D. Y. Patil College of Engineering and Technology

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

Accredited by NAAC with 'A' Grade

Structure and Syllabus of S.Y. B. Tech in CSE (Data Science)

Department of Computer Science and Engineering

2021-22

D Y Patil College of Engineering & Technology, Kasaba Bawada, Kolhapur.
Department of Computer Science & Engineering.

Curriculum Structure of Second Year B. Tech. in Computer Science & Engineering (Data Science), Semester – III

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201DSL201	BSC	Linear Algebra	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
2	201DSL202	BSC	Discrete Mathematics and Social Graphs	3	1	-	4	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
3	201DSL203	ESC	Structured Computer Organization and Microprocessors	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
4	201DSL204	PCC	Data Structures	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
5	201DSL205	PCC	Fundamentals of Networking	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
6	201DSP206	PCC	Python Programming Laboratory	2	-	2	3	50	**ISE**	25	10	20
									ESE-POE	25	10	
7	201DSP207	PCC	Data Structures Laboratory	-	-	2	1	75	**ISE**	25	10	30
									ESE-POE	50	20	
8	201DSP208	PCC	Networking Laboratory	-	-	2	1	25	**ISE**	25	10	10
9	201DSP209	HMCS	Soft Skills Laboratory	-	-	2	1	50	**ISE**	25	10	20
									ESE-OE	25	10	
Total				17	1	8	22	700	-	-	-	280
				26								

ISE: In Semester Evaluation ***MSE: Mid Semester Examinati*** ***ESE: End Semester Examination***

Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students.

Note 2 : ESE will be conducted for 100 marks and converted to 50 marks

Curriculum Structure of Second Year B. Tech. in Computer Science & Engineering (Data Science), Semester – IV

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201DSL210	BSC	Probability and Statistics	3	1	-	4	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
2	201DSL211	PCC	Operating Systems	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
3	201DSL212	PCC	Computer Algorithms	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
4	201DSL213	PCC	Fundamentals of Data Science	3		-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
5	201DSL214	PCC	Theory of Computations	3	-	-	3	100	**ISE**	20	20	40
									MSE	30		
									ESE	50	20	
6	201DSP215	PCC	R Programming Laboratory	2	-	2	3	50	**ISE**	**25**	20	20
									ESE-POE	25		
8	201DSP216	PCC	Data Science Laboratory	-	-	2	1	50	**ISE**	25	10	20
									ESE-POE	25	10	
9	201DSP217	PROJ	Project-I	-	-	2	1	50	**ISE**	25	10	20
									ESE-OE	25	10	
10	201DSMC218	MC	Environmental Studies(Mandatory Course -I)	2	-	-	-	50	**ESE**	50	20	20
Total				19	1	6	21	700	-	-	-	280

ISE: In Semester Evaluation ***MSE: Mid Semester Examination*** ***ESE: End Semester Examination***

Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students.

Note 2 : ESE will be conducted for 100 marks and converted to 50 marks

Course Plan

Course Title: Linear Algebra	
Course Code: 201DSL201	**Semester: III**
Teaching Scheme: L-T-P: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE+ MSE Marks: 20 + 30	**ESE Marks:50**

Course Description:
This course is about the understanding and application of fundamental techniques involved in the analysis of engineering systems. This aims to equip the students with mathematics needed to analyze and solve a range of engineering problems with focus on conceptual understanding.This course focuses on vector space, subspace, linear transformation and fuzzy logics**.**

Course Objectives:

1. To understand basic concepts of linear algebra to illustrate its power and utility through applications to computer science and engineering.
2. To apply the concepts of vector spaces, subspace and linear transformations in engineering.
3. To identify the convergence of infinite series.
4. To understand the fundamentals of fuzzy logic.

