KNOWLEDGE INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, Affiliated to Anna University, Chennai.
Accredited by NBA (CSE, ECE, EEE & MECH), Accredited by NAAC with "A" Grade
KIOT Campus, Kakapalayam (PO), Salem – 637 504, Tamil Nadu, India.

Beyond Knowledge

B.E. / B.Tech. Regulations 2023

B.TECH. – Artificial Intelligence and Data Science

Curriculum and Syllabi

(For the Students Admitted from the Academic Year 2023-24 Onwards)

Version: 1.0	**Date:** 06.07.2024

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	Approved by AICTE, Affiliated to Anna University, Accredited by NAAC and NBA (B.E.:Mech., ECE, EEE & CSE)
	Website: www.kiot.ac.in

B.E. / B.Tech. REGULATIONS 2023 (R 2023)

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

B.TECH. – ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

VISION OF THE INSTITUTE
• To be a world class institution to impart value and need based professional education to the aspiring youth and carving them into disciplined world class professional who have the quest for excellence, achievement orientation and social responsibilities.

MISSION OF THE INSTITUTE	
A	To promote academic growth by offering state-of-art undergraduate, postgraduate and doctoral programs and to generate new knowledge by engaging in cutting – edge research
B	To nurture talent, innovation, entrepreneurship, all-round personality and value system among thestudents and to foster competitiveness among students
C	To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry
D	To pursue global standards of excellence in all our endeavors namely teaching, research, consultancy, continuing education and support functions

VISION OF THE DEPARTMENT
To create globally competent software professionals with social values to cater the ever-changing industry requirements.

MISSION OF THE DEPARTMENT	
M1	To inculcate innovation and creativity through experiential learning with the modern infrastructure and technologies.
M2	To collaborate with the industry for enhancing the students' research ability on cutting edge technologies of AI and Data Science.
M3	To develop competent industry-ready professionals with right attitude, values and ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1	Perform data processing, analysis and visualization in real time applications for better prediction and data-driven decision making.
PEO 2	Enable multitasking for existing resources and execute complex tasks using Artificial Intelligence.
PEO 3	Carry out fundamental research to cater the critical needs of the society through cutting edge technologies of AI.

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PROGRAM OUTCOMES (POs)	
Engineering Graduates will be able to:	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)	
After the successful completion of B.Tech. Programme in Artificial Intelligence and Data Science, the graduates will able to	
PSO 1	Apply the concepts of Machine Learning and Data Science to solve the real time business problems.
PSO 2	Exhibit their professional skills in team building, leadership, communication, values and ethics.
PSO 3	Build a suitable model to assist business analytics and helps solving business problems.

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B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE										Version: 1.1		
Courses of Study and Scheme of Assessment (Regulations 2023)										Date: 06.07.2024		
Sl. No.	Course Code	Course Title	Periods / Week							Maximum Marks		
			CAT	CP	L	T	P	C		IA	ESE	Total
SEMESTER I												
-	-	Induction Programme	-	-	-	-	-	-		-	-	-
	THEORY											
1.	BE23EN101	Communicative English - I	HS	2	1	1	0	2		40	60	100
2.	BE23MA201	Calculus for Engineers	BS	3	2	1	0	3		40	60	100
3.	BE23PH201	Basic and Applied Physics	BS	3	3	0	0	3		40	60	100
4.	BE23CY201	Engineering Chemistry	BS	3	3	0	0	3		40	60	100
5.	BE23GE301	Overview of Engineering and Technology	ES	3	3	0	0	3		40	60	100
6.	BE23MC901	Heritage of Tamils	MC	1	1	0	0	1		40	60	100
	THEORY CUM PRACTICAL											
7.	BE23GE307	Problem Solving using C Programming	ES	5	3	0	2	4		50	50	100
	PRACTICAL											
8.	BE23BS201	Physics and Chemistry Laboratory	BS	4	0	0	4	2		60	40	100
9.	BE23GE305	Engineering Practices Laboratory	ES	4	0	0	4	2		60	40	100
	EMPLOYABILITY ENHANCEMENT											
10.	BE23PT801	Human Excellence and Value Education – I	EEC	2	1	0	1	NC		100	-	100
Total				30	17	2	11	23		510	490	1000
SEMESTER II												
	THEORY											
1.	BE23EN102	Communicative English - II	HS	2	1	1	0	2		40	60	100
2.	BE23MA202	Vector Calculus and Numerical Methods	BS	3	2	1	0	3		40	60	100
3.	BE23GE304	Engineering Graphics and Network Drawings	ES	5	1	0	4	3		40	60	100
4.	BE23CS401	Digital Principles and Computer Organization	PC	3	3	0	0	3		40	60	100
5.	BE23CB403	Design Thinking	PC	3	3	0	0	3		40	60	100
6.	BE23MC902	Tamils and Technology	MC	1	1	0	0	1		40	60	100
7.	BE23MC903	Universal Human Values and Ethics	MC	3	2	1	0	3		40	60	100
	THEORY CUM PRACTICAL											
8.	BE23GE310	Object Oriented Programming Using C++	ES	5	3	0	2	4		50	50	100
	EMPLOYABILITY ENHANCEMENT											
9.	BE23PT802	Human Excellence and Value Education – II	EEC	2	1	0	1	NC		100	-	100
10.	BE23PT804	Engineering Clinic – I	EEC	2	0	0	2	1		100	-	100
11.	BE23PT806	Aptitude Skills – I	EEC	1	0	0	1	0.5		100	-	100
Total				30	17	3	10	23.5		630	470	1100

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B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE												
Courses of Study and Scheme of Assessment (Regulations 2023)												
Sl. No.	Course Code	Course Title	Periods / Week						Maximum Marks		
			CAT	CP	L	T	P	C	IA	ESE	Total
	SEMESTER III											
	THEORY											
1.	BE23MA203	Discrete Mathematics	BS	3	2	1	0	3	40	60	100
2.	BE23AD401	Introduction to Artificial Intelligence	PC	3	2	1	0	3	40	60	100
	THEORY CUM PRACTICAL										
3.	BE23CS403	Python FOR Data Science	PC	5	2	1	2	4	50	50	100
4.	BE23CS404	Data Structures and Algorithms	PC	5	2	1	2	4	50	50	100
5.	BE23CS405	Database Management Systems	PC	5	2	1	2	4	50	50	100
6.	BE23CS406	Operating Systems	PC	5	2	1	2	4	50	50	100
	PRACTICAL										
7.	BE23EN103	Professional Communication Laboratory – I	HS	2	0	0	2	1	60	40	100
8.	BE23AD402	Artificial Intelligence Laboratory	PC	4	0	0	4	2	60	40	100
	EMPLOYABILITY ENHANCEMENT										
9.	BE23PT805	Engineering Clinic – II	EEC	2	0	0	2	1	100	-	100
10.	BE23PT807	Aptitude Skills – II	EEC	1	0	0	1	0.5	100	-	100
Total				35	12	6	17	26.5	600	400	1000

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BE23MA203	DISCRETE MATHEMATICS	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	Common to B.E. (CSE) and B.Tech. (IT, CSBS and AI&DS)	Version: 1.0				

Course Objectives:

1.	To extend student's logical and mathematical ability to deal with abstraction.
2.	To understand the concepts of lattices and Boolean algebra.
3.	To introduce the basic terminologies used in computer science courses and application of ideas to solve practical problems.
4.	To familiarize the applications of algebraic structures.
5.	To interpret the basic concepts of graph theory.

