: https://libguides.rollins.edu/c.php?g=503927&p=8015000

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Two students plotted histograms for the exact same data in R with the same bin width and boundary values; however their plots have completely different shape. What could be the cause of this?
2	Load the room temperature dataset into R, Python or MATLAB, or whichever software tool you prefer to plot with. 1. Plot the 4 trajectories, FrontLeft, FrontRight, BackLeft and BackRight on the same plot. 2. Comment on any features you observe in your plot. 3. Be specific and describe how spark lines of these same data would improve the message the data is showing.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of 20 Marks

2. Two assignments each of 10 Marks/One Skill Development Activity of 20 marks
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to 30 marks.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. Interactive Data Visualization: Foundations, Techniques, and Applications, Matthew O. Ward, Georges Grinstein, Daniel Keim, CRC Press 2015
2. The Visual Display of Quantitative Information Edward Tufte Graphics Press 2001

Web links and Video Lectures (e-Resources):

1. https://www.classcentral.com/course/datavisualization-2737
2. https://www.shiksha.com/it-software/data-visualization-chp
3. https://www.youtube.com/watch?v=7kPqESo1vRw

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Queries:

- (Why should we use scientific visualizations in teaching Earth Science?)
- (Recognize and interpret various mapping representations of Earth's common features.)

- (Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere.)

MANAGING BIG DATA			
Course Code	**22SDS231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To ensure a high level of data quality and accessibility for business intelligence and big data analytics applications.

Module-1	
Meet Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals MapReduce: A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming The Hadoop Distributed File system The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-2	
YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness. Hadoop I/O Data Integrity, Data Integrity in HDFS, Local FileSystem, Checksum File System, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: SequenceFile.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-3	
Developing a MapReduce Application The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, JobControl, Apache Oozie How MapReduce Works Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers.	
Teaching-	

Learning Process	Chalk and Talk/ PPT/ Web resources

Module-4

MapReduce Types and Formats: MapReduce Types, Input Formats: Input Splits and Records, Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output, Flume Installing Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog

Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-5

Pig Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data. Spark An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN

Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- Three Unit Tests each of 20 Marks
- Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Hadoop: The Definitive Guide, Tom White, O'Reilley 3 rd Edition, 2012
2. SPARK: The Definitive Guide, Bill Chambers MateiZaharia, O'Reilley 2018
3. Apache Flume: Distributed Log Collection for Hadoop, D'Souza and Steve Hoffman, O'Reilley 2014

Web links and Video Lectures (e-Resources):

1. https://www.techtarget.com/searchdatamanagement/definition/big-data-management
2. https://www.smartdatacollective.com/7-helpful-tips-managing-big-data/

Skill Development Activities Suggested

1. Analytical Skills and Data Visualization Skills.
2. Familiarity with Business Domain and Big Data Tools.
3. Skills of Programming with Problem Solving Skills.
4. SQL – Structured Query Language with Skills of Data Mining.
5. Familiarity with Technologies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand managing big data using Hadoop and SPARK technologies	L2
CO2	Install, configure, and run Hadoop and HDFS.	L3
CO3	Perform map-reduce analytics using Hadoop and related tools and Explain SPARK concepts	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X										
CO2			X		X							
CO3					X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1

2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10

11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

NATURAL LANGUAGE PROCESSING			
Course Code	**22SDS232**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To design and build computer systems that is able to analyze natural languages that generate their outputs in a natural language, too.
- The essential understanding that students will need to handle written text includes Finite automata, Regular Expressions, and Probabilistic Models using N-grams.

Module-1	
Overview And Language Modeling: Overview: Origins and challenges of NLP-Language and Grammar Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-2	
Word Level And Syntactic Analysis: Word Level Analysis: Regular Expressions-Finite-State AutomataMorphological Parsing-Spelling Error Detection and correction-Words and Word classes- Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing- Probabilistic Parsing.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-3	
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-4
Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-5

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

Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

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Suggested Learning Resources:

Books

1. Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press 2008
2. Natural Language Processing and Text Mining, Anne Kao and Stephen R. Potee, Springer 2007.
3. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky and James H Martin PHI 2nd Edition, 2008
4. Natural Language Understanding, James Allen, Benjamin / Cummings publishing company 2 nd Edition, 1995.