Course Outcomes COs: At the end of this course students will be able to

C201.1	Calculate base and dimension of vector spaces
C201.2	Recognize and usebasic properties of subspace and vector space.
C201.3	Interpret the properties of vector spaces and subspaces using linear trnsformations
C201.4	Determine the convergence of infinite series.
C201.5	Explain the fundamental concepts of fuzzy sets, knowledge representation of fuzzy rules and fuzzy logics.
C201.6	Apply arithmetic operations on fuzzy numbe rsuch as Addition and Multiplication

Prerequisite	Vectors, Sequence and Series, Eigen Values and Eigen Vectors, Set Theory

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C201.1	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C201.2	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C201.3	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C201.4	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C201.5	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C201.6	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3

Content	Hours
Unit 1 Vector Spaces The Euclidean space and vector space, subspace, linear combination, span, linearly dependent, independent, bases, dimensions, finite dimensional vector space.	**06**
Unit 2 Subspace Properties Row and column spaces, rank and nullity, bases for subspace, invertibility, application ininterpolation.	**06**
Unit 3 Linear Transformations and applications Linear transformations, basic properties, invertible linear transformation, matrices of lineartransformations, vector space of linear transformations, change of bases	**06**
Unit 4 Infinite Series Introduction of sequence and series**,** comparison test, integral test, D'Alemberts ratio test, Cauchy's root test.	**06**
Unit 5 Introduction to Fuzzy sets Crisp set and Fuzzy set, basic concepts of fuzzy sets, basic operations on fuzzy sets, properties of fuzzy sets	**06**

Unit 6 Fuzzy Arithmetic Fuzzy numbers, Fuzzy cardinality, arithmetic operations on Fuzzy numbers, solutions of Fuzzy equations of type A + X = B and A.X = B.	**06**

Text Books:

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer (2004) (Unit-1,2,3)
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R.Hill, 9th Edition Pearson Education, 2011. (Unit- 4)
3. FuzzySets&FuzzyLogic: Theoryand Applications, by George J. Klir&Bo Yuan. (Unit- 5, 6)

Reference Books:

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition,Academic Press(2016)
2. Applied Abstract Algebra, Rudolf Lidl, GuterPilz, 2nd Edition, Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Course Plan

Course Title: Discrete Mathematics and Social Graphs	
Course Code: 201DSL202	**Semester: III**
Teaching Scheme: L-T-P: 3-1-0	**Credits: 4**
Evaluation Scheme: ISE+ MSE Marks: 20 + 30	**ESE Marks: 50**

Course Description:

The main goal of this course is to introduce topics in Discrete Mathematics relevant to Data Analysis. The objective of this course is to teach students how to think logically and mathematically. This Course consists of concepts of discrete mathematical structures such as Set Theory, Algebraic systems, Lattices, Probability. The course also aims the study of Combinatorial Structure that is the most relevant for Data Analysis, namely Graphs, its Basic Properties and Graphs of Social Networks.

Course Objectives:

1. To develop logical thinking and its application to Computer Science.
2. To understand operations on Relations & Functions.
3. To expose the students to the Concepts of Lattices.
4. To introduce basic concepts of Graph and its Applications.
5. To understand the concepts of Permutations, Combinations, Probability.

Course Outcomes (COs):

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

C202.1	Write an argument using logical notation and determine if the argument is valid or invalid.
C202.2	Identify different types of binary relations on the basis of its properties.
C202.3	Identify the appropriate lattice and minimize the Boolean function.
C202.4	Understand graph theory and apply it to computer science application.
C202.5	Solve the problems using Permutations and Combinations.

Prerequisite:	Mathematics - Probability theory, Set theory

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C202.1	2	-	1		-	-	-	-	-	-	-	1	-	-	5
C202.2	2	-	-	-	-	-	-	-	-	-	-	1	1	-	3
C202.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C202.4	2	-	-	-	2	-	-	-	-	-	-	-	2	-	3
C202.5	2	-	-	-	-	-	-	-	-	-	-	1	-	-	3

Content	Hours
Unit 1: Mathematical logic Statements and Notations, Connectives–negation,Conjunction,disjunction, conditional, bi-conditional, Statement formulas and truth tables, well-formed formulas, Tautologies, Equivalence of formulas, Duality law, Tautological implications, functionally complete sets of connectives, other connective, Normal and principal normal forms, completely parenthesized infix and polish notations, Theory of Inference for statement calculus – validity using Truth Table, Rules of Inference.	9
Unit 2: Binary Relations & Ordering Relation and Ordering - properties of binary relations in a set, Relation Matrix and the Graph of a Relation, Partition and Covering of set, Equivalence relations, Composition of Binary relations, Partial ordering , POSET and Hasse Diagram, Functions – Types, composition of Functions, Inverse Functions.	9
Unit 3: Lattices and Boolean Algebra Lattice as POSETs, definition, examples and properties, Lattice as algebraic systems, Special lattices. Boolean Algebra Definition and examples, Boolean Functions, representation and minimization of Boolean Functions.	6

