Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme and Detailed Syllabus (DJ19)

Second Year B.Tech

in

Artificial Intelligence and Data Science

(Semester III)

Shri Vile Parle Kelavani Mandal's

DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING

(Autonomous College Affiliated to the University of Mumbai)

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Proposed Scheme for Second Year Undergraduate Program in Artificial Intelligence and Data Science: Semester III (Autonomous) (Academic Year 2022-2023)

Sr	Course Code	Course	Teaching Scheme(hrs)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					Aggregate (A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th	O	P	O &P	Total SEA (B)		
1	DJ19ADC301	Engineering Mathematics-III	4	--	--	4	25	--	25	75	--	--	--	75	100	5
	DJ19ADT301	Engineering Mathematics -III Tutorial	--	--	1	1	--	25	25	--	--	--	--	--	25	
2	DJ19ADC302	Data Structures and Algorithms	3	--	--	3	25	--	25	75	--	--	--	75	100	4
	DJ19ADL302	Data Structures and Algorithms Lab	--	2	--	1	--	25	25	--	--	--	25	25	50	
3	DJ19ADC303	Database Management Systems	3	--	--	3	25	--	25	75	--	--	--	75	100	4
	DJ19ADL303	Database Management Systems Lab	--	2	--	1	--	25	25	--	--	--	25	25	50	
4	DJ19ADC304	Discrete Structures	4	--	--	4	25	--	25	75	--	--	--	75	100	4
	DJ19ADT304	Discrete Structures Tutorial	--	--	1	1	--	25	25	--		--	--	--	25	
5	DJ19ADC305	Operating Systems	3	--	--	3	25	--	25	75	--	--	--	75	100	4
	DJ19ADL305	Operating Systems Lab	--	2	--	1	--	25	25	--	--	--		--	25	
6	DJ19ADL306	Programming Lababotary I (Python Programming)	--	2	--	1	--	25	25	--	--	--	25	25	50	1
7	DJ19A2	Innovative Product Development-I	--	2	--	--	--	--	--	--	--	--	--	--	--	--
8	DJ19A3	Constitution of India	1	--	--	--	--	--	--	--	--	--	--	--	--	--
		Total	**18**	**10**	**2**	**23**	**125**	**150**	**275**	**375**	**0**	**0**	**75**	**450**	**725**	**22**

Th	Theory	**T/W**	Termwork
P	Practical	**O**	Oral
T	Tuturial		

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
Theory	One Term test (based on 40 % syllabus)	25 each (Avg.25)	1
	Second Term test (next 40 % syllabus) / presentation / assignment / course project / group discussion / any other.		as applicable
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory &Tutorial	Performance in the laboratory and tutorial.	25	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	75	3
	* Computer-based assessment in the college premises.		
Oral	Questions based on the entire syllabus.	25	as applicable
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the examination and on the entire syllabus.	as per the scheme	2

Program: **Second Year B. Tech. in Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: III**
Course: Engineering Mathematics - III (DJ19ADC301)		
Course: Engineering Mathematics - III Tutorial (DJ19ADT301)		

Pre-requisite: -- Knowledge of

1. Solving a simultaneous linear equation using concept of matrices.
2. Calculus.

Objectives:

1. Understanding basic concepts of linear algebra.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill and Optimization techniques.

Outcomes: On completion of the course, learner will be able to:

1. Learn the basic notation of vector spaces and subspaces.
2. Apply the concept of vector spaces using linear transformations which is used in computer graphics and inner product spaces.
3. Apply the concepts of eigenvalue and eigenvectors and diagonalization in linear systems.
4. Expand the periodic function by using Fourier series and complex form of Fourier series.
5. Apply the concept of Linear & Non-Linear Programming Problem to the engineering problems.

Engineering Mathematics - III (DJ19ADC301)		
Unit	**Description**	**Duration**
1	**Vector Space and Inner Product Spaces:** Definition of vector space over $\mathbb{R}$, Subspaces. Linear combinations, Linearly dependent and independent vectors, Basis, Dimension. **Inner Product Spaces:** Dot product in $\mathbb{R}^n$, Definition of general inner product on a vector space over $\mathbb{R}$. Norm of a vector in an inner product space. Cauchy-Schwarz inequality. Orthogonal sets and orthonormal sets in an inner product space. Orthogonal and orthonormal bases. Gram-Schmidt orthogonalization process simple examples in $\mathbb{R}^2$, $\mathbb{R}^3$.	**12**

2	**Linear Transformations:** Definition and properties. Kernel and image of a linear transformation, Rank-Nullity Theorem. Invertible Linear Transformation, Relation between matrices and Linear Transformations, Change of bases.	**10**
3	**Matrices:** Eigen values, Eigen vectors and their properties. Cayley-Hamilton theorem (without proof) and its application. Similar matrices, diagonalization of matrix. Functions of square matrix. Singular value decomposition.	**8**
4	**Calculus**: Gradient, directional derivatives, Jacobian, Hessian, convex sets, convex functions, and its properties.	**4**
5	**Optimization:** Unconstrained and Constrained optimization. Unconstrained optimization techniques: Newton's method, Quasi Newton method. Constrained optimization techniques: gradient descent, stochastic gradient descent, Penalty function method, Lagrange multiplier method, Karush–Kuhn–Tucker method, Simplex method, Penalty and Duality, Dual simplex method, Downhill simplex method.	**10**
6	**Fourier series:** Dirichlet's conditions, Fourier series of periodic functions with period 2π and 2L and Fourier series for even and odd functions. Half range sine and cosine Fourier series, Parseval's identities (without proof). Complex form of Fourier series, Orthogonal and Orthonormal set of functions.	**8**
	Total Lecture Hours	**52**

Engineering Mathematics - III Tutorial (DJ19ADT301)	
Tut.	**Suggested Tutorials**
1	Vector Space.
2	Inner Product Space.
3	Linear Transformation.
4	Eigen Value and Eigen Vector and Similarity of Matrices.
5	Cayley-Hamilton Theorem, Functions of square matrix.
6	Singular value decomposition.

7	Calculus.
8	Unconstrained Optimization Techniques.
9	Constrained Optimization Techniques.
10	Fourier Series.
11	Half-Range Fourier Series
12	Complex Form of Fourier Series.

Minimum eight tutorials from the above suggested list or any other tutorial based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

Text books:

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer (2004).
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.
3. Operation Research by Hira & Gupta,S Chand.
4. Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley India, 2015.

Reference Books:

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016).
2. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2 nd Edition, Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003.
4. Introduction to Linear Algebra, Gilbert Strang, 5 th Edition, Cengage Learning (2015).
5. Operations Research by S.D. Sharma Kedar Nath, Ram Nath & Co. Meerat.
6. Engineering optimization (Theory and Practice) by Singiresu S.Rao, New Age International publication.
7. Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers, India, 2015.

Prepared by Checked by Department Coordinator Principal

Program: Second Year B. Tech. in Artificial Intelligence & Data Science	S.Y B.Tech	Semester: III
Course: Data Structures and Algorithms (DJ19ADC302)		
Course: Data Structures and Algorithms Laboratory (DJ19ADL302)		

Pre-requisite: Computer Fundamentals

Course Objectives:

- To understand the basic concepts of data structures and algorithms
- To differentiate linear and non-linear data structures and the operations upon them.
- Ability to perform sorting and searching in a given set of data items.
- To comprehend the necessity of time complexity in algorithms

Course Outcome:

On completion of the course, the learner will be able to:

- Understanding the fundamental analysis and time complexity for a given problem.
- Articulate linear and non-linear data structures and operations permitted on them.
- Applying a suitable algorithm for searching and sorting.
- Understanding the importance of hashing.
- Application of appropriate data structures to find solutions to practical problems.