Web links and Video Lectures (e-Resources):

- https://hackr.io/blog/best-nlp-courses
- https://www.youtube.com/watch?v=igKTO7lQxNo
- https://www.youtube.com/watch?v=6I-Alfkr5K4

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Analyse the natural language text and Generate the natural language.	L3
CO2	Demonstrate Text mining.	L3
CO3	Apply information retrieval techniques.	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X	X									
CO2				X								
CO3					X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3

4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

SOFT AND EVOLUTIONARY COMPUTING			
Course Code	**22SDS233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To develop intelligent machines to provide solutions to real world problems, which are not modelled or too difficult to model mathematically.
- Apply various evolutionary computation methods and algorithms for particular classes of problems.
- Develop evolutionary algorithms for real-world applications.

Module-1	
Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations, Membership functions.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-2	
Defuzzification, Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Rule Base and Approximate Reasoning, Fuzzy Decision Making, Architecture and Operation of FLC System and applications.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-3	
Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General Genetic Algorithm, Operators in Genetic Algorithm, Stopping Condition for Genetic Algorithm Flow, Constraints in Genetic Algorithm, Problem Solving Using Genetic Algorithm, The schema theorem, Genetic programming, applications.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-4	
Swarm Intelligence System: Introduction, background of SI, Ant colony system Working of ant colony optimization, ant colony for TSP.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources

Module-5	
Unit commitment problem, particle Swarm Intelligence system Artificial bee colony system, Cuckoo search system.	
Teaching-Learning	Chalk and Talk/ PPT/ Web resources

Process	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Principles of Soft computing, Shivanandam, Deepa S. N, Wiley 2011
2. Soft Computing with MATLAB Programming, N. P. Padhy, S. P. Simon, Oxford 2015

Web links and Video Lectures (e-Resources):

1. https://youtu.be/K9gjuXjJeEM?list=PL5cGuSxneHHd7X4ZbHs8DPbRnoiYixpBA
2. https://www.youtube.com/watch?v=-WKZglCAQwE&t=176s
3. https://onlinecourses.nptel.ac.in/noc20_cs17/preview

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Implement machine learning through neural networks.	L3
CO2	Design Genetic Algorithm to solve the optimization problem.	L4
CO3	Develop a Fuzzy expert system.	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			X									
CO2			X	X								
CO3				X	X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7

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

PATTERN RECOGNITION			
Course Code	**22SDS234**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To develop the mathematical tools required for the pattern recognition

Module-1	
Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-2	
Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation of Classifiers and Clustering	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-3	
Nearest Neighbour based classifiers & Bayes classifier: Nearest Neighbour Algorithm, Variants of NN Algorithm, Use of NN for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection, Bayes theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with NNC, Naive Bayes classifier, Bayesian belief network.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources : https://www.youtube.com/watch?v=ygwgm7oxKhs

Module-4	
Hidden Markov models: Markov Models for Classification, Hidden Markov Models and Classification Using HMMS. Decision Trees: Introduction, Decision Trees for Pattern Recognition, Construction of Decision Trees, Splitting at the Nodes, Over fitting & Pruning, Example of Decision Tree Induction.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web Resources: https://www.ukessays.com/essays/engineering/hmm-pattern-recognition-9997.php#:~:text=A%20Hidden%20Markov%20Model%20HMM,of%20a%20set%20of%20observations.

Module-5
Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), Clustering Large Data Sets, examples, An application: Handwritten Digit recognition.

