TULSIRAMJI GAIKWAD-PATIL
College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institute

Department

of

Computer Science and Engineering (Data Science)

B.Tech. Computer Science and Engineering (Data Science)

Teaching Scheme

Considering

National Education Policy 2020

From

Academic Year 2026-27

Vision of Institute

To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management.

Mission of Institute

1. To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
2. To provide facilities and services to meet the challenges of Industry and Society.
3. To facilitate socially responsive research, innovation and entrepreneurship.
4. To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Vision of the Department

"To emerge as a Centre of Excellence in Data Science, nurturing expertise in Analytics and Machine Learning for national development"

Mission of the Department

- To build a strong foundation in Data Science by fostering professionalism, integrity, and accountability.
- To create advanced learning ecosystems and resources that prepare students for industry and societal challenges in the digital era.
- To encourage impactful research, innovation, and entrepreneurial ventures with emphasis on Data Analytics and Artificial Intelligence.
- To promote the overall growth of students and faculty by integrating knowledge, values, and lifelong learning into practice.

Program Education Objectives (PEO)

PEO 1: Demonstrate essential technical skills to identify, analyze and solve problems and design issues in Electronics and Communication Engineering.

PEO 2: Apply field knowledge, research and professional practices to meet the requirements of industries.

PEO 3: Imbibe lifelong learning practices and entrepreneurship skills in tune with emerging technologies.

PEO 4: Inculcate professional ethics and managerial skills to satisfy real life problems for serving the needs of society and environment.

Program Outcomes (PO)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/ components/ processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7). **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSO)

PSO 1:	**Data Analytics Proficiency:** Apply statistical methods, data mining, and machine learning techniques to analyze and interpret complex data for meaningful insights.
PSO 2:	**Solution Design & Development:** Design, develop, and implement data-driven solutions and predictive models to address real-world industry and societal challenges.
PSO 3:	**Research, Innovation & Ethics:** Conduct socially responsive research, innovate in data-driven applications, and demonstrate professional ethics with lifelong learning orientation.

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SCHEME OF INSTRUCTION & SYLLABI

Programme: B. Tech. in Computer Science and Engineering – Data Science

Scheme of Instructions: B. Tech. Computer Science and Engineering – Data Science (As Per New NEP 2020)

Year – II/Semester- IV

Sr. No	Sem	Type	BoS/ Dept	Sub Code	Subject	T/P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/IA	CA	ESE		
1	IV	PCC	DS	BDS42401	Fundamentals of Operating System	T	2	-	2	2	14	6	30	2 Hrs	50
2		PCC	DS	BDS42402	Formal Languages and Automata Theory	T	3	-	3	3	30	10	60	3 Hrs	100
3		PCC	DS	BDS42403	Introduction to Data Science	T	3	-	3	3	30	10	60	3 Hrs	100
4		PCC	DS	BDS42404	Fundamentals of Operating System Lab	P	-	2	2	1	-	25	25	-	50
5		PCC	DS	BDS42405	Introduction to Data Science Lab	P	-	2	2	1	-	25	25	-	50
6		PCC	DS	BDS42406	Artificial Intelligence	T	3	-	3	3	30	10	60	3 Hrs	100
		PCC	DS	BDS42407	Artificial Intelligence Lab	P	-	2	2	1	-	25	25	-	50
		MDM	S&H	BSH42402	Sampling Methods & Estimation Theory	T	2	-	2	2	14	6	30	2 Hrs	50
9		OE	DS	BDS42408	OE-II: Introduction to Data Science	T	2	-	2	2	14	6	30	2 Hrs	50
10		VSEC	DS	BDS42409	DBA (JDBC/SQL) Lab	P	-	4	4	2	-	50	50	-	100
11		AEC	S&H	BSH424	Liberal Learning Modules - 4	P	-	2	2	1	50	-	-	-	50
Total							**15**	**12**	**27**	**21**	**182**	**173**	**395**	**15 Hrs**	**750**