INTRODUCTION (Not for Examination)	2

Importance:

Discrete mathematics forms the backbone of theoretical computer science and provides the essential mathematical tools and concepts for solving a wide range of problems in computer engineering. It helps computer engineers to develop a deeper understanding of algorithms, Data structures, Logic design, Cryptography and Networking.

Real Life Examples:

Railway planning – Cell phone communications – Delivery Route Problems – Electricity Board.

Linkages:

Pre-requisite: Basic arithmetic operations.

Future Courses: Theory of Computation – Data structures – Computer Architecture.

UNIT–I	LOGIC AND PROOFS	6+3

Propositional Logic (L2) – Propositional Equivalences (L3) – Normal Forms (using truth table) (L3) – Rules of Inference (Inference Theory) (L3).

UNIT–II	SETS AND RELATIONS	6+3

Set, Relation (Basic definitions) (L2) – Partial Ordering (L2)- Poset (L2) - Hasse diagram (L3) - Lattices (L2) – Properties of Lattices (L3) – Boolean Algebra (L3).

UNIT– III	COMBINATORICS	6+3

Mathematical Induction (L2) – Strong Induction and Well Ordering (L3) – Pigeonhole Principle (L3) – Permutations and Combinations (L3) – Inclusion and Exclusion Principle (L3).

UNIT – IV	ALGEBRAIC SYSTEM	6+3

Algebraic systems (L2) – Groups (L3) – Subgroups (L3) – Homomorphism (L2) – Lagrange's theorem (L3) - Vector space (L2) – Linear dependence and independence of vectors (L3) – Bases and Dimensions (L3).

UNIT–V	GRAPH THEORY	6+3

Introduction to Graph theory (L2) – Graph terminology and special types of graphs (L3) – Matrix Representation of Graphs and Graph isomorphism (L3) – Connectivity (L3) – Euler and Hamilton paths (L3) - Trees (Basic definitions) (L2).

Total: 47 Periods

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	OPEN ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.		
Course Outcomes: **Upon completion of this course, the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply the basic concepts to test the logic of a practical situation.	**L3 – Apply**
CO2	Apply the basic concepts of sets and relations.	**L3 – Apply**
CO3	Apply Combinatorial Principles and Techniques to solve Counting Problems.	**L3 – Apply**
CO4	Solve the problems using various Algebraic Structures.	**L3 – Apply**
CO5	Solve issues by Utilizing Techniques from Graph Theory	**L3 – Apply**

TEXTBOOKS:

1.	Veerarajan.T, "Linear Algebra and Partial Differential Equations", Second Edition, McGraw Hill Education, 2019.
2.	Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", First Edition (35th Reprint), Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2008.

REFERENCE BOOKS

1.	Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2013.
2.	Kenneth H Rosen, "Discrete Mathematics and its Applications with Combinatorics and Graph Theory", 7th Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2011.
3.	Veerarajan.T, "Discrete Mathematics with Graph Theory and Combinatorics", 3rd Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2013.

WEB REFERENCES

S.No.	Publisher	Website link	Type of Content
1.	Springer	ttps://journalofbigdata.springeropen.com/articles/10.1186/s40537-016-0042-7	Article
2.	Wilmington University	https://www.researchgate.net/publication/344863390_Discrete_Mathematics_The_Backbone_of_Computer_Science	Article

VIDEO REFERENCES

S.No.	Video Details	Name of the Expert	Type of Content	Video link
1.	NPTEL	Dr.Kamala Krithivasan / IIT Chennai	Lecture	https://youtu.be/xlUFkMKSB3Y?si=JX94vlnBuvRuHqPk
2.	NPTEL	Dr Sugata Gangopadhyay / IIT Roorkee	Lecture	https://youtu.be/fSHwjxsGsH4?si=2MPnHH3QLpcbgCLO
3.	NPTEL	Prof.Arabind Kumar Lal / IIT Kanpur	Lecture	https://youtu.be/9MCjyQSRmR8?si=MmJdDhW66eBI3foS

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Mapping of COs with POs and PSOs															
Cos	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1												
CO2	3	2													
CO3	3	2													
CO4	3	2													
CO5	3	2	1												
AVG	3.0	2.0	1.0												
1-Low, 2 -Medium, 3-High.															

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BE23AD401	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	B.TECH. - ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	Version: 1.0				

Course Objectives:

1.	To understand the fundamental concepts of Artificial Intelligence.
2.	To learn the algorithms, techniques and systems for solving complex problems.
3.	To apply algorithms for making optimal decisions in games and solving constraint satisfaction problems.
4.	To learn the methods of knowledge representation and knowledge inference.
5.	To apply probabilistic reasoning techniques in Bayesian Networks.

INTRODUCTION (Not for Examination) — **2**

Importance:
Simulation of human intelligence in machines that are programmed to think and learn like humans - Automate tasks - analyze data and make decisions etc.,
Real Life Example(s):
Healthcare – Finance - Autonomous vehicles - Natural Language Processing (NLP) - Robotics.
Linkages:
Pre-requisite: Calculus for Engineers, Python Basics, Data Structures and Algorithms.
Future courses: Machine Learning, Data Science.

UNIT–I **INTELLIGENT AGENTS** — **6+3**

Introduction to AI (L1) - Agents and Environments (L2) – Concept of Rationality (L2) – Nature of Environments (L2) – Structure of Agents (L2). Problem Solving Agents (L3) – Search Algorithms (L3) - Uninformed Search Strategies (L3).

UNIT–II **PROBLEM SOLVING** — **6+3**

Heuristic Search Strategies (L3) – Heuristic Functions (L1). Local Search and Optimization Problems (L3) – Local Search in Continuous Space (L3) – Search with Non-Deterministic Actions (L2) – Search in Partially Observable Environments (L3) – Online Search Agents and Unknown Environments (L1).

UNIT– III **GAME PLAYING AND CSP** — **6+3**

Game Theory (L1) – Optimal Decisions In Games (L2) – Alpha-Beta Search (L3) – Monte-Carlo Tree Search (L3) – Stochastic Games (L2) – SSAA (L3). Constraint Satisfaction Problems (CSP) (L2) – Constraint Propagation (L3) – Backtracking Search for CSP (L3) – Local Search for CSP (L3) – Structure of CSP (L2).

UNIT – IV **LOGICAL REASONING** — **6+3**

Knowledge-Based Agents (L2) – Propositional Logic (L2) – Propositional Theorem Proving (L3) – Propositional Model Checking (L3) – Agents Based on Propositional Logic (L3)- Horn Clauses and Definite Clauses (L2)-First-Order Logic (L2) – Syntax and Semantics (L2)– Knowledge Representation and Engineering (L3)– Inferences in First-Order Logic (L3) – Forward Chaining (L3)– Backward Chaining (L3)– Resolution(L3)- Events (L2) - Mental Events and Mental Objects (L2).

UNIT–V **PROBABILISTIC REASONING** — **6+3**

Acting under Uncertainty (L2) – Bayesian Inference (L3) – Naïve Bayes Models (L3). Probabilistic Reasoning (L2) – Bayesian Networks(BN) (L2) – Exact Inference in BN (L3) – Approximate Inference in BN (L3) – Causal Networks (L2) - Relational and First - Order Probability (L2).

TOTAL: 47 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course Specific Open Ended Problems will be solved during teaching. Such problems can be given as Assignments and evaluated as IA only and not for the End Semester Examinations.