Teaching-Learning Process	Chalk and Talk/ PPT

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or oneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Pattern Recognition, V Susheela Devi, M Narsimha Murthy, Universities Press 2011
2. Pattern Recognition and Image Analysis, Earl Gose, Richard Johnsonbaugh, Steve Jost, PHI 1996
3. Pattern Classification, Duda R. O., P.E. Hart, and D. G. Stork, Wiley 2000.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ygwgm7oxKhs
- https://hagan.okstate.edu/25_PattRecogCaseStudy.pdf

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Develop algorithms for Pattern Recognition.	L4
CO2	Develop and analyse decision tress.	L4
CO3	Apply Decision tree and clustering techniques to various applications	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			X									
CO2			X		X							
CO3					X	X						

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7

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

HEALTH CARE DATA ANALYTICS			
Course Code	**22SDS235**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Data analytics promote the sharing of information and to ensure that the resultant insight and information is clearly defined and consistently interpreted throughout the HCO.
- The analyses investigate methods of improving the provision of clinical care, enhancing disease prevention, and measuring the effectiveness of various treatment options

Module-1	
An Introduction to Healthcare Data Analytics, Electronic Health Records-A survey: Components of HER, Coding Systems, Benefits of HER, Barrier to Adopting HER Challenges, Phenotyping Algorithms.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources : https://www.fsm.ac.in/bigdata/csha.pdf
Module-2	
Biomedical Image Analysis, Mining of Sensor Data in Healthcare, Biomedical Signal Analysis.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources : https://www.fsm.ac.in/bigdata/csha.pdf
Module-3	
Natural Language Processing and Data Mining for Clinical Text, Mining the Biomedical.	
Teaching-Learning Process	Chalk and Talk/ PPT/ Web resources : https://www.fsm.ac.in/bigdata/csha.pdf
Module-4	
Advanced Data Analytics for Healthcare: Review of Clinical Prediction Models, Temporal Data Mining for Healthcare Data, Visual Analytics for Healthcare, Privacy, Preserving Data Publishing Methods in Healthcare.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources : https://www.managedhealthcareexecutive.com/view/advanced-analytics-an-essential-tool-for-value-based-care-success
Module-5	
Applications and Practical Systems for Healthcare: Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer Assisted Medical Image Analysis Systems	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources : https://www.fsm.ac.in/bigdata/csha.pdf

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Healthcare data analytics, Chandan K. Reddy and Charu C Aggarwal, Taylor & Francis 1 st Edition, 2015
2. Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Hui Yang and Eva K. Lee, Wiley 2016

Web links and Video Lectures (e-Resources):

1. https://www.fsm.ac.in/bigdata/csha.pdf

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Analyze health care data using appropriate analytical techniques.	L3
CO2	Apply analytics for decision making in healthcare services.	L4
CO3	Apply data mining to integrate health data from multiple sources and develop efficient clinical decision support systems.	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X		X								
CO2					X							
CO3			X		X							

Program Outcome of this course

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

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

DATA SECURITY AND PRIVACY			
Course Code	**22SDS241**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Find the network's security problems and fix them.
- Apply rigorous methods, including theoretical ones, to the evaluation of security procedures.
- Describe the significance of data privacy, its constraints, and its applications.
- To secure the data and technologies that help the organization's operations and assets.

Module-1	
Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.youtube.com/watch?v=aQu7jBRd50E

Module-2	
Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public- key cryptosystems. Applications for public-key cryptosystems, requirements for public key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. Other Public-Key Cryptosystems: Diffiehellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, Elliptic curve cryptography, Analog of Diffie-hellman key exchange,	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.youtube.com/watch?v=wXB-V_Keiu8

Module-3	
Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, Public Key infrastructure.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.youtube.com/watch?v=YOAY7AIVs9U

Module-4

An Introduction to privacy preserving data mining: Privacy-Preserving Data Mining Algorithms, The Randomization Method, Group Based Anonymization.	
Teaching-Learning Process	Chalk and Talk/ PPT
Module-5	
Distributed Privacy-Preserving Data Mining, Privacy-Preservation of Application Results, and Limitations of Privacy: The Curse of Dimensionality, Applications of Privacy- Preserving Data Mining.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.cs.purdue.edu/homes/clifton/DistDM/kddexp.pdf