Course Category	BSC/ ESC (Basic Science Course/ Engineering Science Course.)	PCC/PEC (Programme Core courses)	VSEC (Skill Course)	Multidisciplinary Courses		Humanities Social Science & Management				Experiential Learning Courses				CC (Co-Curricular Courses)
				MDM (Multidisciplinary minor	OE(Open Elective)	AEC (Ability Enhancement Course)	IKS(Indian Knowledge System)	VEC(Value education Course	Management Course	Research Methodology	CEP	Project	Internship /OJT	
Credits	-	14	02	02	02	01	-	-	-	-	-	-	-	-
Cumulative Sum	16 / 13	27	06	04	06	04	02	02	-	-	02	-	-	04

PROGRESSIVE TOTAL CREDITS: 65+21=86

Chairperson	Dean Academics / Vice-Principal	Director Administration	Dr. Premanand Naktode Principal	October, 2026	1.00	Applicable for AY 2026-27 Onwards
				Date of Release	Version	

Head of Department
CSE - Data Science
Tulsiramji Gaikwad-Patil College of Engineering and Technology Nagpur

Vice Principal (Academics)
TGPCET, NAGPUR

Dr. Pragati Patil Bedekar
Director (Administration)
Tulsiramji Gaikwad - Patil College Of Engineering Technology, Nagpur.

Dr. Premanand Naktode
Principal
TGPCET, Nagpur

Tulsiramji Gaikwad-Patil College of Engineering and Technology

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Program: B.Tech Second Year (CSE- Data Science)

Semester		Course Code		Course Name	
IV		BDS42401		Fundamentals of Operating System	
Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	2 Hr / Week	CT-I	7	-	-
Practical(P)	-	CT-II		-	-
Total Credits	2	CA	5	-	-
Duration of ESE: 2 Hrs		ESE	30	-	-
		Total Marks	50	-	-

Pre-Requisites:

Course Outcomes:

CO1	**Analyze** the evolution of OS functionality, structures and layers.
CO2	**Evaluate** a model scheduling algorithm to compute various scheduling criteria.
CO3	**Estimate** page replacement algorithms, memory management problems and segmentation.

Course Content

Unit I	**Introduction:** Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, OS structure: Layered, Monolithic, Microkernel Operating Systems.
Unit II	**Process Management:** Process concept, Process control Block, Process states, Primitive and Non-Primitive Processes, Types of scheduler, context switch, threads, multithreading model **Scheduling:** Goals of scheduling and different scheduling algorithm (FIFO, SJF, Priority, and Round Robin).
Unit III	**Memory Management:** Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging, page faults and instruction restart, page replacement algorithms **File Systems:** File concept, Access methods, Disk space management and space allocation strategies, directory structures, Recovery, Log-structured File System, disk scheduling algorithms.

Text Books

1	Operating System Concepts (8th Edition) by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley Indian Edition (2010).
2	Modern Operating Systems (Third Edition) by Andrew S Tanenbaum, Prentice Hall India (2008)
3	Operating Systems by D.M. Dhamdhere, Tata McGraw Hill 2nd edition

Reference Books

1	Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall India, 2000
2	Operating System: Concepts and Design by Milan Milenkovik , McGraw Hill Higher Education

Useful Links

1	https://nptel.ac.in/courses/106/105/106105214/
2	https://nptel.ac.in/courses/106/102/106102132/

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Program: B.Tech Second Year (CSE- Data Science)

Semester	Course Code	Course Name
IV	BDS42402	Formal Languages and Automata Theory

Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	3 Hr / Week	CT-I	15	-	-
Practical(P)	-	CT-II		-	-
Total Credits	3	CA	10	-	-
Duration of ESE: 3 Hrs		ESE	60	-	-
		Total Marks	100	-	-

Pre-Requisites:

Course Outcomes:

CO1.	**Understand** formal language, translation logic, essentials of translation, alphabets, language representation and apply it to design Finite Automata and its variants
CO2	**Construct** regular expression to present regular language and understand pumping lemma for RE
CO3	**Design** Context Free Grammars and learn to simplify the grammar
CO4	**Construct** Pushdown Automaton model for the Context Free Language Design Turing Machine for the different requirements outlined by theoretical computer science
CO5	**Understand** different classes of problems, classify and analyze them and study concepts of NP completeness