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Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Understand the fundamental concepts of Artificial Intelligence.	**L2 – Understand**
CO2	Identify appropriate methods to solve searching problems.	**L2 – Understand**
CO3	Apply the techniques to represent optimal decisions in games and Constraint Satisfaction problems.	**L3 – Apply**
CO4	Apply logical reasoning and inference methods in knowledge based system.	**L3– Apply**
CO5	Understand the concept of probabilistic reasoning techniques and Bayesian networks.	**L2 – Understand**

TEXTBOOKS:

1.	Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2.	David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Second Edition, Cambridge University Press, 2017.

REFERENCE BOOKS:

1.	Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008.
2.	Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007.
3.	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4.	Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Coursera	https://www.coursera.org/learn/ai-for-everyone	Blog
2.	Geeksforgeeks	https://www.geeksforgeeks.org/constraint-satisfaction-problems-csp-in-artificial-intelligence/?ref=gcse	Blog

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	YouTube	Patric H. Winston , Massachusetts Institute Of Technology	Lecture	https://www.youtube.com/watch?v=TjZBTDzGeGg&list=PLUI4u3cNGP63gFHB6xb-kVBiQHYe_4hSi
2.	YouTube	Dorsa sadigh, Standford online	Lecture	https://www.youtube.com/watch?v=ZiwogMtbjr4

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1							2			3	3	1
CO2	3	3	2		2					2			3	3	1
CO3	3	3	2		2					2			3	3	1
CO4	3	3	2		2					2			3	3	1
CO5	3	3	2		2					2			3	3	1
AVG	**3**	**3**	**2**		**2**					**2**			**3**	**3**	**1**

1–Low, 2 –Medium, 3–High.

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BE23CS403	PYTHON FOR DATA SCIENCE	CP	L	T	P	C
		5	2	1	2	4
Programme & Branch	Common to B.E. (CSE) and B.Tech. (IT, CSBS and AI&DS)	Version: 1.0				

Course Objectives:

1.	To gain knowledge of fundamental programming concepts in python language.
2.	To learn the process of structuring the data using string, list, tuple, and dictionary.
3.	To understand the data science fundamentals and process.
4.	To utilize python libraries for data wrangling.
5.	To use visualization libraries in python to present and interpret data.

	INTRODUCTION (Not for Examination)	2

Importance of Data Science

Data science drives decision-making and innovation across industries by analyzing complex data to uncover actionable insights, predict future trends, and optimize operations.

NumPy and Pandas are two powerful Python libraries that facilitate data manipulation and analysis.

Matplotlib and Seaborn are popular Python libraries for creating static, animated and interactive visualizations.

Python's Importance in Data Science

Python is the leading programming language in data science due to its simplicity, powerful libraries, and widespread industry adoption.

Learning about **decision control statements and functions** provides the necessary groundwork for writing efficient and structured code.

Understanding **Python data structures (strings, lists, tuples, dictionaries)** is essential for efficiently managing and manipulating different types of data. Each structure has unique properties that make it suitable for specific tasks.

Real Life Examples:

Python: Student Grade Calculator - User Authentication System - Contact Book - Grocery Shopping List.

Data Science: Predicting House Prices - Healthcare Analytics - Analyzing Customer Reviews - Credit Risk Assessment.

Linkages:

Pre-requisite: Problem Solving using C Programming, Object Oriented Programming using C++.

Future Courses: Mathematics for Business Analytics, Foundations of Artificial Intelligence and Machine Learning.

UNIT–I	BASICS OF PYTHON PROGRAMMING, DECISION CONTROL STATEMENTS & FUNCTIONS	6 + 3

Python Basics: Introduction(L1) – Features(L1) – Execution Environment(L2) – Indentation(L2) – Comments(L2) – **Basic Elements**: Data Types(L2) – Variables(L2) – Input/Output Statements(L3) – format()(L3) – **Sequential** – Basics of Conditionals(L3) – **Selection (Conditional)**: Simple if(L3) – if else(L3) – if elif else(L3) – Nested if(L3) – **Loops**: for(L3) – for else(L3) – while(L3) – while else(L3) – **Selection (Unconditional)**: break(L3) – continue(L3) – pass(L3) – **Nested Loops**(L3) – **Functions:** Introduction to Functions(L2), Inbuilt functions(L2), User defined functions(L3), Passing parameters(L3), Return values(L3), Recursion(L3), Lambda functions(L3).

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UNIT–II	PYTHON DATA STRUCTURE, MODULES & PACKAGES	6 + 3
Introduction to Python Data Structure – **String**: Introduction(L2) – Operations (Creation – Indexing – Delete – Traversal – Slices)(L3) – Built-in methods(L3) – **List**: Introduction(L2) – Operations(L3) – Built-in methods(L3) – Cloning(L3) – List Comprehension(L3) – map()(L3) – **Tuple**: Introduction(L2) – Operations(L3) – Built-in methods(L3) – List vs Tuple(L2) – **Dictionary:** Introduction(L2) – Operations(L3) – Built-in methods(L3) – **Modules & Packages**: Introduction(L2) – Built-in modules(L3) – Import(L3) – User defined modules(L3) – Packages(L3).		
UNIT– III	**INTRODUCTION TO DATA SCIENCE & DEPICTING RELATIONSHIPS**	**6 + 3**
Data Science: Benefits and uses(L2) – Facets of data(L2) – Data Science Life Cycle(L2) – **Describing Data:** Types of Data(L2) – Types of Variables(L2) – Describing Data with Tables and Graphs(L3) – Describing Data with Averages(L3) – Describing Variability(L3) – Normal Distributions and Standard(z) Scores(L3) – **Correlation** – Computational formula for correlation coefficient(L3) – Regression(L3) – Regression line(L3) – Least squares regression line(L3) – Standard error of estimate(L3).		
UNIT – IV	**PYTHON LIBRARIES FOR DATA WRANGLING – NUMPY, PANDAS**	**6 + 3**
NumPy arrays: Creation of ndarray(L3), Initializing(L3), Accessing(L3), Slicing(L3), Joining(L3), Splitting, Searching and Sorting(L3) – **Data manipulation with Pandas:** data indexing and selection(L3) – Operating on data(L3) – Missing data(L3) – Hierarchical indexing(L3) – Combining datasets(L3) – Aggregation and Grouping(L3) – Pivot tables(L3).		
UNIT–V	**DATA VISUALIZATION – MATPLOTLIB & SEABORN**	**6 + 3**
Matplotlib: Importing Matplotlib and its uses(L3) – Line plots(L3) – Scatter plots(L3) – Visualizing errors(L3) – Density and contour plots(L3) – Histograms(L3) – Legends(L3) – Colors(L3) – Subplots(L3) – Text and Annotation(L3) – Three-dimensional plotting(L3) – Seaborn: Visualization with Seaborn(L3).		
		Total (LT) : 47 Periods

LIST OF EXPERIMENTS/EXERCISES:

1.	Implementation of various selection and control statements in Python,
2.	Implementation of string operations and functions in Python.
3.	Implementation of List, Tuples and Dictionary in Python.
4.	NumPy, Pandas, SciPy, Seaborn, Stats models, and Matplotlib packages can be downloaded and explored for their features.
5.	Working on NumPy Packages.
6.	Working on Pandas Packages.
7.	The following tasks can be done using the real-time data set from Kaggle a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b. Bivariate analysis: Linear and logistic regression modeling. c. Multiple Regression analysis. d. Also compare the results of the above analysis for any two data sets.