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Cryptography and Network Security, William Stallings, Pearson 7 th Edition 2017
2. Privacy Preserving Data Mining: Models and Algorithms, Charu C. Aggarwal, Philip S Yu, Kluwer Academic 2008

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=wXB-V_Keiu8
2. https://www.cs.purdue.edu/homes/clifton/DistDM/kddexp.pdf

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Identify the security issues in the network and resolve it.	L2
CO2	Describe importance of data privacy, limitations and applications	L3
CO3	Evaluate security mechanisms using rigorous approaches, including theoretical.	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X										
CO2		X				X						
CO3				X	X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4

5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

TIME SERIES ANALYSIS AND FORECASTING			
Course Code	**22SDS242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Identify the nature of the phenomenon represented by the sequence of observations, and forecasting (predicting future values of the time series variable).
- Evaluate the changes related to the selected data point to changes in other variables during the same time frame.

Module-1	
An Introduction to Forecasting: Forecasting and Data. Forecasting Methods. Errors in Forecasting. Choosing a Forecasting Technique. An Overview of Quantitative Forecasting Techniques. Regression Analysis: The Simple Linear Regression Model. The Least Squares Point Estimates. Point Estimates and Point Predictions. Model Assumptions and the Standard Error. Testing the Significance of the Slope and y Intercept. Confidence and Prediction Intervals. Simple Coefficients of Determination and Correlation. An F Test for the Model.	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-2	
Multiple Linear Regressions: The Linear Regression Model. The Least Squares Estimates, and Point Estimation and Prediction. The Mean Square Error and the Standard Error. Model Utility: R2, Adjusted R2, and the Overall F Test. Model Building and Residual Analysis: Model Building and the Effects of Multicollinearity. Residual Analysis in Simple Regression. Residual Analysis in Multiple Regressions. Diagnostics for Detecting Outlying and Influential Observations.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://www.scribbr.com/statistics/multiple-linear-regression/

Module-3	
Time Series Regression: Modeling Trend by Using Polynomial Functions. Detecting Autocorrelation. Types of Seasonal Variation. Modeling Seasonal Variation by Using Dummy Variables and Trigonometric Functions. Growth Curves. Handling First-Order Autocorrelation. Decomposition Methods: Multiplicative Decomposition. Additive Decomposition. The X-12-ARIMA Seasonal Adjustment Method. Exercises. Exponential Smoothing: Simple Exponential Smoothing. Tracking Signals. Holt's Trend Corrected Exponential Smoothing. Holt-Winters Methods. Damped Trends and Other Exponential.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Module-4	
Non-seasonal Box-Jenkins Modeling and Their Tentative Identification: Stationary and Non-stationary Time Series. The Sample Autocorrelation and Partial Autocorrelation Functions: The SAC and SPAC. An Introduction to Nonseasonal Modeling and Forecasting. Tentative Identification of Non-seasonal Box-Jenkins Models. Estimation, Diagnostic Checking, and Forecasting for Non-seasonal Box-Jenkins Models: Estimation. Diagnostic Checking. Forecasting. A Case Study. Box-Jenkins Implementation of Exponential Smoothing.	
Teaching-Learning	Chalk and Talk/ PPT / Web resources : https://link.springer.com/chapter/10.1007/978-0-85729-974-1_8

Process	

Module-5

Box-Jenkins Seasonal Modeling: Transforming a Seasonal Time Series into a Stationary Time Series. Examples of Seasonal Modeling and Forecasting. Box-Jenkins Error Term Models in Time Series Regression. Advanced BoxJenkins Modeling: The General Seasonal Model and Guidelines for Tentative Identification. Intervention Models. A Procedure for Building a Transfer Function Model Causality in time series: Granger causality. Hypothesis testing on rational expectations. Hypothesis testing on market efficiency.