Course Content

Unit I	**Finite Automata (FA):** An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language. FA without output: Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion. Minimization of DFAs. FA with output: Moore and Mealy machines -Definition, models, inter-conversion
Unit II	**Regular Expression:** Operators of RE, Precedence of operators, Algebraic laws for RE, Language to Regular Expressions, Equivalence of two REs. Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages.
Unit III	**CFG & CFL:** Basic Elements of Grammar Formal Definition of Context Free Grammar Sentential form, Derivation and Derivation Tree/ Parse Tree, Context Free Language (CFL) Ambiguous Grammar, writing grammar for language. Simplification of CFG: Eliminating ϵ productions, unit productions, useless production, and useless symbols. Normal Forms: Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy
Unit IV	**Pushdown Automata:** Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDA vs CFLs. Deterministic CFLs. **Turing Machines:** Formal definition of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction
Unit V	**Computability Theory:** Decidable Problems and Un-decidable Problems, Church-Turing Thesis. **Complexity Classes:** Time and Space Measures, The Class P, Examples of problems in P, The Class NP, Examples of problems in NP, P Problem Versus NP Problem, NP-completeness and hard Problems.

Text Books	
1	Michael Sipser, Introduction to the Theory of Computation, CENGAGE Learning, 3 rdEdition ISBBN13:978-81-315-2529-6.
2	Vivek Kulkarni, Theory of Computation, Oxford University Press, ISBN-13: 978-0-19-808458-7.
Reference Books	
1	Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall India, 2000
2	Operating System: Concepts and Design by Milan Milenkovik , McGraw Hill Higher Education
3	Hopcroft Ulman, Introduction to Automata Theory, Languages and Computations, Pearson Education Asia, 2nd Edition, ISBN: 9788131720479.
Useful Links	
1	https://archive.nptel.ac.in/courses/106/104/106104148/
2	http://www.digimat.in/nptel/courses/video/106104148/L01.html

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Program: B.Tech Second Year (CSE- Data Science)

Semester		Course Code		Course Name	
IV		BDS42403		Introduction to Data Science	
Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	3 Hr / Week	CT-I	15	-	-
Practical(P)	-	CT-II	15	-	-
Total Credits	3(Th)	CA	10	CA	25 Marks
Duration of ESE: 3Hrs		ESE	60	ESE	25 Marks
		Total Marks	100	Total Marks	50 Marks

Pre-Requisites:

Course Outcomes:

CO1	Apply toolboxes in data science
CO2	Understand statistics, measure, learn inference frequency approach
CO3	Analyze data using statistical and visualization methods.
CO4	Develop and evaluate regression models.
CO5	Optimize models using validation and parameter tuning techniques.

Course Content

Unit I	**Introduction to Data Science** Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues. Architecture of data, data acquisition.
Unit II	**Data Collection and Data Pre-Processing** Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.
Unit III	**Exploratory Data Analytics** Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, PivotTable, Heat Map, Correlation Statistics, ANOVA
Unit IV	**Model Development** Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making, Feature Engineering
Unit V	**Model Evaluation** Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search

Text Books

1	Data Science from Scratch-Joel Grus
2	Introduction to Data Structures With Applications, 2nd Edition by Jean-Paul Tremblay Paul Sorenson, McGraw Hill Education India Pvt Ltd.
3	Data Science for Business- Tom Fawcett

Reference Books

1	Designing data-Intensive Applications-Martin Kleppmann

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Program: B.Tech Second Year (CSE- Data Science)

Semester	Course Code	Course Name
IV	BDS42404	Fundamentals of Operating System Lab

Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	-	CT-I	-	-	-
Practical(P)	2 Hrs/Week	CT-II	-	-	-
Total Credits	2	CA	-	CA	25 Marks
Duration of ESE:		ESE	-	ESE	25 Marks
		Total Marks	-	Total Marks	50 Marks

Pre-Requisites: Basic Understanding of Organizational Behavior, Introduction to Management, Foundations of Psychology, Communication Skills and Problem-Solving and Critical Thinking

Course Outcomes:

CO1	**Analyze** the evolution of OS functionality, structures and layers.
CO2	**Evaluate** a model scheduling algorithm to compute various scheduling criteria.
CO3	**Estimate** page replacement algorithms, memory management problems and segmentation.