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8.	Explore and apply various plotting functions to Kaggle real-time data sets a. Normal curves. b. Density and contour plots. c. Correlation and scatter plots. d. Histograms. e. Three-dimensional plotting.
	Total (P) : 30 Periods
	Total (LT+P) : 77 Periods

	OPEN ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.		
Course Outcomes: **Upon completion of this course, the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Demonstrate the understanding of fundamental concepts of python programming.	L3 – Apply
CO2	Demonstrate programming skills using list, tuples, dictionary, modules and packages.	L3 – Apply
CO3	Define the data science process.	L3 – Apply
CO4	Use the Python Libraries for Data Wrangling.	L3 – Apply
CO5	Apply visualization Libraries in Python to interpret and explore data.	L3 – Apply

TEXTBOOKS:

1.	Reema Thareja, "Python Programming: Using Problem Solving Approach", 2nd Edition, Oxford University Press, 2023.
2.	Magnus Lie Hetland, "Beginning Python: From Novice to Professional", 3rd Edition, A Press, 2020.
3.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
4.	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
5.	Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

REFERENCE BOOKS:

1.	John V Guttag, "Introduction to Computation and Programming Using Python", 2nd Edition, PHI Learning Private Limited, 2021.
2.	Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem- Solving Focus", 1st Edition, Wiley India Edition, 2020.
3.	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2020.

WEB REFERENCES:

S.No.	Publisher	Website link	Type of Content
1.	W3Schools	https://www.w3schools.com/python/	Problem Solving

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2.	Geeksforgeeks	https://www.geeksforgeeks.org/data-science-tutorial/	Web Reference
3.	Realpython	https://realpython.com/	Web Reference

VIDEO REFERENCES:

S.No.	Video Details	Name of the Expert	Type of Content	Video link
1.	NPTEL	Prof. Raghunathan Rengaswamy, IIT Madras.	Lecture	https://youtu.be/2najYfEgwyM
2.	YouTube	Mr.Mosh	Lecture	https://www.youtube.com/watch?v=_uQrJ0TkZIc&t=17s&pp=ygUOTXIuTW9zaCBweXRob24%3D
3.	YouTube	SimpliLearn	Lecture	https://www.youtube.com/watch?v=ITSMDeOgXxw&t=1277s
4.	YouTube	Apna College	Lecture	https://youtu.be/ERCMXc8x7mc

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3					2		2	2		
CO2	3	2	2	2	3					2		2	2		
CO3	3	2	2	3	3					2		2	2		
CO4	3	3	2	3	3					2		2	2		
CO5	3	3	3	3	3					3		3	2		
AVG	**3.0**	**2.4**	**2.2**	**2.6**	**3.0**					**2.2**		**2.2**	**2.0**		

1–Low, 2 –Medium, 3–High.

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BE23CS404	DATA STRUCTURES AND ALGORITHMS	CP	L	T	P	C
		5	2	1	2	4
Programme & Branch	Common to B.E (CSE) and B.Tech. (IT, CSBS and AI&DS)	Version: 1.0				

Course Objectives:

1.	To understand the types of data structures and implement list ADT.
2.	To design algorithm using linear data structures like stack and queue.
3.	To compare efficiency of various sorting and searching techniques.
4.	To solve the problems using non-linear data structure tree.
5.	To solve various problems using non-linear data structure graph.

	INTRODUCTION (Not for Examination)	**2**

Importance:
Efficiency in Data Management – Performance Optimization – Real-World Applications – Competitive Programming and Contest – Problem Solving Skills.

Real Life Examples:
Arrays: Online Shopping Carts – Linked Lists: Music Playlists – Stacks: Web Browser History – Queues: Customer Service Systems – Trees: File Systems – Graphs: Social Networks and Google Maps.

Linkages:
Pre-requisite: Problem Solving using C Programming – Computer Organization – Design Thinking.
Future Courses: Design and Analysis of Algorithms – Coding Skills – I – Coding Skills – II.

UNIT–I	**DATA STRUCTURES TYPES AND LIST ADT**	**6+3**

Data Structure(L1) – Types(L1) – Abstract Data Types (ADTs)(L1) – **List ADT:** Array and Linked List implementation(L3) – Singly linked lists(L3) – Circular Singly linked list(L3) – Doubly linked lists(L3) – Circular Doubly linked list(L3).

UNIT–II	**STACK ADT AND QUEUE ADT**	**6+3**

Stack ADT: Operations – Array and Linked List implementation(L3) – Applications: Expression Evaluation – Infix to Postfix conversion(L3) – Evaluation of Postfix Expression(L3). – **Queue ADT**: Operations – Array and Linked List implementation(L3) – Circular Queue(L3) – Deque(L3) – Priority Queue(L3).

UNIT– III	**SORTING, SEARCHING AND HASHING**	**6+3**

Sorting: Introduction(L2) – Types – Bubble Sort(L3) – Selection Sort(L3) – Insertion Sort(L3) – Merge Sort(L3) – Quick Sort(L3) – **Searching**: Introduction(L2) – Linear Search(L3) – Binary Search(L3) – Applications(L3) – **Hashing**: Introduction(L2) – Hash Table (L2) – Hash function(L2) – Types(L2) – Collision(L2) – Collision Resolution Techniques: Closed Addressing (Separate Chaining)(L3) – Open Addressing (Linear Probing, Quadratic probing)(L3) – Rehashing(L3).

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UNIT – IV	TREES	6+3
Tree Definition(L1) – Tree terminologies(L2) – General tree(L2) – Binary Tree(L3) – Tree traversal(L3) – Expression tree(L3) – Binary Search Tree(L3) – AVL Tree(L3) – Binary Heap(L3).		
UNIT–V	**GRAPHS**	**6+3**
Graph Definition(L1) – Graph terminologies(L2) – Representation of Graphs(L2) – Graph traversal(L3) – Topological sort(L3) – **Shortest Path algorithms:** Dijkstra's and Floyd's algorithms(L3) – **Minimum Spanning Tree:** Prim's and Kruskal's algorithms(L3).		
		Total (LT) : 47 Periods

LIST OF EXPERIMENTS/EXERCISES:	
1.	Implement array and pointer-based list.
2.	Implement array and pointer-based stack.
3.	Implement array and pointer-based queue.
4.	Implement various sorting and searching.
5.	Implement binary tree traversals.
6.	Implement priority queue using heap.
7.	Implement Shortest Path algorithms.
8.	Implement Minimum Spanning Tree.
	Total (P): 30 Periods
	Total (LT + P): 77 Periods

	OPEN ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.		
Course Outcomes: **Upon completion of this course, the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Implement linear data structure operations using List.	L3 – Apply
CO2	Use Stack and Queue data structure operations for solving a given problem.	L3 – Apply
CO3	Compare efficiency of various sorting and searching techniques.	L3 – Apply
CO4	Solve problems using non–linear data structure tree.	L3 – Apply
CO5	Apply appropriate graph algorithms for graph applications.	L3 – Apply

TEXTBOOKS:	
1.	Reema Thareja, "Data Structures Using C", Third Edition, Oxford University Press, 2023.

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2.	Ritika Mehra, "Data Structures using C", First Edition, Pearson Education, 2021.

REFERENCE BOOKS:

1.	Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 1st edition, Pearson, 2009.
2.	Ashok N.Kamthane, "Introduction to Data Structures in C", 1st Edition, Pearson Education, 2007.
3.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2005.