Teaching-Learning Process	Chalk and Talk/ PPT / Web resources

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Forecasting, Time Series, and Regression, Bruce L. Bowerman, Richard O'Connell, Anne Koehler, Cengage Learning 2004
2. The Econometric Modelling of Financial Time Series, Terence C. Mills, Raphael N. Markellos, Cambridge University Press, 2008

Web links and Video Lectures (e-Resources):

1. https://www.tableau.com/learn/articles/time-series-forecasting#:~:text=Time%20series%20forecasting%20occurs%20when,drive%20future%20strategic%20decision%2Dmaking.
2. https://link.springer.com/chapter/10.1007/978-0-85729-974-1_8
3. https://www.youtube.com/watch?v=dQNpSa-bq4M

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Identify how to choose an appropriate forecasting method in a particular environment.	L2
CO2	Apply various forecasting methods, which include obtaining the relevant data and carrying out the necessary computation using suitable statistical software.	L3
CO3	Improve forecast with better statistical models based on statistical analysis	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X										
CO2					X							
CO3				X	X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3

4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

APPLIED SOCIAL NETWORK ANALYSIS			
Course Code	**22SDS243**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Create a network map of the connections between them and attempting to identify important persons, groups (or "components") inside the network, and/or connections between the individuals.
- The fundamentals of network structures, network data structures are analysed using theory models.

Module-1	
What is a Network?- Basic Network Concepts, Adjacency Matrices, Graphs, and Notation, Nodes and Links, Good Will Hunting Problem, Formal and Informal Networks, summary. Centrality measures- What is "Centrality" and Why do we Study It?, calculating Nodal Centrality Measures, Directed Networks and Centrality Measures, Location in the Network. Graph Level Measures- Density , Diameter , Centralization , Average Centralities, Network Topology	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-2	
Social Theory: Social Links- Individual Actors, Social Exchange Theory, Social Forces, Graph Structure, Agent Optimization Strategies in Networks, Hierarchy of Social Link Motivation, Summary. Subgroup Analysis: Subgroups, Organizational Theory, Random Groups, Heuristics for Subgroup Identification, Analysis Methods, Summary. Diffusion and Influence: Applications for Social Diffusion, Strain Theory, Social Context, Group Impacts on Diffusion, Network Structure and Diffusion, Group Influence Strategies and Bases of Power.	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-3	
Meta-Networks and Relational Algebra: Modes of Data, Source, Target, Direction, Multimode Networks, Bridging a Meta-Network, Strength of Ties. Sources of Data: Network Sampling, Measuring Links, Data Quality, Additional Ethnographic Data Collection Methods, Anonymity Issues.	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resource : example like https://www.researchgate.net/publication/221615377_A_Relational_Algebra_for_DataMetadata_Integration_in_a_Federated_Database_System

Module-4	
Information Networks and the World Wide Web: The Structure of the web, Link Analysis and Web Search, Sponsored Search Markets	
Teaching-Learning Process	Chalk and Talk/ PPT / Web resources: https://web.stanford.edu/class/cs344g/www-1992.pdf

Module-5	
Network Dynamics: Structural Models, The Small-World Phenomenon, Epidemics.	
Teaching-Learning Process	Chalk and Talk/ PPT

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
    a. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Social Network Analysis with Applications, Ian McCulloh, Helen Armstrong and Anthony Johnson, Wiley 2013.
2. Networks, Crowds, and Markets: Reasoning About a Highly Connected World, David Easley and John Kleinberg, Cambridge University Press 2010
3. Social and Economic Networks, Matthew O. Jackson, Princeton University Press 2008

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=vpLDz0Aq_p0
2. https://web.stanford.edu/class/cs344g/www-1992.pdf

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Demonstrate, summarize and compare networks.	L3
CO2	Explain basic principles behind network analysis algorithms.	L3
CO3	Analyzing real world network	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X		X								
CO2		X										
CO3		X	X									

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5

6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

IMAGE AND VIDEO ANALYTICS			
Course Code	**22SDS244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Processing video for motion estimation, object tracking, and human action recognition.
- Theoretical analyses of network performance of convolutional neural networks in terms of learning rates and system size.
- Linear models for classification and regression, Gradient descent optimization.