Sr.no	List of Experiments
1	Write a C program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time for the FCFS.
2	Write a C program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time for the SJF.
3	Write a C program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time for the Round Robin.
4	Write a C program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time for the Priority.
5	Write a C program to simulate multi-level queue scheduling algorithm considering the following scenario. All the processes in the system are divided into two categories – system processes and user processes. System processes are to be given higher priority than user processes. The priority of each process ranges from 1 to 3. Use fixed priority scheduling for all the processes.
6	Write a C program to simulate the Sequential file allocation strategies.
7	Write a C program to simulate the Linked file allocation strategies.
8	Write a C program to simulate the Indexed file allocation strategies.
9	Write a C program to simulate the MVT and MFT memory management techniques.
10	Write a C program to simulate the following contiguous memory allocation techniques a) Worst-fit b) Best-fit c) First-fit

Text Books

1	Operating System Concepts (8th Edition) by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley Indian Edition (2010).
2	Modern Operating Systems (Third Edition) by Andrew S Tanenbaum, Prentice Hall India (2008)
3	Operating Systems by D.M. Dhamdhere, Tata McGraw Hill 2nd edition

Reference Books

1	Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall India, 2000
2	Operating System: Concepts and Design by Milan Milenkovik , McGraw Hill Higher Education
Useful Links	
1	https://nptel.ac.in/courses/106/105/106105214/
2	https://nptel.ac.in/courses/106/102/106102132/

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Program: B.Tech Second Year (CSE- Data Science)

Semester		Course Code		Course Name	
IV		BDS42405		Introduction to Data Science Lab	
Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	-	CT-I	-	-	-
Practical(P)	2 Hrs/week	CT-II	-	-	-
Total Credits	1	CA	-	CA	25 Marks
Duration of ESE:		ESE	-	ESE	25 Marks
		Total Marks	-	Total Marks	50 Marks

Pre-Requisites:

Course Outcomes:

CO1	Understand basic concepts of data science and key issues
CO2	Understand data collection and pre-processing
CO3	Apply statistical analytics on datasets
CO4	Implement regression models on datasets.
CO5	Implement model evaluation and validation of datasets.

Sr.no	List of Experiments
1	Perform and implement various control structures in Python
2	Apply the data frames in python for data reading, preparation and pre-processing
3	Perform the analysis of various dataset and plot histogram on it.
4	Study and Implement various clustering models on data sets
5	Study and Implement Polynomial Regression with Python Implementation
6	To Implement Stock market prediction using python
7	Introduction of Num Pie.
8	Introduction of Panda
9	Case Study-1
10	Mini Project/ Case study

Text Books

1	CathyO 'Neiland Rachel Schutt," Doing Data Science", O'Reilly,2015
2	Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGIGlobal

Reference Books

1	Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and DataScience",PACKT,2016.
2	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

Useful Links

1	https://archive.nptel.ac.in/courses/110/106/110106072/
2	https://archive.nptel.ac.in/courses/106/106/106106179/

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Program: B.Tech Second Year (CSE- Data Science)

Semester	Course Code	Course Name
IV	**BDS42406**	**Artificial Intelligence**

Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	4HRS/week	**CT-I**	15	-	-
Practical(P)	-	**CT-II**	15	-	-
Total Credits	**4**	**CA**	10	-	-
Duration of ESE: 3Hrs		**ESE**	60	-	-
		Total Marks	100	-	-

Course Outcomes: After the completion of this course, students will be able to-

CO1	**Understand** fundamental concepts, applications, and techniques of Artificial Intelligence
CO2	**Apply** appropriate search techniques to solve AI-based problems
CO3	**Demonstrate** knowledge representation and reasoning techniques for intelligent systems
CO4	**Explain** machine learning techniques and their role in intelligent decision-making
CO5	**Apply** AI concepts and techniques to solve real-world problems