WEB REFERENCES:

S. No.	Publisher	Website link	Type of Content
1.	Tutorialspoint	https://www.tutorialspoint.com/dsa_using_c/dsa_using_c_useful_resources.htm	Web Reference
2.	Hackerrank	https://www.hackerrank.com/domains/data-structures	Problem Solving
3.	Geeks for Geeks	https://www.geeksforgeeks.org/real-time-application-of-data-structures/	Web Reference

VIDEO REFERENCES:

S. No.	Video Details	Name of the Expert	Type of Content	Video link
1.	YouTube	K. Ravikumar	Lecture	https://www.youtube.com/@reachtutorravi3115
2.	YouTube	Jenny's Lectures	Lecture	https://www.youtube.com/watch?v=AT14lCXuMKI&list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLI8LU&pp=iAQB
3.	NPTEL	Sudarshan Iyengar	Lecture	https://onlinecourses-archive.nptel.ac.in/noc18_cs25/preview

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1				1			2	3	1	1
CO2	3	2	2	1	1				1			2	3	1	1
CO3	3	2	2	1	1	2			1			2	2	1	1
CO4	3	2	2	1	1				1			2	3	1	1
CO5	3	2	2	1	1	2			1			2	3	1	1
AVG	**3.0**	**2.0**	**2.0**	**1.0**	**1.0**	**2.0**			**1.0**			**2.0**	**2.8**	**1.0**	**1.0**

1–Low, 2 –Medium, 3–High.

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BE23CS405	DATABASE MANAGEMENT SYSTEM	CP	L	T	P	C
		5	2	1	2	4
Programme & Branch	Common to B.E. (CSE) and B.Tech. (IT, CSBS and AI&DS)	Version: 1.0				

Course Objectives:

1.	To learn the fundamentals of data models, relational algebra and SQL.
2.	To familiarize the database system using ER diagrams and normalization.
3.	To understand the concepts of transaction, concurrency and recovery processing.
4.	To explain the internal storage structures using files, indexing and hashing techniques to support for physical database design.
5.	To explore the knowledge of distributed databases, NoSQL and database security.

	INTRODUCTION (Not for Examination)	**2**

Importance:
Databases are the technique of storing, maintaining and accessing any sort of data. They collect data on people, places or things. It provides organizations a complete, clear view into the way data is shared and ensuring there aren't unnecessary copies of data. It offers data abstraction, integrity, security and analysis. It hides the low-level details of how data is stored and accessed, and provides a high-level interface for users and applications.

Real Life Examples:
Mark sheet generation – EB bill - Online shopping - Library Management System – Banking System.

Linkages:
Pre-requisite: Problem Solving using C++.
Future Courses: Data Science – Cloud Computing – Big Data Analytics – Business Intelligence

UNIT–I	**INTRODUCTION TO RELATIONAL DATABASE**	**6+3**

Purpose of Database System(L2) – Views of data(L2) – Data Models(L2) – Database System Architecture(L2) – Introduction to Relational Databases(L2) – Relational Model(L2) – Constraints(L2) – Relational Algebra(L3). Overview of the SQL Query Language(L3) – Basic Structure of SQL Queries(L3) – DDL(L3) – DML(L3) – Keys(L3).

UNIT–II	**DATABASE DESIGN**	**6+3**

Entity-Relationship model(L2) – E-R Diagrams(L3) – ER-to-Relational Mapping(L3) – Functional Dependencies(L3) – Non-loss Decomposition(L3) – First, Second and Third Normal Forms(L3) – Dependency Preservation(L3) – Boyce-Codd Normal Form(L3) – Multi-valued Dependencies and Fourth Normal Form(L3) – Join Dependencies and Fifth Normal Form(L3). SQL Set Operations(L3), Aggregate Functions(L3) – Group By(L3) – Having(L3), Joins(L3), Sub Queries(L3), Views(L3), Triggers(L3).

UNIT– III	**TRANSACTION MANAGEMENT**	**6+3**

Transaction Concepts(L2) – ACID Properties(L2) – Schedules(L3) – Serializability(L3) – Concurrency Control(L2) – Need for Concurrency(L2) – Locking Protocols(L3) – Two Phase Locking(L3) – Deadlock(L2) – Transaction Recovery(L2) – Save Points(L3) – Isolation Levels(L2) – SQL Facilities for Concurrency and Recovery(L2) – Backup and Recovery System(L2). SQL DCL and TCL Commands(L3).

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UNIT – IV	IMPLEMENTATION TECHNIQUES	6+3
RAID(L2) – File Organization(L2) – Organization of Records in Files(L2) – Indexing and Hashing(L2) – Ordered Indices(L2) – B+ Tree Index Files(L3) – B Tree Index Files(L3) – Static Hashing(L2) – Dynamic Hashing(L2) – Query Processing Overview(L2) – Query Optimization using Heuristics and Cost Estimation(L3).		
UNIT–V	**ADVANCED TOPICS**	**6+3**
Distributed Databases: Architecture(L2) – Types of Distributed Databases(L2) – Transaction Processing(L2). NoSQL Databases: Introduction(L2) – CAP Theorem(L2) – Document Based Systems(L2) – Key Value Stores(L2) – Column Based Systems(L2) – Graph Databases(L2). Database Security: Security Issues(L2) – Access Control Based on Privileges(L2) – Role Based Access Control(L2) – SQL Injection(L2) – Encryption and Public Key Infrastructures(L2) – Challenges(L2).		
		Total (LT) : 47 Periods

LIST OF EXPERIMENTS/EXERCISES:	
1.	Design a Database and create required tables. For e.g. Bank, College Database.
2.	Create a database table, add constraints (primary key, unique, check, Not null), insert rows, update and delete rows using SQL DDL and DML commands.
3.	Create a set of tables, add foreign key constraints and incorporate referential integrity.
4.	Query the database tables using different 'where' clause conditions and also implement aggregate functions.
5.	Query the database tables and explore sub queries and simple join operations.
6.	Write SQL Triggers for insert, delete, and update operations in a database table.
7.	Create View and index for database tables with a large number of records.
8.	Execute complex transactions and realize DCL and TCL commands.
9.	Write a program to implement B+ tree.
10.	Create Document data using NOSQL database tools.
	Total (P) : 30 Periods
	Total (LT+P) : 77 Periods

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.

Course Outcomes: **Upon completion of this course, the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply the relational algebra operations and SQL queries for database management tasks.	L3 – Apply
CO2	Design the database using ER model and normalize the designed database.	L3 – Apply
CO3	Construct queries to handle transaction processing and retain the consistency of the database.	L3 – Apply

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CO4	Identify the appropriate file organization technique and indexing for an application.	L3 – Apply
CO5	Classify the advanced databases and find a suitable database for the given requirement.	L2 – Understand

TEXTBOOKS:

1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Impression, McGraw Hill, 2023.
2.	Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventeenth Impression, Pearson Education, 2024.

REFERENCE BOOKS:

1.	C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2.	Raghu Ramakrishnan,"Database Management System", Tata McGraw-Hill Publishing Company, 2014.
3.	Rajesh Narang, "Database Management systems", PHI Learning Pvt. Ltd, New Delhi,2011.