Data Structures and Algorithms (DJ19ADC302)		
Unit	**Description**	**Duration**
1	**Introduction to Algorithms and Analysis** Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency–best case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation –Recursive Tree Method, Master Theorem.	3
2	**Linear Data Structures**	10

	Stack– Stack Operations, Applications of stack: Expression Evaluation- Conversion of Infix to postfix and prefix expression, Queue- Queue Operations, Types of Queues: Circular Queue, Double Ended Queue, Applications –Priority Queue using Arrays List-Singly linked lists, Doubly linked lists, Circular linked lists, Operations on Singly Linked List, Stack and Queue implementation using Linked Lists	
3	**Non-Linear Data Structures** Tree-Terminology, Binary Tree– Terminology and Properties, Tree Traversals, Expression Trees– Binary Search Trees– operations in BST– insertion, deletion, finding min and max, Applications –Dictionary Graph–basic definition and Terminology– Representation of Graph–Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) –Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra 's Algorithm, Bellman Ford, Multistage graph, All Pair Shortest Path, Travelling salesperson problem, Least-cost answer node-15-puzzle problem	14
4	**Heaps and Balanced Binary Search Trees** Heaps- Heapsort, Applications- Priority Queue using Heaps, AVL trees– Terminology- basic operations (rotation, insertion, and deletion), B Tree	4
5	**Searching and Sorting** Searching- Linear Search and binary search, Fibonacci Search, Analysis Applications- Finding square root of 'n '- Longest Common Prefix Sorting–Insertion sort- Selection sort, Quicksort, Merge sort, Analysis	6
6	**Hashing** Hash functions, open hashing-separate chaining, closed hashing -linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications–Dictionary-Telephone directory	2
	Total	**39**

Data Structures and Algorithms Laboratory (DJ19ADL302)	
Exp	**Suggested experiments**
1	Implementation of stack to find the just next greater number which can be formed using digits of given number.
2	Implementation of multi-stack in one array.
3	Using a stack find the length of the longest prefix of each of the given parenthesis's expressions that is valid, or 0 if there's no such prefix.
4	Implementation of Infix to Postfix. Transformation and its evaluation program.
5	Implementation of Infix to Prefix. Transformation and its evaluation program.
6	Using a queue find if the love mobiles can be brought into the order that the organizers want them to be.
7	Using the concepts of stack and queue sort the elements of a given array.
8	Implementation of circular queue menu driven program.
9	Implementation of double ended queue menu driven program.
10	Implementation of queue menu driven program.
11	Implementation of Priority queue program using array.
12	Implementation of Linked Lists menu driven program.
13	Implementation of different operations on linked list –copy, concatenate, split, reverse, count no. of nodes etc.
14	Implementation of polynomials operations (addition, subtraction) using Linked List.
15	Implementation of Linked Lists menu driven program (stack and queue).
16	Implement merging of even and odd positioned nodes into new linked list.
17	Implementation of construction of expression tree using postfix expression.
18	Implementation of BST program.
19	Write a program to verify whether the given 3 traversals are of the same tree or not.
20	Implementation of various operations on trees like – copying tree, mirroring trees, counting the number of nodes in the tree, counting only leaf nodes in the tree.

21	Implementation of Graph menu driven program (DFS & BFS).
23	Implementations of Heap & Heap Sort menu driven program.
24	Implementation of Advanced Bubble Sort, Insertion Sort and Selection Sort menu driven Program.
26	Implementation of hashing functions with different collision resolution techniques

A minimum of 10 experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

Textbooks:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C", 2nd Edition, Cengage Learning, 2005.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, W. H. Freeman, and Company 2008.
3. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", Career Monk Publications, 2nd Edition, 2011
4. Thomas H. Cormen, C.E. Leiserson, R L. Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.

Reference Books:

1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C", 4th Edition, Pearson, 2014.
2. M. T. Goodritch, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++", Wiley, 2004.
3. Kruse, Leung, Tondo, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2013.
4. Tenenbaum, Langsam, Augenstein, "Data Structures using C", Pearson, 2004.
5. J. P. Tremblay and P. G. Sorenson, "Introduction to Data Structures and its Applications", 2nd Edition, McGraw-Hill, 1984.
6. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Addison-Wesley, 2010.
7. Reema Thareja, "Data Structures using C", Oxford, 2017.
8. Seymour Lipschutz, Data Structures, Schaum's Outline Series, 1st Edition, Tata McGraw-Hill, 2010.

Evaluation Scheme:
Semester End Examination (A):
Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):
Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on DJ19ADL302 with minimum 12 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 marks
ii. Journal Documentation (Write-up and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Department Coordinator Principal

Program: **Second Year B. Tech. in Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: III**
Course: Database Management Systems (DJ19ADC303)		
Course: Database Management Systems Laboratory (DJ19ADL303)		

Pre-requisite: Computer Fundamentals

Course Objectives:

1. Learn and practice data modelling using Entity-Relationship modelling and developing database by applying normalization.
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3. Learn techniques for controlling the consequences of concurrent data access.

Course Outcomes: On completion of the course, the learner will be able to:

1. Construct SQL queries to perform operations on database.
2. Demonstrate appropriate transaction recovery techniques for a given problem.
3. Design an application using advanced database.

Database Management Systems (DJ19ADC303)		
Unit	**Description**	**Duration**
1	**Introduction Database Concepts:** Introduction, Characteristics of databases, File system v/s Database system, Users of Database system, Data Independence, DBMS system architecture, Database Administrator	3
2	**Entity–Relationship Data Model** The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation **Relational Model and Relational Algebra** Introduction to the Relational Model, relational schema and concept of keys, Mapping the ER and EER Model to the Relational Model Relational Algebra – unary and set operations, Relational Algebra Queries.	7

3	**Structured Query Language (SQL)** Overview of SQL, Data Definition Commands, and Data Manipulation commands, Data Control commands, Transaction Control Commands. Integrity constraints - key constraints, Domain Constraints, Referential integrity, check constraints, set and string operations, aggregate function, group by clause, having Clause Views in SQL, joins, Nested and complex queries, Triggers Introduction to PL/SQL - Procedures and Functions	10
4	**Relational–Database Design** Pitfalls in Relational-Database designs, Concept of normalization, Functional Dependencies, First Normal Form, 2NF, 3NF, BCNF	8
5	**Transactions Management and Concurrency** Transaction concept, Transaction states, ACID properties, Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Deadlock Handling **Recovery System:** Introduction to Recovery system, Log based Recovery, Shadow paging.	6
6	**Advance Databases:** NoSQL, Document Orientated databases, Graph database, Time Series Databases, Spatial and Temporal Databases	5
	Total	**39**

Database Management Systems Laboratory (DJ19ADL303)	
Exp.	**Suggested experiments**
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) /Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create and populate database using Data Definition Language (DDL) and DML Commands (Apply various Integrity Constraints)
4	Perform Simple queries, string manipulation operations.
5	Nested queries and Complex queries.
6	Perform Join operations.
7	Views and Triggers.
8	Procedures (PL/SQL)
9	Examine the consistency of database using concurrency control technique (Locks)

10	Mini project using any advanced database. (Cassandra, MongoDB, Redis, Neo4J, InfluxDB/KairosDB, PostgreSQL etc.)

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

Text books:

1. Korth, Silberchatz, Sudarshan, ―Database System Concepts, 7th Edition, McGraw – Hill, 2019.
2. Elmasri and Navathe, ―Fundamentals of Database Systems, 7th Edition, Pearson education, 2016.
3. Peter Rob and Carlos Coronel, ―Database Systems Design, Implementation and Management, Thomson Learning, 5th Revised Edition, 2002.
4. G. K. Gupta ―Database Management Systems, 3rd Edition, McGraw – Hill, 2018.
5. Xun (Brian) Wu, Sudarshan Kadambi, Devram Kandhare, Aaron Ploetz ― Seven NoSQL Databases in a Week, Packt Publishing Limited, 2018

Reference Books:

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press, 2012
2. Gillenson, Paulraj Ponniah, ―Introduction to Database Management‖, Wiley Publication, 1st , 2007
3. Sharaman Shah, ―Oracle for Professional, Shroff Publishers & Distributers Private Limited, 1st edition, 2008
4. Raghu Ramakrishnan and Johannes Gehrke, ― Database Management Systems, 3rd Edition, McGraw – Hill, 2014.
5. Lynn Beighley, "Head First SQL", O'Reilly Media, 2007.
6. Gaurav Vaish ―Getting started with NoSQL, Packt Publishing Limited, 2013.
7. https://www.mongodb.com/

Evaluation Scheme:

Semester End Examination (A):
Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Laboratory work will be based on **DJ19ADL303** with minimum 12 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 marks
ii. Journal Documentation (Write-up and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Department Coordinator Principal

Program: **Second Year B.Tech in Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: III**
Course: Discrete Structures (DJ19ADC304)		
Course: Discrete Structures Tutorial (DJ19ADT304)		

Pre-requisite: Basic Mathematics

Course Objectives:

1. To cultivate clear thinking and creative problem solving.
2. To thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3. To thoroughly prepare for the mathematical aspects of other Computer Engineering courses.

Course Outcomes: On completion of the course, the learner will be able to:

1. Verify the correctness of an argument using propositional and predicate logic and truth tables.
2. Understand relations, Diagraph and lattice, functions.
3. Apply principles and concepts of graph theory in practical situations.
4. Demonstrate the ability to solve problems using counting techniques and combinatorics in the context of discrete probability.
5. Understand the different Algebraic structures and demonstrate use of groups and codes in Encoding and Decoding.

Discrete Structures (DJ19ADC304)		
Unit	**Description**	**Duration**
1	**Sets and Logic:** **Set Theory:** Introduction to Set Theory, Venn diagrams, Operations on Sets, Power sets, Laws of set theory, Cartesian Product, Partitions of sets, The Principle of Inclusion and Exclusion, Introduction to Fuzzy sets, Properties of Fuzzy sets, Fuzzy set operations, Fuzzy Cartesian product **Mathematical Logic:**	12

	Propositions and Logical operations, Truth tables, Laws of Logic, Logical Equivalence, Normal Forms, Predicates, Fallacies, Quantifiers, Mathematical induction Introduction to First Order Predicate Logic, Inference Rules: Universal and Existential instantiation, Universal and Existential generalization, Universal Modus Ponens, Universal Modus Tollens, Multiple Quantifiers, Negation of more than one variable	
2	**Relations, Posets and Lattices** **Introduction:** Relations and their properties, Paths and Digraphs, Types of binary relations, Operations on relations, Equivalence relations: Closures, Warshall's algorithm, Composition of relations. Introduction to Fuzzy Relations. Properties of Fuzzy relations, Fuzzy composition of relations: Max-min composition and Max-product composition **Posets and Lattices:** Partial ordered sets, Hasse diagram, Lattice and its types, Boolean algebra.	10
3	**Functions** Types of functions - Injective, Surjective and Bijective, Composition of functions, Identity and Inverse function, Pigeon hole principle	4
4	**Graphs and Trees** **Introduction to Graph theory:** Definitions, Paths, circuits, connectivity, Types of Graphs, Eulerian and Hamiltonian Graph, Sub Graphs, Planar Graphs, Chromatic number, Graph coloring, Isomorphism of graphs, **Introduction to Trees:** Trees, rooted trees, path length in rooted trees, Prefix codes and optimal prefix codes	4
5	**Generating Function and Recurrence relation**: Recurrence Relation: linear recurrence relation with constant coefficients, Homogeneous and non-homogeneous recurrence relation, Generating function	4
6	**Number Theory and Algebra** **Groups:** Binary operations, Group, Semigroup, Monoid, Sub-group, Cyclic group, Homomorphism and Isomorphism of groups, Cosets. **Coding theory:** Group codes, Parity-check and Generator matrix, Hamming codes, Maximum likelihood technique **Rings and Fields:** Definition, Sub rings, Integral domain, Field, Integer modulo n, Ring homomorphism.	5

	Total	**39**

Minimum eight tutorials based on syllabus will be conducted. Mini project relevant to the subject may be included, which would help the learner to apply the concept learnt.

Tutorials: Discrete Structures Tutorial (DJ19ADT304)

1	Problems on Set Theory
2	Problems on Mathematical Logic
3	Problems on Relations
4	Problems on Posets and Lattices
5	Problems on Functions
6	Problems on Graph theory
7	Problems on Trees
8	Problems on Generating Function
9	Problems on Recurrence relation
10	Problems on Groups
11	Problems on Coding theory
12	Problems on Rings and Field

Books Recommended:

Text books:

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education 2015.
2. C.L. Liu, D P Mohapatra, "Elements of Discrete Mathematics", 4E, McGraw-Hill 2012.
3. Douglas B West.," Introduction to Graph Theory" 2nd Edition, Eastern Economy Edition published by PHI Learning Pvt. Ltd.
4. Ralph Grimaldi, "Discrete and Combinatorial Mathematics" 5th ed., Pearson Education
5. S.N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", 2nd Edition, 2011 Wiley India Pvt. Ltd.

Reference Books:

1. Y N Singh, "Discrete Mathematical Structures", Wiley-India.
2. J. L. Mott, A. Kandel, T. P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Prentice Hall of India.

3. J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", McGraw-Hill.
4. Seymour Lipschutz, Marc Lipson, "Discrete Mathematics", Schaum's Outline Series McGraw Hill Education.

Evaluation Scheme:
Semester End Examination (A):
Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):
Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Tutorial: (Term work) Term work shall consist of minimum 8 Tutorials covering the entire modules. The distribution of marks for term work shall be as follows: Tutorial– 25 marks

The final certification and acceptance of term work will be subject to satisfactory performance of tutorial work and upon fulfilling minimum passing criteria in the term work.

Program: **Second Year B. Tech. in Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: III**
Course: Operating Systems (DJ19ADC305)		
Course: Operating Systems Laboratory (DJ19ADL305)		

Pre-requisite: Computer Fundamentals

Course Objectives:

The objective of this course is to understand the structure, functions and characteristics of computer system and operating systems

Course Outcomes:

Students will be able to

1. Describe the fundamental organization of a computer system.
2. Apply appropriate memory mapping, process scheduling and disk scheduling methods.
3. Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.
4. Differentiate between various processor architectures.