Module-1	
Digital image representation- Visual Perception- Sampling and Quantization- Basic Relations between Pixels Mathematical Tools Used in Digital Image Processing: Fundamental Operations –Vector and Matrix Operations Image Transforms (DFT, DCT, DWT, Hadamard).	
Teaching-Learning Process	Chalk and Talk/ PPT / Web reference link : https://www.youtube.com/watch?v=eK4ZAsKgCg4

Module-2	
Fundamentals of spatial filtering: spatial correlation and convolution-smoothing blurring- sharpening- edge detection - Basics of filtering in the frequency domain: smoothing-blurring- sharpening--Histograms and basic statistical models of image.	
Teaching-Learning Process	Chalk and Talk/ PPT / https://www.youtube.com/watch?v=eDyJsFHYFFI

Module-3	
Detection of Objects of Interest, Tracking of Objects of Interest in a Sequence of Images, Tracking Objects of Interest Through a Camera Network.	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-4	
Biometric Techniques Applied to Video Surveillance, Vehicle Recognition in Video Surveillance, Activity Recognition.	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-5
Unsupervised Methods for Activity Analysis and Detection of Abnormal Events, Analysis of Crowded Scenes in Video, Detection of Visual Context, Example of an Operational Evaluation Platform: PPSL

Teaching-Learning Process	Chalk and Talk/ PPT

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
2. Two assignments each of 20 Marks or one Skill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

1. Digital Image Processing, R.C. Gonzalez and R.E. Woods, Pearson 2009
2. Intelligent Video Surveillance Systems, Jean-Yves Dufour, Wiley 2013

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=FihWwdfwATs
2. https://www.youtube.com/watch?v=_Fmkqwrt_Gk

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Apply spatial filtering to images for the pre-processing purposes	L3
CO2	Make use of detection and classification methods for image and video data	L3
CO3	Apply and analyze the techniques through case studies	L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					X							
CO2		X		X								
CO3		X			X							

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7

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

CLOUD COMPUTING			
Course Code	**22SDS245**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Cloud computing delivers hosted services over the internet.
- Contribute easy, scalable access to computing resources and IT services.

Module-1	
Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-2	
Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.	
Teaching-Learning Process	Chalk and Talk/ PPT

Module-3	
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems	
Teaching-Learning Process	Chalk and Talk/ PPT / Web reference link: https://www.youtube.com/watch?v=Sb5SO3WRSws

Module-4
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

Teaching-Learning Process	Chalk and Talk/ PPT

Module-5

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

Teaching-Learning Process	Chalk and Talk/ PPT

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of 20 Marks
    a. Two assignments each of 20 MarksoroneSkill Development Activity of 40 marks to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be scaled down to 50 marks

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

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

Suggested Learning Resources:

Books

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

Web links and Video Lectures (e-Resources):

1. https://www.simplilearn.com/tutorials/cloud-computing-tutorial/cloud-computing-architecture
2. https://www.infoworld.com/article/3634774/how-to-secure-cloud-infrastructure-across-the-development-lifecycle.html

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Identify the architecture, infrastructure and delivery models of cloud computing	L2
CO2	Apply suitable virtualization concept and Choose the appropriate cloud player	L3
CO3	Address the core issues of cloud computing such as security, privacy and interoperability and Design Cloud Services	L2,L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		X				X						
CO2		X			X							
CO3			X									

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4

5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

Deep Learning Laboratory			
Course Code	22SDSL26	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	01:02:00	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:

- Handle large amounts of datasets using various deep learning methods in NLP, Neural Networks etc.
- Demonstrate several libraries and datasets publicly available will be used to illustrate the application of these algorithms.