WEB REFERENCES:

S. No.	Publisher	Website link	Type of Content
1.	MYSQL	https://dev.mysql.com/doc/	MYSQL Documentation
2.	W3Schools	https://www.w3schools.in/dbms	Tutorial
3.	IGI Global	https://www.igiglobal.com/journal/journal-database-management/1072	Articles on recent advancements

VIDEO REFERENCES:

S. No.	Video Details	Name of the Expert	Type of Content	Video link
1.	NPTEL	Prof. Arna Battacharya	Lecture	https://nptel.ac.in/courses/106104135
2.	Youtube	Edureka	SQL Course	https://www.youtube.com/watch?v=q_JsgpiuY98&list=PL9ooVrP1hQOG6DQnOD6ujdCEchaqADfCU
3.	Youtube	Prof Jenny	Lectures	https://www.youtube.com/playlist?list=PLdo5W4Nhv31b33kF46f9aFjoJPOkdlsRc

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	1					3	1	1		
CO2	2	3	2	1	2	1						1			
CO3	2	3	3	1	2	1					2	1	1		
CO4	2	3	3	2	2	1					1	1	1		
CO5	2	3	3	1		2						1			
AVG	**2.0**	**2.8**	**2.6**	**1.2**	**2.0**	**1.2**					**2.0**	**1.0**	**1.0**		

1–Low, 2 –Medium, 3–High.

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BE23CS406	OPERATING SYSTEMS	CP	L	T	P	C
		5	2	1	2	4
Programme & Branch	Common to B.E. (CSE) and B.Tech. (IT, CSBS and AI&DS)	Version: 1.0				

Course Objectives:

1.	To understand the basic operating system services.
2.	To understand the different scheduling algorithms and the importance of deadlocks.
3.	To implement the memory management techniques.
4.	To learn and apply the file management concepts and disk scheduling algorithms.
5.	To learn basics of Mobile OS and Linux OS.

INTRODUCTION (Not for Examination)	2

Importance:

Software & Hardware Interface: The communication between the software applications and the underlying hardware of a computer system.

Memory (Primary & Secondary): It facilitates efficient allocation, utilization and abstraction of physical memory for software processes and system operations.

Processes: Memory allocation, execution state, resource management for efficient multitasking and concurrent operations.

Real-life Examples:

Android OS: Accessing the mobile phone resources like camera, gallery, Bluetooth, contacts.

Windows OS: To manage and organize computer resources such as CPU, RAM, and hard disk.

Linkages:

Pre-requisites: Programming Languages (C, C++)

Future Courses: Data Structures and Algorithms, Design and Analysis of Algorithms, Principles of Compiler Design, Computer Architecture.

UNIT–I	FUNDAMENTALS OF OPERATING SYSTEMS	6+3

Introduction to Operating Systems(L1) – Evolution(L1) – Operating System structure(L2) – Services(L2) – System Calls(L3) – System Boot(L1) – User-Operating System Interface(L3) – System programs(L2) – Protection and Security(L3).

UNIT–II	PROCESS MANAGEMENT	6+3

Processes: Process Concept(L2) – Process States(L2) – Scheduling algorithms(L2) – CPU Scheduling(L3) – Threads and Threading issues(L2) – Process Synchronization(L2) – The Critical-Section problem(L3) – Semaphores(L3) – Monitors(L2) – Deadlock(L2) – Methods for handling deadlocks(L2) – Deadlock prevention(L2) – Deadlock avoidance(L3) – Deadlock detection(L2) – Recovery from deadlock(L2).

UNIT– III	MEMORY MANAGEMENT	6+3

Main Memory: Swapping(L2) – Contiguous Memory Allocation(L2) – Paging(L3) – Structure of the Page Table(L3) – Segmentation(L3) – Paging with Segmentation(L2) – Virtual Memory(L2) – Demand Paging(L2) – Copy on Write(L2) – Page Replacement(L3) – Allocation of Frames(L3) – Thrashing(L2).

UNIT – IV	STORAGE MANAGEMENT	6+3

File-System Interface(L2) – File concept(L1) – Access methods(L2) – Directory Structure(L2) – Protection(L2) – File System Implementation(L2) – File System Structure(L2) – File System Operations(L2) – Directory implementation(L2) – Allocation Methods(L2) – Free Space Management(L2) – Mass Storage system(L2) – Disk Structure(L2) – Disk Scheduling(L3) – Disk Management(L2) – Swap(L2) – Space Management(L2).

UNIT–V	MOBILE OS AND CASE STUDIES	6+3

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Mobile OS(L2) – iOS and Android(L2). The Linux System: Linux Architecture(L2) – Kernel Modules(L2) – Process Management(L2) – Scheduling(L3) – Memory Management(L2) – File Systems(L2) – Input and Output(L2) – Inter process communication(L2).	
Total(LT): 47 Periods	
LIST OF EXPERIMENTS/EXCERCISES:	
1.	Installation of windows and Linux operating systems.
2.	UNIX commands and Basic Shell Programming.
3.	Write C programs to implement the various CPU Scheduling Algorithms.
4.	Implement mutual exclusion by Semaphore.
5.	Write C programs to avoid Deadlock using Banker's Algorithm.
6.	Write C program to implement Threading.
7.	Write C program to implement the paging Technique.
8.	Write C programs to implement the various Page Replacement Algorithms.
9.	Implement the following File Allocation Strategies using C programs: a. Sequential b. Indexed c. Linked
Total(P): 30 Periods	
Total(LT+P): 77 Periods	

	OPEN-ENDED PROBLEMS / QUESTIONS	
Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment only and not for the End semester Examinations.		
Course Outcomes: **Upon completion of this course, the students will be able to:**		**BLOOM'S Taxonomy**
CO 1	Explain the main concepts, key ideas, strengths and limitations of operating system services.	**L2 – Understand**
CO 2	Demonstrate the CPU scheduling algorithms and methods for effective resource utilization.	**L3 – Apply**
CO 3	Compare and contrast the different memory management techniques.	**L3 – Apply**
CO 4	Solve the problems related to file management systems and Disk Scheduling.	**L3 – Apply**
CO 5	Summarize the features of Mobile OS and Linux OS.	**L2 – Understand**

TEXTBOOKS:	
1.	Silberschatz Abraham, Greg Gagne, Peter B. Galvin, "Operating System Concepts", 9th Edition, Wiley, 2018. (Unit–I–V).
2.	Andrew S Tanenbaum, "Modern Operating Systems", 5th Edition, Pearson, New Delhi, 2022. (Unit–II, III, IV).
REFERENCE BOOKS:	
1.	Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill, 2019.
2.	William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, Prentice Hall, 2018.
3.	Achyut S. Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2017.
WEB REFERENCES:	

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	Publisher	Website link	Type of Content
1.	javatpoint	https://www.javatpoint.com/operating-system	Reading Material
2.	geeksforgeeks	https://www.geeksforgeeks.org/operating-systems/?ref=lbp	Reading Material
3.	Techtarget	https://www.techtarget.com/searchmobilecomputing/definition/mobile-operating-system	Reading Material

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video Link
1.	Youtube	Jenny's Lectures CS, IT	Lecture	https://www.youtube.com/playlist?list=PLdo5W4Nhv31a5ucW_S1K3-x6ztBRD-PNa
2.	Coursera	Patrick Ester Chalece DeLaCoudray	Lecture	https://www.coursera.org/specializations/codio-introduction-operating-systems
3.	NPTEL	Prof. Santanu Chattopadhyay	Lecture/Real – time applications	https://nptel.ac.in/courses/106105214

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												1	2	
CO2	3	3	3	1										2	3
CO3	3	3	3	1	1										
CO4	3	3	3	1									1	2	1
CO5	3	1			3	2							1	3	1
Avg.	**3.0**	**2.5**	**3.0**	**1.0**	**2.0**	**2.0**							**1.0**	**2.2**	**1.6**

1–Low, 2 –Medium, 3–High.