Operating Systems (DJ19ADC305)		
Unit	**Description**	**Duration**
1	**Operating System Architecture:** Basic functions and services, System calls, Types of Operating Systems: Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S. Case Study on Linux OS	6
2	**Process Management:** Process Concept, Process states, Process control, Threads, Uni-processor Scheduling: Types of scheduling: Pre-emptive, Non pre-emptive, Scheduling algorithms: FCFS, SJF, RR, Priority.	6
3	**Memory Management:** Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging. Segmentation, Demand paging and Page replacement policies.	8
4	**Concurrency control Concurrency:** Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer Consumer	8

	problems and solutions. Deadlock: Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher problem	
5	**File and I/O management:** File access methods, I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache	4
6	**Computer Architecture:** Characteristics of Multiprocessors, Flynn's taxonomy, Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers – Introduction to Multiprocessor network topologies	**6**
	Total	**39**

Operating Systems Laboratory (DJ19ADL305)	
Exp.	**Suggested experiments**
1	Explore the basic commands of Linux. pwd, cd, ls, cp, mv, mkdir, rmdir, rm, touch, grep, sudo, chmod, chown Display current shell, home directory, current path setting, current working directory. Illustrate the use of sort, grep, awk, etc.
2	Implement CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
3	Implement Multithreading.
4	Implement Best Fit, First Fit and Worst Fit Memory allocation policy
5	Implement various page replacement policies
6	Implement Producer -Consumer problem with Semaphore
7	Implement order scheduling in supply chain using Banker's Algorithm
8	Implement Disk Scheduling Algorithm
9	Using the CPU-OS simulator analyze and synthesize the following: a. Process Scheduling algorithms. b. Thread creation and synchronization. c. Deadlock prevention and avoidance.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

Text Books

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons , Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition.

Reference Books:

1. Maurice J. Bach, "Design of UNIX Operating System", PHI
2. Achyut Godbole and Atul Kahate, Operating Systems, Mc Graw Hill Education, 3rd Edition
3. The Linux Kernel Book, Remy Card, Eric Dumas, Frank Mevel, Wiley Publications.

Evaluation Scheme:
Semester End Examination (A):
Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):
Theory:
1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)
The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 marks
ii. Journal Documentation (Write-up and Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Department Coordinator Principal

Program: **Second Year B. Tech. in Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester : III**
Course: Programming Laboratory – I (Python Programming)(DJ19ADL306)		

Pre-requisite: C Programming

Course Objectives:

1. To cultivate clear thinking and creative problem solving.
2. To study various advanced python concepts like inheritance, exception handling, modules etc.
3. Learn to develop GUI based standalone and web application.

Course Outcomes: On completion of the course, the learner will be able to:

1. Understand basic and object-oriented concepts, data structure implementation in python.
2. Apply file, directory handling and text processing concepts in python.
3. Apply database connectivity, client-server communication using python.
4. Develop python-based application (web/Desktop) using Django web framework/Tkinter.

Programming Laboratory – I (Python Programming)(DJ19ADL306)		
Unit	**Description**	**Duration**
1	**Python basics** Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries.	4
2	**Control Statements and Functions:** If statement, if-elif-else, Repetition using while loop, for loop, defining a Function, Checking & Setting Your Parameters, Default arguments, Variable length arguments, Defining and calling functions within a function, Layers of Functions, Lambda and Filter, Zip (), Map (), Reduce () function, recursion, Function Decorators.	4

3	**Introduction to OOP:** Creating a Class, Self-Variables, Constructors, Types of Methods, Constructors in Inheritance, Polymorphism, the super () Method, Method Resolution Order (MRO), Operator Overloading, Method Overloading & Overriding, Interfaces in Python Exceptions Handling: Exceptions, Exception Handling, Types of Exceptions, Except Block, assert Statement, User Defined Exceptions	6
4	**Advanced Python** Building Modules, Packages: Python Collections Module, Opening and Reading Files and Folders (Python OS Module, Python Datetime Module, Python Math and Random Modules, Text Processing, Regular expression in python	3
5	**Python Integration Primer Graphical User interface using Tkinter** : Form designing, Networking in Python: Client Server socket programming Python database connectivity: Data Definition Language (DDL), and Data Manipulation Language (DML)	3
6	**Django Framework** **Introduction to Django**: Django's take on MVC: Model, View and Template, Installation and set upmodels.py, urls.py, views.py, Setting up database connections Managing Users & the Django admin tool Designing a good URL scheme, Generic Views, Form classes, Validation, Authentication, Advanced Forms processing techniques	**6**
	Total	**26**

Programming Laboratory – I (Python Programming)(DJ19ADL306)	
Exp.	**Suggested experiments**
1	Write python programs to understand Expressions, Variables, Quotes, Basic Math operations.
2	Write a Python program to implement Basic String Operations & String Methods.
3	Write a Python program to implement functions of List, Tuples, and Dictionaries.
4	Write a Python program to implement Arrays (1D, 2D) applications.
5	Write python programs to demonstrate applications of different decision-making statements.
6	Write a Python program to implement Functions and Recursion.

7	Write a Python program to implement Programs based on Lambda, Map, and Reduce Functions.
8	Write a Python program to implement program to implement concept of Function decorators.
9	Write python programs to implement Classes & objects, Constructors
10	Write python programs to implement Inheritance & Polymorphism.
11	Write python programs to implement Exception handling.
12	Write python programs to understand different File handling operations with exception handling.
13	Write python programs to implement database connectivity and DDL and DML commands in Python using SQLite.
14	Write python programs to understand GUI designing (Programs based on GUI designing using Tkinter.
15	Write a Python program to implement Web based application with Django Framework.

Minimum eight experiments from the above suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Books Recommended:

Text books:

1. Dr. R. Nageswara Rao, "Core Python Programming", 3rd Edition, Dreamtech Press, 2018.
2. Mark Lutz, "Learning Python", 5th Edition, Oreilly Publication, 2013.
3. E Balagurusamy, "Introduction to computing and problem-solving using Python", McGraw Hill Education, 2018.

Reference Books:

1. Zed A. Shaw, "Learn Python the Hard Way", 3rd Edition, Addison–Wesley Publication, 2014.
2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication, 2015.

Evaluation Scheme:
Semester End Examination (A):
Laboratory:

1. Practical and Oral examination will be based on the entire syllabus including the practicals performed during laboratory sessions.

Continuous Assessment (B):

Laboratory: (Term work)

Laboratory work will be based on above syllabus of DJ19ADL306 with

1. At least 16-18 programs and mini project
2. Two assignments covering whole syllabus

The distribution of marks for term work shall be as follows:

1. Laboratory work (Performance of Experiments): 10 Marks
2. Journal Documentation (Write-up and Assignments): 05 marks
3. Mini Project: 10 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by Checked by Department Coordinator Principal

Program: **Second Year B.Tech in Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: III**
Course: Innovative Product Development (DJ19A2)		

Pre-requisite: Computer Fundamentals

Course Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualise and create a successful product.

Course Outcomes:

On completion of the course, the learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualising a product, especially while working in a team. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
3. Draw proper inferences through theoretical/ experimental/simulations and analyse the impact of the proposed method of design and development of the product.
4. Develop interpersonal skills, while working as a member of the team or as the leader.
5. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
6. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication

Guidelines for the proposed product design and development:

1. Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
2. Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
3. Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
4. Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
5. Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
6. A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
7. The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
8. The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, ie during the semesters III and IV.

Guidelines for Assessment of the work:

1. The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
2. In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
3. Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
4. Marks awarded by the supervisor based on log-book: 20
5. Marks awarded by review committee: 20
6. Quality of the write-up: 10

Review/progress monitoring committee may consider the following points during the assessment.

1. The entire design proposal shall be ready, including components/system selection as well as the cost analysis.
2. Two reviews will be conducted based on the presentation given by the student's team.
3. First shall be for finalization of the product selected.
4. Second shall be on finalization of the proposed design of the product.