Sl.NO	Experiments
1	Medical Image classification of any 2 diseases using any two repository using python as tool
2	Two experiments on text extraction from a large file using Mat Lab or Python.
3	Solving any two optimization problems using deep learning techniques like TSP,NapSac etc
4	Implementation of Perceptron Networks using Matlab
5	Implementation of Adeline network for system identification using Matlab
6	For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable „mpg" (Miles per gallon)
7	Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyperparameters. Train model with the following set of hyperparameters RBF-kernel, gamma=0.5, onevs-rest classifier, no-feature-normalization. Also try C=0.01,1,10C=0.01,1,10. For the above set of hyperparameters, find the best classification accuracy along with total number of support vectors on the test data
8	Train a regularized logistic regression classifier on the iris dataset (https://archive.ics.uci.edu/ml/machine- earning-databases/iris/ or the inbuilt iris dataset) using sklearn.Train the model with the following hyperparameter C = 1e4 and report the best classification accuracy.
	Demonstration Experiments (For CIE) if any
9	Consider the dataset spiral.txt (https://bit.ly/2Lm75Ly). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods: K – means Clustering Single – link Hierarchical Clustering Complete link hierarchical clustering. Also visualize the dataset and which algorithm will be able to recover the true clusters
10	Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining.
11	Project related to application of machine learning in sports analytics
12	Project related to application of machine learning in Time Series Analysis & Forecasting.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Optimize the data using Classifiers
- Apply clustering algorithms and logistic regressions on data sets
- Apply kernel techniques on datasets

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.
Continuous Internal Evaluation (CIE):
CIE marks for the practical course is 50 Marks.
The split-up of CIE marks for record/ journal and test are in the ratio 60:40.
Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
Weightage to be given for neatness and submission of record/write-up on time.
Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
The suitable rubrics can be designed to evaluate each student's performance and learning ability.
The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).
The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):
SEE marks for the practical course is 50 Marks.
SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Suggested Learning Resources:
- https://shorturl.at/bgzW1
- https://shorturl.at/lsvXZ

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Semester-III

Scheme of Teaching and Examinations and Syllabus

M. Tech in Data Science (SDS)

(Effective from the Academic year 2022-23)

Registrar, Visvesvaraya Technological University JnanaSangam, Machhe, Belagavi-590018eMail: registrar@vtu.ac.in

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
M. Tech in Data Science (SDS)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/Seminar	Skill Development Activities (Hours are	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	22SDS31	Business Intelligence and Analytics	03	00	02	03	50	50	100	4
2	PEC	22SDS32X	Professional Elective 3	03	00	00	03	50	50	100	3
3	OEC	22SDS33X	Open Elective Courses-1	03	00	00	03	50	50	100	3
4	PROJ	22SDS34	Project Work phase -1	00	06	00	--	100	--	100	3
5	S	22SDS35	Societal Project	00	06	00		100		100	3

6	INT	22SDSI36	Internship	(06 weeks Internship Completed during the intervening vacation ofII and III	03	50	50	100	6

				semesters.)						
TOTAL				**09**	**12**	**03**	**12**	**400**	**200**	**600**	**22**
Note: PCC: Professional core Courses, PEC: Professional Elective Courses. PROJ-Project Work, INT-Internship, OEC Open Elective Courses, SP- Societal Project										

Professional Elective 3		Open Elective 1	
Course Code under 22SDS32X	**Course title**	**Course Code under 22SDS33X**	**Course title**
22SDS321	High Performance Computing	22SDS331	IoT and Applications
22SDS322	Cyber Security and Cyber Law	22SDS332	Fundamentals of Artificial Intelligence
22SDS323	Cloud Computing for Data Analysis	22SDS333	Big Data Analytics
22SDS324	Blockchain Technology	22SDS334	Web Technologies
22SDS325	Spatial Data Analysis	22SDS335	Natural Language Processing

Note:

1. **Project Work Phase-1:**The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary projectrequires more participants, then a group consisting of not more than three shall be permitted.

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in caseof multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report,Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

2. **Societal Project:** Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology toworkout/proposing viable solutions for societal problems.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE (University examination) for this course.

3. **Internship:** Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to

complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE

(University examination) shall be as per the University norms.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.