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BE23EN103	PROFESSIONAL COMMUNICATION LABORATORY - I	CP	L	T	P	C
		2	0	0	2	1
Programme & Branch	(COMMON TO ALL BRANCHES EXCEPT B.Tech CSBS)	Version : 1.0				

Course Objectives:

1.	To use language for employment and social interaction.
2.	To help learners frame sentences in the correct context.
3.	To develop learners' confidence for presentation.
4.	To strengthen learners' communication in formal contexts.
5.	To participate confidently and appropriately in team conversations.

INTRODUCTION (Not for Examination)

Importance:

- The course provides a platform for students to enhance their language competence.
- It helps learners acquire career skills sought by industries for campus recruitment.
- It improves communication skills in formal and informal situations.

Real-life Example(s):

Writing letters - drafting e-mails - blog writing - writing abstracts - public speaking- presentation

Linkages:

Pre-requisite: Communicative English - I, Communicative English - II.

LIST OF EXPERIMENTS

1.	Listening & Reading Comprehension (L2)
2.	Root words & Sentence formation (L3)
3.	Expressing oneself in an everyday situation (L3)
4.	Conversation and Just a minute talk (L3)
5.	Oral presentation – Long turn (L3)
6.	Group Discussion (L3)
7.	Creative writing (L3)
8.	Business Letter writing (L3)
9.	Giving constructive feedback and offering suggestions (L3)
10.	E-mail writing (L3)

Total: 30 Periods

Course Outcomes: Upon completion of this course, the students will be able to:		**BLOOM'S Taxonomy**
CO1	Use language effectively for employment.	**L3 - Apply**
CO2	Enhance writing skills for better communication.	**L3 - Apply**
CO3	Present ideas in public forum.	**L3 - Apply**
CO4	Write business letters in a comprehensive manner.	**L3 - Apply**
CO5	Express opinions assertively in group discussions.	**L3 - Apply**

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TEXTBOOKS:	
1.	Richardson, Mathew. Advanced Communication Skills. Charlie Creative Lab, 2020.
2.	Rizvi, Ashrif. Effective Technical Communication, Tata Mc Grahill, 2011.

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1.	Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English.Cambridge University Press, Cambridge: Reprint 2011
2.	Terk, Natasha. Reports, Proposals and Procedures: A write it well guide. Gildan Media, 2015.
3.	Carnegie, Dale. The Art of Public Speaking. Prabhat Prakashan Pvt. Ltd. 1st Edition: New Delhi, 2016

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Leverageedu	https://leverageedu.com/blog/group-discussion-topics/	others
2.	Forbes	https://www.forbes.com/advisor/in/business/business-letter-format/	others

	Video Details	Expert	Type of Content	Video Link
1.	NPTEL	Dr.T.Ravichandran IIT, Kanpur	Lecture	https://nptel.ac.in/courses/109104031
2.	NPTEL	Dr.Binod Mishra IIT, Roorkee	Lecture	https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									1	3		1			
CO2									1	3		1			
CO3									1	3		1			
CO4									1	3		1			
CO5									1	3		1			
Avg.									**1**	**3**		**1**			

1–Low, 2 –Medium, 3–High.

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BE23AD402	ARTIFICIAL INTELLIGENCE LABORATORY	CP	L	T	P	C
		4	0	0	4	2
Programme & Branch	B.TECH. – ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	Version: 1.0				

Course Objectives:

1.	To design and implement search strategies
2.	To implement game playing techniques
3.	To implement CSP techniques
4.	To develop systems with logical reasoning
5.	To develop systems with probabilistic reasoning

INTRODUCTION: (Not for Examination)	1

Importance:

These experiments provide hands-on experience, reinforcing theoretical concepts and enhancing problem-solving skills in AI.

Real Life Example(s):

Mobile robots for path finding, Digital forensics to decrypt messages, Google Maps, Strategy games to determine optimal moves, Timetabling for universities, Expert systems for medical diagnosis, Email spam filtering.

Linkages:

- Python or JavaScript
- Data Structures and Algorithms, Search Algorithms, Graph Theory.

List of Experiments / Exercises:

1.	Implement basic search strategies – 8-Puzzle, 8 - Queens problem, Cryptarithmetic.
2.	Implement A* and memory bounded A* algorithms
3.	Implement Mini-Max algorithm for game playing (Alpha-Beta pruning)
4.	Solve Constraint Satisfaction Problems
5.	Implement propositional model checking algorithms
6.	Implement forward chaining, backward chaining, and resolution strategies
7.	Build Naïve Bayes models
8.	Implement Bayesian networks and perform inferences
9.	Mini-Project

Total: 60 PERIODS

Course Outcomes:

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

		BLOOM'S Taxonomy
1.	Design and implement search strategies	L3 – Apply
2.	Implement game playing and CSP techniques	L3 – Apply
3.	Develop logical reasoning systems	L3 – Apply
4.	Develop probabilistic reasoning systems	L3 – Apply

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SOFTWARE:	
1.	Python 3.10

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Geeks for Geeks	https://www.geeksforgeeks.org/8-queen-problem/	Blog

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	Youtube	Sean Riley	Lecture	https://www.youtube.com/watch?v=ySN5Wnu88nE
2.	Youtube	Sebastian Lague	Animation	https://www.youtube.com/watch?v=l-hh51ncgDI

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2					3	3	2	2	2	1	1
CO2	1	3	2	2	2				2	2	2	1	3	1	1
CO3	2	1	2	2	2				1	1	1	1	1	2	1
CO4	2	2	2	2	2				3	2	3	2	1	2	1
Average	**2**	**2**	**2**	**2**	**2**				**2**	**2**	**2**	**2**	**2**	**2**	**1**

1–Low, 2 –Medium, 3–High

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BE23PT805	ENGINEERING CLINIC - II	CP	L	T	P	C
		2	0	0	2	1
(COMMON TO ALL BRANCHES)						
Programme & Branch	B.E.- MECHANICAL ENGINEERING	Version: 1.0				

Course Objectives:

1	To provide a platform for hands-on learning experiences in order to build relevant engineering skills.
2	To enable students to learn and develop skills on designing of new product for real world application using 3D Printer and IoT.
3	To take entrepreneurship, product development, startup-related activities and problem-solving skills in higher semesters and final semester project work.

A. CONCEPT

Engineering Clinic laboratory provides hands-on training for students to develop certain simple real-world products or applications with the help of faculty. It is a team activity consisting of maximum 3 students per team. A list of products or applications will be given. Engineering Clinic - II focus on product development involving interdisciplinary Engineering courses. Each team can choose one or more products for a given application. The students have to design, fabricate and demonstrate the working of the product.

B. EXECUTION

Day	Session	Course content / Activity	No. of Periods
1	S 1	Introduction to Embedded Systems and IoT.	2
	S 2	Hands-on Training to write a code for IoT Circuit design using open-source software.	4
	S 3	Demonstration and explanation of real-time IoT application circuits in various sectors.	6
2	S 4	Introduction to 3D Printing Technology.	2
	S 5	Hands-on Training to design 3D Printing model using open-source software.	4
	S 6	Fabrication of 3D Printing Models.	6
3	S 7	Demonstration of Sublimation and Vinyl cutter Machine.	3
	S 8	Demonstration of Wood router Machine.	3
		Total	**30 Periods**

A list of sample applications/products is attached.