The overall work done by the team shall be assessed based on the following criteria:

1. Quality of survey/ need identification of the product.

2. Clarity of Problem definition (design and development) based on need.

3. Innovativeness in the proposed design.

4. Feasibility of the proposed design and selection of the best solution.

5. Cost effectiveness of the product.

6. Societal impact of the product.

7. Functioning of the working model as per stated requirements.

8. Effective use of standard engineering norms.

9. Contribution of each individual as a member or the team leader.

10. Clarity on the write-up and the technical paper prepared.

Guidelines for Assessment of Semester Reviews:

1. The write-up should be prepared as per the guidelines given by the department.
2. The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution

Prepared by Checked by Department Coordinator Principal

Program: Second Year B.Tech in Artificial Intelligence & Data Science	S.Y B.Tech	Semester: III
Course: Constitution of India (DJ19A3)		

Pre-requisite: NIL

Course Objectives:

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Course Outcomes:

On completion of the course, learner will be able to

1. Have general knowledge and legal literacy and thereby to take up competitive examinations. Understand state and central policies, fundamental duties.
2. Understand Electoral Process, special provisions.
3. Understand powers and functions of Municipalities, Panchayats and Co-Operative Societies,
4. Understand Engineering ethics and responsibilities of Engineers
5. Understand Engineering Integrity & Reliability

Constitution of India(DJ19A3)		
Unit	**Description**	**Duration**
1	**Introduction to the Constitution of India** The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	8
2	**Directive Principles of State Policy:** Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	8
3	**State Executives:** Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments	7

4	**Special Provisions:** For SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. **Human Rights:** Meaning and Definitions, Legislation Specific Themes in Human Rights-Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchayats and Co – Operative Societies	10
5	**Scope & Aims of Engineering Ethics:** Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering	6
	Total	**39**

Books Recommended:

Text books:

1. Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) Prentice – Hall EEE, 19th / 20th Edn., 2001
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins "Engineering Ethics" Thompson Asia, 2003-08-05.

Reference Books:

1. M. V. Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. M. Govindarajan, S. Natarajan, V. S. Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004
3. Brij Kishore Sharma, "Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.
4. Latest Publications of Indian Institute of Human Rights, New Delhi

Website Resources:

1. www.nptel.ac.in
2. www.hnlu.ac.in
3. www.nspe.org
4. www.preservearticles.com

Prepared by Checked by Department Coordinator Principal

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme and Detailed Syllabus (DJ19)

Second Year B.Tech

in

Artificial Intelligence and Data Science

(Semester IV)

Shri Vile Parle Kelavani Mandal's

DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING

(Autonomous College Affiliated to the University of Mumbai)

NAAC Accredited with "A" Grade (CGPA : 3.18)

Proposed Scheme for Second Year Undergraduate Program in Artificial Intelligence and Data Science: Semester IV (Autonomous) (Academic Year 2022-2023)

Sr	Course Code	Course	Teaching Scheme(hrs)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					Aggregate (A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th	O	P	O &P	Total SEA (B)		
1	DJ19ADC401	Statistics for Engineers	4	--	--	4	25	--	25	75	--	--	--	75	100	5
	DJ19ADL401	Statistics for Engineers Laboratory	--	2	--	1	--	25	25	--	--	--	--	--	25	
2	DJ19ADC402	Artificial Intelligence	3	--	--	3	25	--	25	75	--	--	--	75	100	4
	DJ19ADL402	Artificial Intelligence Laboratory	--	2	--	1	--	25	25	--	--	--	25	25	50	
3	DJ19ADC403	Foundations of Data Science	3	--	--	3	25	--	25	75	--	--	--	75	100	4
	DJ19ADL403	Foundations of Data Science Laboratory	--	2	--	1	--	25	25	--	--	--	25	25	50	
4	DJ19ADC404	Computer Networks and Security	3	--	--	3	25	--	25	75	--	--	--	75	100	4
	DJ19ADL404	Computer Networks and Security Laboratory	--	2	--	1	--	25	25	--	--	--	25	25	50	
6	DJ19ADL405	Programming Laboratory-II (Java)	--	4	--	2	--	25	25	--	--	--	25	25	50	2
7	DJ19IHC1	Universal Human Values	2	--	--	2	25	--	25	75	--	--	--	75	100	3
	DJ19IHT1	Universal Human Values Tutorial	--	--	1	1	--	25	25	--	--	--	--	--	25	
8	DJ19A4	Innovative Product Development II (A)	--	2	--	--	--	--	--	--	--	--	--	--	--	--
		Total	15	14	1	22	125	150	275	375	0	0	100	475	750	22

Th	Theory	T/W	Termwork
P	Practical	O	Oral
T	Tutorial		

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: IV**
Course: Statistics for Engineers (DJ19ADC401)		
Course: Statistics for Engineers Lab(DJ19ADL401)		

Prerequisite: Calculus.

Objectives:

To build the strong foundation in statistics which can be applied to analyze data and make predictions.

Outcomes: On completion of the course, learner will be able to:

1. Interpret data using descriptive statistics.
2. Demonstrate sampling distributions and estimate statistical parameters.
3. Develop hypothesis based on data and perform testing using various statistical techniques.
4. Perform analysis of variance on data.
5. Examine relations between data.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Statistics:** Types of statistics, population vs sample. Measures of Central Tendency, Measures of dispersion: range, quartile deviation, mean deviation, standard deviation, properties, variance, empirical relations between measures of dispersion, absolute and relative dispersion, coefficient of variation, outlier, moments, Pearson's β and γ coefficients, skewness, kurtosis, population parameters and sample statistics. Measures of position: quartiles, interquartile range, semi-interquartile range, percentiles, percentile rank, 10–90 percentile range, box and whisker plot. Correlation: Scatter plot, covariance, Karl Pearson's coefficient of correlation	8
2	**Probability, Random variables:** Probability: Conditional probability, mutually and pair wise independent events, Bayes' theorem. Random variables: Discrete random variable, probability mass function, discrete distribution function, continuous random variable, probability density function, continuous distribution function, mathematical expectation, moment generating function, two-dimensional random variable and its joint probability mass and density function, marginal distribution function, conditional distribution functions, covariance, joint moments.	8
3	**Probability distributions:** Discrete probability distribution: Binomial distribution, Poisson distribution, Hypergeometric distribution.	8

	Continuous probability distribution: Uniform distribution, Exponential distribution, Normal distribution, Beta distribution, Gamma distribution.	
4	**Sampling distribution and Estimation**: Sampling distribution: Central limit theorem, population distribution, Chi-square distribution, Z - distribution, Student's t-distribution, F-Distribution. Statistical Estimation: Characteristics of estimators, consistency, unbiasedness, unbiased estimates, efficient estimates, sufficient estimators, point estimates, interval estimates, determination of sample size for estimating mean and proportions, estimates of population parameters, probable error.	**7**
5	**Hypothesis Testing for data driven decision making:** Hypothesis testing: Test of significance, null and alternative hypothesis, type I and type II error, factors affecting Type II error, probability of Type II error, power of test, p Value, critical region, level of significance. Confidence interval: Population mean, difference between two population means, population proportion, difference between two population proportions, variance, ratio of variances of two populations. Goodness of fit test using Kolmogorov-Smirnov test. Tests using z-statistics: difference between sample proportion and population proportion, difference between two sample proportion, difference between sample mean and population mean with known σ and unknown σ, difference between two sample means, one tailed and two tailed tests. Test using t-statistics: difference between sample mean and population mean, difference between two independent sample means, difference between means from the same group. Test using F-statistics: equality of population variance Test using chi-square statistics: test of independence, goodness of fit.	**12**
6	**Analysis of Variance (ANOVA) for data analysis:** Sample size calculation, one way ANOVA, POST-HOC Analysis (Tukey's Test), randomized block design, two-way ANOVA.	**7**

List of Laboratory Experiments: (Minimum any eight using Python)	
Sr. No.	**Suggested Experiments**
1	To perform descriptive statistics on data.
2	To visualize descriptive statistics on data.
3	To perform correlation on given data.
4	To calculate probability using probability distribution.
5	To prove central limit theorem.
6	To study sampling distributions and their parameters.
7	To perform statistical estimation tests on data.
8	To calculate confidence interval for different parameters.
9	To perform goodness of fit using Kolmogorov-Smirnov test and Anderson Darling test.
10	To perform hypothesis test using Z statistics.
11	To perform hypothesis test using t statistics.
12	To perform hypothesis test using F statistics.
13	To perform hypothesis test using Chi square.
14	To perform ANOVA on given data.
15	To perform POST-HOC Analysis (Tukey's Test) on given data.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Statistical Methods, S. P. Gupta, Sultan Chand, 2021, 46th revised edition.
2. An Introduction to Statistics with Python, Thomas Hasalwanter, Springer, 2016.
3. Think Stats: Probability and Statistics for Programmers, Allen B. Downey, Green Tea Press, 2011.
4. Testing Statistical Hypotheses, E. L. Lehmann, Joseph P. Romano, Springer, 2008, third edition.