Course Content

Unit I	**Introduction to Artificial Intelligence**: Introduction to Artificial Intelligence, History and Evolution of AI, Goals and Characteristics of AI, Types of AI, Intelligent Agents and their Types, Agent Environments, Applications of AI, Advantages, Limitations and Ethical Issues.
Unit II	**Problem Solving and Search Techniques**: Problem Formulation, State Space Representation, Uninformed Search: BFS, DFS and Uniform Cost Search, Informed Search: Greedy Best First Search and A* Algorithm, Heuristic Functions, Hill Climbing and Constraint Satisfaction Problems.
Unit III	**Knowledge Representation and Reasoning**: Knowledge Representation Techniques, Propositional and Predicate Logic, Semantic Networks, Frames, Production Rules, Forward and Backward Chaining, Rule-Based Systems, Expert Systems and Bayesian Reasoning
Unit IV	**AI Applications and Emerging Technologies**: Introduction to Natural Language Processing (NLP), Chatbots, Sentiment Analysis, Computer Vision, Image Recognition, Artificial Neural Networks, Deep Learning, Generative AI, Large Language Models (LLMs), AI Applications and Responsible AI.
Unit V	**Machine Learning Fundamentals**: Introduction to Machine Learning, Supervised, Unsupervised and Reinforcement Learning, Classification and Regression, Decision Trees, K-Nearest Neighbors (KNN), K-Means Clustering, Model Training, Testing and Evaluation Techniques.

Text Books

1	Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th Edition, Pearson.
2	Elaine Rich, Kevin Knight and Shivashankar B. Nair, *Artificial Intelligence*, 3rd Edition, McGraw Hill.

Reference Books	
1	Nils J. Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann.
2	Tom M. Mitchell, *Machine Learning*, McGraw Hill.
3	Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, MIT Press.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc24_ge47/preview
2	https://nptel.ac.in/courses/106105077
3	https://onlinecourses.nptel.ac.in/noc25_mg07/preview

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Program: B.Tech Second Year (CSE- Data Science)

Semester		Course Code		Course Name	
IV		BDS42407		Artificial Intelligence Lab	
Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	-	CT-I	-	-	-
Practical(P)	2 Hrs/week	CT-II	-	-	-
Total Credits	1	CA	-	CA	25 Marks
Duration of ESE:		ESE	-	ESE	25 Marks
		Total Marks	-	Total Marks	50 Marks

Pre-Requisites:

Course Outcomes:

CO1	**Demonstrate** the working of intelligent agents using Python programming
CO2	**Implement** uninformed and informed search algorithms for solving computational problems.
CO3	**Apply** knowledge representation and logical reasoning techniques to develop rule-based systems.
CO4	**Implement** basic machine learning algorithms for prediction, classification and clustering.
CO5	**Develop** simple AI applications using Natural Language Processing techniques.

Sr.no	List of Experiments
1	Write a Python program to demonstrate the working of a Simple Reflex Agent using predefined conditions and actions.
2	Implement Breadth First Search (BFS) and Depth First Search (DFS) algorithms in Python to solve a graph traversal problem.
3	Implement the A* Search Algorithm using Python to find the optimal path between two nodes in a graph.
4	Write a Python program to demonstrate knowledge representation using propositional logic and logical operators.
5	Implement Forward Chaining and Backward Chaining techniques using Python for a rule-based expert system.
6	Implement a Linear Regression model using Python to predict numerical values from a given dataset.
7	Develop a classification model using the K-Nearest Neighbors (KNN) algorithm and evaluate its performance.
8	Implement the K-Means Clustering algorithm using Python to group similar data points into clusters.
9	Develop a simple sentiment analysis application using Python and Natural Language Processing (NLP) techniques.
10	Design and develop a simple AI-based chatbot using Python to respond to predefined user queries.

Text Books

1	Artificial Intelligence By Rich Elaine; Knight Kevin; Nair Shivashankar B. Mc Graw Hill
2	Artificial Intelligence: Structures and Strategies for Complex Problem Solving — George F. Luger.

Reference Books

1	Introduction to Artificial Intelligence — Eugene Charniak and Drew McDermott.
2	Artificial Intelligence: Foundations of Computational Agents — David L. Poole and Alan K. Mackworth.

Useful Links

1	https://onlinecourses.nptel.ac.in/noc24_ge47/preview
2	https://nptel.ac.in/courses/106105077
3	https://onlinecourses.nptel.ac.in/noc25_mg07/preview

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Program: B.Tech Fourth Year (CSE- Data Science)

Semester	Course Code	Course Name
IV	BSH42402	Sampling Method & Estimation Theory

Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	2 Hrs/week	CT-I	7 Marks	-	-
Practical(P)	-	CT-II	7 Marks	-	-
Total Credits	2(Th)	CA	6 Marks	-	-
Duration of ESE:2Hrs		ESE	30 Marks	-	-
		Total Marks	50 Marks	-	-

Pre-Requisites: Mean, mode, median, standard deviation etc.