C. ASSESSMENT

i. Assessment is done by internal mode only and there is no End Semester Examination.
ii. Sessions (S7 & S8) are intended for demonstration purposes only, not for assessment.
iii. Marks distribution for Infernal Assessment is,

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Method	Review I	Review II	Review III	Review IV
Details	System description and Circuit design.	Testing, Validation and Demonstration.	Design and Fabrication of 3D Printing Models.	Final Product Demonstration / Presentation.
Marks	25	25	25	25

For Product/Application the student team can choose themselves.

Total: 30 PERIODS

Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Understand the Basics of IoT components.	L2- Understand
CO2	Design and Demonstrate the prototype of expedient product using 3D Printer.	L4 -Analyze
CO3	Practice the culture of Innovation and Product Development towards Start-ups in an Institution.	L4 - Analyze

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	1	2	2	2	2	2	2	3
CO2	3	3	3	2	2	2	2	1	2	2	3	2	2	2	3
CO3	3	3	3	2	2	2	2	1	2	3	3	2	2	2	3
Average	3	3	3	2	2	2	2	1	2	2.3	2.6	2	2	2	3

1-Low, 2 -Medium, 3-High.

List of sample Applications / Products for Engineering Clinic II

1. Automated Irrigation System
2. Smart Home Automation
3. AI based Image Capturing Robot
4. Vehicle Tracking System
5. IoT based Smart Traffic Management
6. IoT based Smart Hybrid Energy Management System
7. IoT based Garbage Monitoring System
8. Miniature of Home / Buildings / Bridges
9. Miniature of Robot /Quad copter/Motor and Drives
10. Development of Wood Wall Art/logo pendant /Door design.

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BE23PT807	APTITUDE SKILLS - II	CP	L	T	P	C
		1	0	0	1	0.5
Programme & Branch	Common to all B.E. / B.Tech. Courses	Version: 1.0				

Course Objectives:

1.	To develop foundational knowledge and skills in averages, percentages, problems on ages, ratios and proportions
2.	To enhance logical reasoning skills from Venn diagrams, cubes and cuboids charts, tables and graphs

INTRODUCTION (Not for Examination)	01

Importance:

Problem-solving skills, analytical skills and logical reasoning are crucial in various aspects of an engineering education, career, and professional development. Hence, aptitude skills are needed for engineers in the following areas:

1. Engineering Design and Analysis
2. Innovation and Research
3. Project Management
4. Competitive Exams and Career Advancement

Real-Life Example(s):

a. **Budgeting and Financial Planning**: Managing personal or business finances involves calculating expenses, savings, investments, and returns. For instance, creating a monthly budget requires understanding percentages and basic arithmetic to allocate funds appropriately.

b. **Productivity:** A manager in a factory calculates the average number of units produced by employees to gauge overall productivity.

c. **Data Analysis:** In various professions, analyzing data to make informed decisions is crucial. For example, a marketing analyst uses quantitative skills to interpret sales data and forecast future trends.

d. **Shopping and Discounts**: While doing shopping, calculating discounts and comparing prices involves quantitative skills.

Linkages:

Previous Courses: Aptitude Skills I
Future Courses: Aptitude Skills III and Aptitude Skills IV

UNIT–I	Quantitative Aptitude	08

Number system(L3): Remainder Theorem - Unit digits - Factor and Factorial Theorem - Divisibility Rule

Averages(L3): Basic Concepts of Averages - Properties of Averages- Weighted Averages - Problems on Averages - Averages of Averages

Percentage(L3): Basic Concepts of Percentages - Percentage Increase and Decrease - Finding Percentages - Percentage Change - Successive Percentage Changes - Percentage Comparisons

Profit and Loss(L3): Basic Concepts of Profit and Loss - Profit and Loss Percentages - Selling Price and Cost Price Calculations - Mark Price and Discount - Successive Selling and Buying - Overheads and Additional Costs - Markup and Margin - Cost Variations and Impact on Profit/Loss - Application of Profit and Loss in Business Scenarios

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Problems on Ages(L3): Basic Concepts of Age Problems - Formulating Equations Based on Age Statements - Solving Single-variable Age Problems - Solving Multi-variable Age Problems - Age Differences - Sum of Ages - Average Age - Age Ratios - Age Problems Involving Future and Past Scenarios - Age Problems in Competitive Exams - Age Puzzles and Riddles

Ratios & Proportions(L3): Basic Concepts of Ratios - Comparing Ratios - Proportions - Direct Proportion - Inverse Proportion - Compound Ratios - Ratio and Proportion in Real-life Applications - Ratio of Increase and Decrease - Advanced Problems on Ratios and Proportions

UNIT–II	Logical Reasoning	06

Venn Diagrams(L3): Basic Concepts of Venn Diagrams - Types of Venn Diagrams - Union and Intersection of Sets - Difference of Sets - Complement of a Set - Cardinality of Sets - Subset and Superset Relationships - Using Venn Diagrams for Logical Reasoning - Diagrammatic Representation of Data - Real-life Applications

Cubes & Cuboids(L3) : Basic Concepts and Definitions - Surface Area of Cubes and Cuboids - Volume of Cubes and Cuboids - Diagonal of Cubes and Cuboids - Face Diagonal of Cubes and Cuboids - Relationship Between Edge Lengths and Dimensions - Construction of Cubes and Cuboids - Applications in Real-life Scenarios

Data-Interpretation and Data-Sufficiency(L3): Introduction to Data Interpretation - Types of Charts and Graphs - Calculations and Approximations - Percentage Calculations - Comparison and Analysis – Problem Solving Techniques

TOTAL: 15 PERIODS

Course Outcomes: **Upon completion of this course the students will be able to:**		**Bloom's Taxonomy**
CO1	solve quantitative problems, including averages, percentages, problems on ages, ratios and proportions	L3 – Apply
CO2	apply logical reasoning and draw conclusions from Venn diagrams, cubes and cuboids, charts, tables and graphs	L3 – Apply

TEXTBOOKS:

1.	Dr. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand and Company Ltd., 2022
2.	Dr. R.S. Aggarwal, "A Modern Approach to Logical Reasoning", S.Chand and Company Ltd., 2022
3.	FACE, "Aptipedia: Aptitude Encyclopedia", 2nd edition, Wiley India Pvt. Ltd., 2017

REFERENCE BOOKS:

1.	Arun Sharma, "Quantitative Aptitude for the CAT" 10th edition, McGraw-Hill Publishing, 2022
2.	Praveen R. V., "Quantitative Aptitude and Reasoning", 3rd edition, PHI Learning Pvt. Ltd., 2016

WEB REFERENCES:

	Publisher	Website link	Type of Content
1.	Indiabix	https://www.indiabix.com/online-test/aptitude-test/	Tests for Practice

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2.	Placement preparation	https://www.placementpreparation.io/quantitative-aptitude/	Tests for Practice
3.	Geeks for geeks	https://www.geeksforgeeks.org/aptitude-for-placements/	Learning Resources and Tests for Practice

VIDEO REFERENCES:

	Video Details	Name of the Expert	Type of Content	Video link
1.	YouTube	CareerRide	Video Lectures	https://www.youtube.com/playlist?list=PLpyc33gOcbVA4qXMoQ5vmhefTruk5t9lt
2.	YouTube	Freshersworld.com	Video Lectures	https://www.youtube.com/playlist?list=PLjLhUHPsqNYkcq6YOfiywbTfnvf_TN7i9

Mapping of COs with POs and PSOs

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	2													
Avg.	3	2													

1–Low, 2 –Medium, 3–High.

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