Reference Books:

1. Fundamentals of mathematical statistics, S. C. Gupta, V. K. Kapoor, Sultan Chand, 2020, 12th edition.
2. Practical Statistics for data scientists 50+ Essential Concepts Using R and Python, Peter Bruce, Andrew Bruce, Peter Gedeck, Orelly, second edition, 2020.
3. Statistics, Freedman, David, Robert Pisani, Roger Pervis, W. W. Norton, 2007.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal documentation (Write-up and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: IV**
Course: Artificial Intelligence (DJ19ADC402)		
Course: Artificial Intelligence Laboratory (DJ19ADL402)		

Prerequisite: Knowledge of 1. Basic Mathematics 2. Algorithms 3. Discrete Structures

Objectives:

1. Provide the basic ideas and techniques underlying the design of intelligent systems.
2. Impart the knowledge of various search techniques for problem solving.
3. Learn knowledge representation and reasoning.
4. Impart the knowledge of planning and forms of learning.

Outcomes: On completion of the course, learner will be able to:

1. Classify given problem and identify the need of intelligent agent.
2. Apply appropriate search-based method for a given problem.
3. Analyze various AI approaches to knowledge– intensive problem solving, reasoning and planning.
4. Design an expert system for a given AI problem.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Artificial Intelligence:** Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Current trends in AI **Intelligent Agents:** Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent.	**6**
2	**Problem solving:** Solving Problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems. **State Space Search Methods:** **Uninformed Search Methods:** Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID) **Informed Search Methods:** Greedy Best first Search, A* Search **Stochastic Local Search Algorithms:** Hill climbing search, Simulated annealing	**8**
3	**Adversarial Search:** Game Theory, Board Games and Game Trees, Algorithm Minimax, Alpha-Beta Pruning	**6**

4	**Knowledge and Reasoning:** Knowledge based Agents, The WUMPUS World, Inference in FOL, Forward chaining, Backward chaining, Knowledge Engineering in First-Order Logic, Unification, Resolution, Logic programming (PROLOG)	**8**
5	**Planning:** The planning problem, Planning with State Space Search, STRIPS, Goal Stack Planning, Planning graphs, Partial order planning, Hierarchical planning	**6**
6	**Expert System:** Introduction, Phases in building Expert Systems, ES Architecture, Case Study on MYCIN Rule based system	**5**

List of Laboratory Experiments: (Minimum any eight using Python /PROLOG)	
Sr. No.	**Suggested Experiments**
1	Select a problem statement relevant to AI. i) Identify the problem ii) PEAS Description iii) Problem formulation
2	Identify and analyze uninformed search Algorithm to solve the problem. Implement BFS/DFS/DFID search algorithms to reach goal state.
3	Identify and analyze informed search Algorithm to solve the problem. Implement A* search algorithm to reach goal state.
4	Program to implement Local Search algorithm: World Block Problem using Hill climbing search.
5	Experiment to illustrate Game playing.
6	Implementation on any AI Problem: Wumpus world, Tic-tac-toe, 8-Queens Problem.
7	The laboratory will emphasize the use of PROLOG. (For example, Program to implement Family Tree in Prolog)
8	The laboratory will emphasize the use of PROLOG.
9	Case study on Planning Problem. Identify and analyze a planning problem.
10	Case study on an AI Application.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", Fourth Edition, Pearson Education, 2022
2. Saroj Kaushik "Artificial Intelligence", First Edition, Cengage Learning, 2011
3. George F Luger "Artificial Intelligence" Low Price Edition, Pearson Education., Fifth edition, 2005

4. Deepak Khemani.” A First Course in Artificial Intelligence”, McGraw Hill Education (India), Sixth reprint 2018 edition (1 July 2017).

Reference Books:

1. Ivan Bratko “PROLOG Programming for Artificial Intelligence”, Addison-Wesley, 4th edition, 2011
2. Elaine Rich and Kevin Knight “Artificial Intelligence” Third Edition, 2017
3. Davis E. Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
4. Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley, Third Edition, 1992
5. Han Kamber, “Data Mining Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd edition, 2011
6. N.P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

iii. Laboratory work (Performance of Experiments): 15 Marks
iv. Journal documentation (Write-up and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by **Checked by** **Head of the Department** **Principal**

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: IV**
Course: Foundation of Data Science (DJ19ADC403)		
Course: Foundation of Data Science (DJ19ADC403)		

Prerequisite: Basic database concepts, Concepts of algorithm design and analysis

1. To identify the scope and essentiality of Data Processing and Warehouse.
2. To visualize data and apply relevant modelling techniques to solve real world problems.
3. To develop research interest towards advances in data modelling techniques.

Outcomes: On completion of the course, learner will be able to:

1. Understand data lake and data warehouse fundamentals.
2. Understand ETL process and apply OLAP operations.
3. Apply appropriate pre-processing and visualization techniques.
4. Design and evaluate predictive and descriptive models.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Fundamentals to Data Lake:** Introduction to data lake, Data Lake frameworks, Different data repositories, Differences between data lake and Data warehouse, Data warehouse: Architecture, Multi-tiered Architecture, Data warehouse Models, Schema types. **Extraction Transformation Loading:** Metadata Repositories, Data warehouse Modeling: DataCube , OLTP and OLAP, OLAP operations: Drill down, Roll up, Slice, Dice and Rotation	7
2	**Pre-Processing:** An Overview, Cleaning, Data Integration, data reduction, Data Transformation and Data discretization. **Exploratory Data Analysis (EDA):** Philosophy of EDA - The Data Science Process. Significance of EDA in data science - Basic tools (plots, graphs and summary statistics) of EDA.	7
3	**Predictive Modeling:** Simple linear regression, Multiple Linear Regression **Introduction to decision tree:** Learning Decision tree using ID3 and Gini index; **Ensemble methods**: Bagging (Random Forest) and Boosting (XG Boost).	7

4	**Descriptive Modeling**: Cluster Analysis and Requirements of Cluster Analysis Partitioning Methods: k-Means, k-Medoids Hierarchical Methods: Agglomerative, Divisive, Outlier Analysis, t-SNE.	6
4	**Classification Model Evaluation & Selection:** Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROC Curves	6
5	**Data Analysis and Visualization:** **Data Manipulations**- Sort, filter, remove duplicates-text and math functions-pivot table-lookup Functions-Data visualizations for quantitative and qualitative data-Charts-Excel Modelling- forecast models using advanced lookup and data validation tools. **Tableau (case study):** Creating Visualizations in Tableau-Data hierarchies, filters, groups, sets, calculated fields-Map based visualizations. Build interactive Dashboards-Data Stories. **Introduction to Data Ethics**	6

List of Laboratory Experiments: (Minimum any eight)	
Sr. No.	**Suggested Experiments**
1	Build Data Warehouse/Data Mart for a given problem statement i. Identifying the source tables and populating sample data ii. Design dimensional data model i.e. Star schema
2	To perform various OLAP operations such as slice, dice, drilldown, rollup, pivot.
3	Perform data pre-processing task on given dataset.
4	Implementation of Classification algorithm i. Regression ii. Using Decision Tree (ID3/CART)
5	Implementation of Clustering algorithm i. K-means ii. Hierarchical clustering (single/complete/average)
6	Demonstrate performing Classification, clustering algorithm on data sets using given tool (WEKA, R tool, XL Miner, etc.)
7	Design an application using Predictive modelling and perform model evaluation.
8	Perform various data manipulation techniques on given data.
9	Data visualization using Tableau/ excel/python.
10	Data visualization using t-SNE.