Course Outcomes:

CO1	**Analyze** and interpret results from point and interval estimates.
CO2	**Implement** the most appropriate Sampling Techniques for a given applied problems.
CO3	**Apply** hypothesis testing to real-world scenarios.

Course Content

Unit I	**Estimation Theory:** Unbiased and efficient estimates, Point estimates and interval estimates, Confidence interval for means, Confidence interval for proportions, Confidence interval for differences and sums of mean and proportions.
Unit II	**Sampling Theory:** Population and sample, Sampling with and without replacement, Population parameters, sample statistics, Sampling distribution of means, and Sampling distribution of proportions
Unit III	**Hypothesis testing:** Introduction, significant level and p-value, Null Hypothesis, Alternative Hypothesis, Type-I and Type-II errors, confidence interval, hypothesis test, t-Test, Z-test, chi square test.

Text Books

1	M.R. Spiegal, Theory and problems of Probability and Statistics: 2 nd edition Schaum Series
2	Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication
3	Probability and Statistics (Schaum's Outline Series), Murray Speigal, John Schiller, R. A. Srinivasam.
4	Fundamentals of Mathematical Statistics (Modern Approach) S.C. Gupta and V. K. Kapoor 10th Edition
5	Advanced Engineering Mathematics by Erwin Kreyszig, 8th Edition, Wiley India

Reference Books

1	Advanced Engineering Mathematics by H K Das
2	Introductory methods of Numerical Analysis, by S.S. Sastry, PHI

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Program: B.Tech Second Year (CSE- Data Science)

Semester		Course Code		Course Name	
IV		BDS42408		OE – II (Introduction to Data Science)	
Teaching Scheme		Examination Scheme(Th)		Examination Scheme(P)	
Theory(Th)	2 Hr / Week	CT-I	7	-	-
Practical(P)	-	CT-II	7	-	-
Total Credits	2(Th)	CA	6	-	-
Duration of ESE: 2 Hrs		ESE	30	-	-
		Total Marks	50	-	-

Pre-Requisites:

Course Outcomes:

CO1	Apply toolboxes in data science
CO2	Understand statistics, measure, learn inference frequency approach
CO3	Utilize learning models.

Course Content

Unit I	Introduction to Data Science Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues. Architecture of data, data acquisition.
Unit II	Data Collection and Data Pre-Processing Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.
Unit III	Exploratory Data Analytics Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, PivotTable, Heat Map, Correlation Statistics, ANOVA

Text Books

1	Data Science from Scratch-Joel Grus
2	Introduction to Data Structures With Applications, 2nd Edition by Jean-Paul Tremblay Paul Sorenson, McGraw Hill Education India Pvt Ltd.
3	Data Science for Business- Tom Fawcett

Reference Books

1	Designing data-Intensive Applications-Martin Kleppmann
2	Data Science and Big Data Analytics- EMC Education Services
3	The Data Science Handbook- Field Cady

Useful Links

1	https://archive.nptel.ac.in/courses/110/106/110106072/
2	https://www.youtube.com/playlist?list=PLw5h0DiJ-9PCn4shW4X43FSjEqdBwc1Cn
3	https://www.youtube.com/watch?v=W01tIRP_Rqs

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Program: B.Tech Second Year (CSE- Data Science)					
Semester		**Course Code**		**Course Name**	
IV		BDS42409		DBA (JDBC) - Lab	
Teaching Scheme		**Examination Scheme(Th)**		**Examination Scheme(P)**	
Theory(Th)	-	**CT-I**	-	-	-
Practical(P)	4 Hrs/Week	**CT-II**	-	-	-
Total Credits	**2**	**CA**	-	**CA**	50 Marks
Duration of ESE: -		**ESE**	-	**ESE**	50 Marks
		Total Marks	-	**Total Marks**	100 Marks

Pre-Requisites: NA

Course Outcomes:

CO1	Identify and set up a JDBC connection to a database using JDBC drivers.
CO2	To configure a JDBC environment and execute basic SQL queries like SELECT, INSERT, UPDATE, and DELETE.
CO3	Understand the execution of multiple SQL commands in JDBC for database connections.
CO4	Understand the manipulation of rows and columns in JDBC and rollback to a savepoints.
CO5	Understand the fundamentals of databases, architecture and components of JDBC including its Driver Manager and Connection.