TEXTBOOK:

1. Paulraj Ponniah, “Data Warehousing: Fundamentals for IT Professionals”, Wiley India, 2nd Edition, 2012
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd edition, 2011
3. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education, 1st Edition, 2002

REFERENCES:

1. Reema Theraja, “Data warehousing”, Oxford University Press, 2009
2. Joshua N. Milligan, “Learning Tableau 2022”, Packt Publishing Limited, 5th edition, 2022
3. Ann Jackson, “Tableau Strategies: Solving Real, Practical Problems with Data Analytics”, Shroff/O'Reilly, 1st Edition, 2021

Evaluation Scheme: Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal documentation (Write-up and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Prepared by **Checked by** **Head of the Department** **Principal**

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: IV**
Course: Computer Networks and Security (DJ19ADC404)		
Course: Computer Networks and Security (DJ19ADL404)		

Prerequisite: Knowledge of 1. Basic Mathematics 2. Algorithms

Objectives:

1. To get familiar with contemporary issues and challenges of various protocol designing in layered architecture and performance analysis of routing and transport layer protocols for various applications. Outcomes: On completion of the course, learner will be able to:

Outcomes: On completion of the course, learner will be able to:

1. Understand the concepts of data communication and functionalities of ISO - OSI model & TCP/IP model.
2. Illustrate the functions of Data link layer.
3. Implement and simulate the working of network layer and networking protocols.
4. Demonstrate the working of transport and application layer protocols
5. Identify security vulnerabilities and explore various monitoring measures.
6. Explore the fundamentals of security algorithms

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	Introduction to computer network, Network topology, Networking devices, Reference models: OSI, TCP/IP	04
2	Physical and Data link Layer: Introduction, transmission medium, physical addressing, Error control (Hamming code, CRC), Flow control, Data-Link Layer Protocols: HDLC, Media Access Control: ALOHA, CSMA, Wired LANs: Ethernet, Wireless LANs	08
3	Network Layer: Services, Packet switching, ARP, RARP, Unicast Routing Algorithms-(DVR, LSR), IPv4 Addressing (Classfull and Classless), Subnetting, Supernetting design problems, IPv4 Protocol, IPV6 protocol	09
4	Transport & Application Layer: Services, sockets, Transport Layer Protocols - User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Application layer protocols-HTTP, SMTP, DNS	06
5	Introduction to Security: Security Goals, Security threats and attacks, (Spoofing, Phishing, DOS, Virus, Worm, Trojans, Side-Channel Attack), Intrusion Prevention Systems Intrusion Detection System (IDS), Troubleshooting and monitoring tools, Wireshark, Kali Linux, Honeypot, Nmap, Kismet.	04

6	Fundamentals of security algorithms: Cryptography: Symmetric (Substitution Ciphers, Caesar Cipher, Playfair Cipher, Hill Cipher, Block Ciphers, DES and AES), Asymmetric (PKI, RSA, Digital Signature), Key exchange (Diffie-Hellman), Hashing (MD5, SHA)	**08**

List of Laboratory Experiments: (Minimum any eight)	
Sr. No.	**Suggested Experiments**
1	Installation & Configuration of Network Simulator (NS2) in Linux environment. -Study of different topologies and create duplex link in NS2
2	Implementation of an error detection code using CRC.
3	Implementation of Distance Vector/ Link State Routing algorithm.
4	Study of Network simulator (NS) and performance evaluation of Routing protocols using Simulation tool.
5	Applications using TCP sockets like: a) Echo client and echo server b) Chat c) File Transfer
6	Demonstration of security tools.
7	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer.
8	Design and Implement Caesar cipher cryptographic algorithm by considering letter [A... Z] and digits [0...9]. Apply Brute Force Attack to reveal secret.
9	Design and Implement Encryption and Decryption algorithm using Simple Columnar Transposition cipher technique. Study how dictionary attack can be applied on it.
10	Implement RSA Cryptosystem using RSA Algorithm / Implement Elliptical Curve Digital Signature Algorithm (ECDSA)
11	Demonstrate the data integrity using various cryptographic algorithms viz. MD-5, SHA-1 using VLAB, IIT Bombay.

C/C++/JAVA/Equivalent compiler

• Network Simulator like NS2/OPNET/Wireshark

Books Recommended:

Text books:

1. Andrew S. Tanenbaum, Computer Networks, Sixth Edition, Pearson,2022

2.Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2017.
3.Cryptography and Network Security – Atul Kahate, 3rd edition, Tata Mc Graw Hill, 2017.

4. Computer Security Principles and Practice –William Stallings, Seventh Edition, Pearson Education, 2017

5. Security in Computing – Charles P. Pfleeger, Fifth Edition, Pearson Education, 2015

6. Network Security and Cryptography – Bernard Menezes, Cengage Learning, 2014.

7. Network Security Bible – Eric Cole, Second Edition, Wiley, 2011.

8. Mark Stamp's Information Security: Principles and Practice –Deven Shah, Wiley, 2009

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2017.

2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.

3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.

4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open-Source Approach, McGraw Hill Publisher, 2011.

5. UNIX Network Programming –Richard Steven, Addison Wesley, 2003.

6. TCP/IP Protocol Suite – B. A. Forouzan, 4th Edition, Tata Mc Graw Hill, 2017.

7. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

8. Applied Cryptography, Protocols Algorithms and Source Code in C – Bruce Schneier, 2nd Edition / 20th Anniversary Edition, Wiley, 2015

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper will be based on the entire syllabus summing up to 75 marks.

2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.

2. Total duration allotted for writing each of the paper is 1 hr.

3. Average of the marks scored in the two tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal documentation (Write-up and/or Assignments): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester:IV**
Course: Programming Laboratory-II (Java) (DJ19ADL405)		

Prerequisite: Knowledge of

1. Programming Language C.

Objectives:

The objective of this course is to

1. Make students familiar with basic, Object Oriented features of JAVA and SOLID principles.
2. expose students to analyse a problem statement, develop suitable logic and implement it in JAVA.
3. enable students to design and develop GUI applications.

Outcomes: On successful completion of this course, student should be able to:

1. Develop applications by applying SOLID principles as well as appropriate Object-Oriented concepts and APIs.
2. Debug a given code, rectify the errors to get the desired output.
3. Make suitable modifications to programs as per user requirements for solving real world problems.
4. Develop GUI applications using modern APIs (JAVAFX, swings, etc.)
5. Work effectively as a member of a team.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Fundamental of Java Programming** Overview of procedure and object-oriented Programming, Java Designing Goals, Features of Java Language. Introduction to the principles of object-oriented programming SOLID principles for designing Keywords: Single Responsibility Principle, Open-Closed Principle, Liskov Substitution Principle, Interface Segregation Principle, Dependency Inversion Principle, Data types, Variables, Operators, Expressions, Types of variables and methods. Control Statements, Iteration Statements, Arrays: Irregular arrays, I/O Basics.	**08**
2	**Classes, Objects and Array of Object** Classes & Objects: Class Fundamentals: Assigning Object Reference Variables, passing parameters to Methods and Returning parameters from the methods, pass by value, reference, static and non-static members Nested and Inner Classes, Recursion, finalize (), Method overloading Constructors: Parameterized Constructors, copy constructor, default, non-parameterized, Constructors overloading.	**06**
3	**Inheritance, Interface and Packages** Inheritance Basics, Types of Inheritance in Java, Concept of Super and sub class, inheriting Data members and Methods, Role of Constructors in inheritance, making methods and classes final, Method overriding, Dynamic Method Dispatch (static and dynamic polymorphism), Abstract classes and methods. Interface and implementation, Interfaces vs. Abstract classes. Packages – Steps for defining, creating and accessing a Package, importing packages, java.util.Vector.	**08**
4	**Exception Handling and Multithreading** Exception handling Mechanism: try, catch, throw, throws and finally, user defined exceptions Multithreading: Need of Multithreading, Java thread Model, thread Lifecycle, thread class Methods, Implementing Runnable, extending thread, synchronizing threads, synchronized Statement, Critical Factor in Thread –Deadlock	**06**
5	**Java Swings and Event Handling** Introducing Swing: AWT vs Swings, Components and Containers, Swing Packages, A Simple Swing Application, Painting in Swing, Designing Swing GUI Application using Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars. Event-Driven Programming in Java, Event- Handling Process, Event Handling Mechanism, The Delegation Model of Event Handling, Event	**08**

	Classes, Event Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling.	
6	**Java Collections** Collections Framework List, Set, Sorted Set, Queue, Deque, Map, Iterator, List Iterator, and Enumeration. Array List, Linked List, HashSet, Linked HashSet, Tree Set, Array Deque, Priority Deque, Enum Set, Abstract Collection, Abstract List, Abstract Queue, Abstract Set, and Abstract Sequential List. Map, Map Entry, Sorted Map, and Navigable Map, HashMap, Linked HashMap, Tree Map, Identity HashMap, Weak HashMap, and Enum Map. Comparator, RandomAccess interfaces as well as Observable class	**12**
7	**Generics** Basic generics, bounded type parameters, type inference, wildcards, type erasure.	**04**

List of Laboratory Experiments:

1. Write java programs to understand Expressions, Variables, Basic Math operations.

2. Write java programs to demonstrate different decision-making statements

3. Write java program to demonstrate input output using command line arguments, buffered reader and data input stream reader

4. Write a java program to implement Arrays (1D, 2D, irregular).

5. Write a java program to implement Basic String Operations & String Methods.

6. Write a java program to implement Functions, Recursion.

7. Write java programs to demonstrate classes, objects, array of objects

8. Write java programs to demonstrate call by value and call by reference

9. Write java programs to demonstrate static non static members, nested and inner classes.

10. Write java programs to demonstrate different Object-oriented features: a) Classes & objects b) Constructors c) Inheritance & Polymorphism.

11. Write java programs to demonstrate the concept of abstract classes and interfaces.

12. Write java programs to import inbuilt packages as well as create and import user defined packages.

13. Write java programs to handle exceptions using Exception Handling Mechanism

14. Write java programs to implement multithreading

15. Write java programs to understand GUI designing and database operations (Programs based on GUI designing using swings/ modern APIs)

16. Write java programs to understand java collections

17. Write java program to implement generics.

Books Recommended:

Textbook Books:

1. Herbert Schildt, "Java-The Complete Reference", 11th Edition, Tata McGraw Hill Publication, 2018.
2. E. Balguruswamy, "Programming with Java: A Primer", Fifth edition, Tata McGraw Hill Publication, 2017.

Reference Books:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, 2015.
2. H. M. Deitel, P. J. Deitel, S. E. Santry, "Advanced Java 2 Platform How to Program", 2nd Edition, Prentice Hall, 2007.
3. Script Demics, "Learn to Master JAVA", from Star EDU solutions, 2017.

Evaluation Scheme:

Laboratory:

Practical and oral examination will be based on the entire syllabus including, the practical's performed during laboratory sessions and guided mini project covering the relevant concepts of object-oriented programming. This helps them to apply the OOP knowledge gained during classroom sessions to solve real time problems.

Laboratory: (Term work)

1. Term work shall consist of at least 10 experiments based on the above list.

2. Mini project

The distribution of marks for term work shall be as follows:

i. Laboratory work (Performance of Experiments, Write-up): 15 marks
ii. Mini project / presentation/ assignment/Quiz: 35 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: IV**
Course: Universal Human Values **(**DJ19IHC1**)** **Course:** Universal Human Values Tutorial(DJ19IHT1)		

Prerequisite: Knowledge of

Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.

2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence

3. Strengthening of self-reflection.

4. Development of commitment and courage to act.

Outcomes: On completion of the course, learner will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability.

2. Become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).

3. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	Introduction: Need, Basic Guidelines, Content and Process for Value Education Purpose and motivation for the course. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	**05**
2	Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I am being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.	**06**
3	Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**06**
4	Understanding Harmony in the Nature and Existence: Whole existence as Coexistence Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-	**05**

	regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.	
5	Understanding Harmony in the Nature and Existence: Whole existence as Coexistence Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.	06

Books Recommended:

Textbooks:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj - PanditSunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11.India Wins Freedom - Maulana Abdul Kalam Azad

12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Evaluation:

Semester End Examination

(A): Theory:

1) Question paper will be based on the entire syllabus summing up to 75 marks.

2) Total duration allotted for writing the paper is 3 hrs. Continuous Assessment

(B): Theory:

1) Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.

2) Total duration allotted for writing each of the paper is 1 hr.

3) Average of the marks scored in both the two tests will be considered for final grading.

Continuous Assessment (C):

Tutorials: (Term work)

1. Term work shall consist of minimum 4activities based on activities suggested.

2. Term work shall carry total 25 marks based on the performance in the tutorials.

The tutorials could be conducted as per the following topics: -

Activity No 1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and coexistence) rather than as arbitrariness in choice based on liking-disliking.
Activity No 2	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.
Activity No 3	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
Activity No 4	Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.
Activity No 5	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

The final certification and acceptance of term work will be subject to satisfactory performance of activities and upon fulfilling minimum passing criteria in the term work.

Prepared by **Checked by** **Head of the Department** **Principal**

Program: **Artificial Intelligence & Data Science**	**S.Y B.Tech**	**Semester: IV**
Course: Innovative Product development-II(DJ19A4)		

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualise and create a successful product.

Outcome: Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualising a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyse the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).

- Students should carry out a survey and identify the need, which shall be converted into conceptualisation of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
- Marks awarded by the supervisor based on log-book: 20
- Marks awarded by review committee: 20
- Quality of the write-up: 10 In the last review of the semester IV, the marks will be awarded as follows.
- Marks awarded by the supervisor (Considering technical paper writing) : 30
- Marks awarded by the review committee: 20 Note- A Candidate needs to secure a minimum of 50% marks to be declared to have completed the audit course. Review/progress monitoring committee may consider the following points during the assessment. In the semester III, the entire design proposal shall be ready, including

components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.

1. First shall be for finalisation of the product selected.
2. Second shall be on finalisation of the proposed design of the product.

In the semester IV, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.

- First review is based on readiness of building the working prototype.
- Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

The semester reviews (III and IV) may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester IV. Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester IV.