Sr.no	**List of Experiments**
1	Introduction to database connectivity using Java programming and Understand the procedure for establish database connection.
2	Write a program to perform database operations in Java as SQL Create, Insert, Update, Alter, Delete and Select.
3	Write a program to search the contents of a table in JDBC to sort the elements of a column using Java commands.
4	Write a program to join the contents of more than one table and display in JDBC.
5	Write a program to commit a query in the database and understanding commands to Use Prepared Statements in JDBC.
6	Understanding the execution of multiple SQL commands in JDBC with example.
7	Write a program to get the number of rows of the particular column name in JDBC.

8	Write a program to use methods of column to get column name in JDBC and also understand commands to set and rollback to a savepoints.
9	Write a case study to understand the JDBC Architecture as more useful.
10	Make a group of four each to understand the concept of JDBC Driver for Manipulation and Execution as a module.

Text Books	
1	Java Database Programming with JDBC" by R. Scott Dellinger
2	JDBC: Practical Guide for Java Programmers" by S. K. Srivastava and Vivek K. Singh

Reference Books	
1	"Pro JDBC: Practical Database Programming with Java" by Greg M. Perry
2	"Java Database Best Practices" by Mahmaud Parsian

Useful Links	
1	https://www.geeksforgeeks.org/java-jdbc-programs/
2	https://www.gacwrmd.in/learning/Computer/7MCE1C3-Advanced%20Java%20Programming.pdf
3	https://nptel.ac.in/courses/106105191

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Program: B.Tech Second Year (CSE- Data Science)

Semester		**Course Code**		**Course Name**	
IV		BDS42410		DBA (SQL) - Lab	
Teaching Scheme		**Examination Scheme(Th)**		**Examination Scheme(P)**	
Theory(Th)	-	**CT-I**	-	-	-
Practical(P)	4 Hrs/Week	**CT-II**	-	-	-
Total Credits	**2**	**CA**	-	**CA**	50 Marks
Duration of ESE: -		**ESE**	-	**ESE**	50 Marks
		Total Marks	-	**Total Marks**	100 Marks

Pre-Requisites: NA

Course Outcomes:

CO1	Understand and implement primary key and foreign key relationships, SQL CASE expressions, and set operations such as UNION and UNION ALL.
CO2	Implement Common Table Expressions (CTEs), window functions, and recursive queries to perform advanced data retrieval and analytical operations.
CO3	Create and execute stored procedures and user-defined functions to perform reusable and modular database operations.
CO4	Handle NULL values using SQL operators and functions to ensure accurate data processing and query results.
CO5	Apply database normalization techniques, including 1NF, 2NF, and 3NF, to minimize data redundancy and improve database design.

Sr.no	**List of Experiments**
1	Study and Implementation of Primary Key and Foreign Key Relationships
2	Study and Implementation of SQL CASE Expression
3	Study and Implementation of SQL UNION and UNION ALL
4	Study and Implementation of Common Table Expressions (CTEs)
5	Study and Implementation of SQL Window Functions
6	Study and Implementation of Stored Procedures
7	Study and Implementation of User-Defined Functions

8	Study and Implementation of Recursive Queries
9	Study and Implementation of NULL Value Handling
10	Study and Implementation of Database Normalization
Text Books	
1	Elmasri, R. and Navathe, S. B., Fundamentals of Database Systems, Pearson Education.
2	Silberschatz, A., Korth, H. F. and Sudarshan, S., Database System Concepts, McGraw-Hill.
Reference Books	
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Useful Links	
1	https://www.geeksforgeeks.org/java-jdbc-programs/
2	https://onlinecourses.nptel.ac.in/e-learning/preview/noc2
3	https://nptel.ac.in/courses/106105191

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