Unit 4: Concepts of Graphs. Introduction to graph, Graph Terminology, Storage representation and manipulation of Graphs, PERT and related techniques, Graph Invariants and Graph Isomorphism, Handshaking Lemma, Clustering Coefficients, Distances. Diameter. Eccentricity, Cliques, Independent Sets, Vertex Covers, Approximating Optimal Vertex Cover, Connected Graphs and Connected Components.	5
Unit 5:Graphs of Social Network Graphs, Study of Python library NetworkX, Visualization Computing, Graph Parameters.	4
Unit 6:Permutations,Combinations and Probability Theory . Random Experiments, Sample Space & Events, Pigeon Hole Principle, Permutations and Combinations, Concept of Probability,Discrete Probability, Conditional Probability.	6

Text Books:

1. J. P. Tremblay & R. Manohar,"Discrete Mathematical Structures with Application to Computer Science" MGH International (Unit 1 to 3)
2. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications.North-Holland, 1976.(Unit 4,5)
3. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, Tata McGraw-Hill, 2008, ISBN 10:0-07-066913-9.(Unit 6)

Reference Books:

1. Seymour Lipschutz, MarcLipson, "Discrete Mathematics", MGH Schaum'soutlines.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications" AT&T Bell Labs (mhhe.com/rosen)
3. John Schiller, Murray R. Spigel, "Probability and Statistics" MGH, Schaum'soutlines
4. J. M. Aldous. Graphs and Applications. Springer, LPE, 2007
5. Diestel, R. Graph Theory New York, NY: Springer-Verlag, 1997. ISBN: 3540261834
6. Michael Baron, "Probability and Statistics for Computer Scientists", Second Edition, CRC Press publication

Online Resources:

1. https://nptel.ac.in/courses/111/107/111107058/
2. https://nptel.ac.in/courses/106/106/106106094/
3. https://nptel.ac.in/courses/106/106/106106183/

Term Work:

A]The tutorial session should consists of minimum 10-12 assignments .Out of which minimum 7 assignments on the topics from unit no 1,2,3,6 depending on the unsolved exercise problems from the text books 1].J.P.Tremblay& R.Manohar,"Discrete Mathematical Structures with Application to Computer Science" MGH International (Unit 1 to 3) and 2] C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, Tata McGraw-Hill, 2008, ISBN 10:0-07-066913-9.(Unit 6).And minimum 3-4 assignments related to solving the examples on any of the following topics :

a. Computation of TE & TL values by using PERT in graphs
b. Graph Invariants and Graph Isomorphism
c. Approximating Optimal Vertex Cover
d. Connected Graphs and Connected Components
e. Eccentricity, Cliques
f. Pigeon Hole Principle

B] To write programs in C language on any 2 of the following related topics.

1. Generating truth table of a statement
2. Application of bit representation of sets and operations on sets or relations.
3. Conversion of polish expressions.
4. Obtaining the path matrix, paths of different lengths.
5. Allocation of graphs
6. PERT related techniques

C] Practical assignment on library function NetworkX used to operate on graphs and real-world dataset.

Evaluation Guidelines:

1. ISE-I (10 Marks = 5 + 5)
   5 Marks will be based on first 5 Tutorial assignments.
   5 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc) by the subject in-charge.
   - ISE- I will be conducted before MSE

2. ISE –II (10 Marks = 5 + 5)
   5 Marks will be based on programming assignment
   5 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc) by the subject in-charge.
   - ISE- II will be conducted after MSE

Course Plan

Course Title: Structured Computer Organization and Microprocessors	
Course Code: 201DSL203	**Semester: III**
Teaching Scheme: L-T-P: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE+ MSE Marks: 20 + 30	**ESE Marks: 50**

Course Description:

Course covers historical overview of computer architecture. Various CPU organizations and peripherals are studied. Basic arithmetic operations are studied with the help of combinational logic design. Basic microprocessor and microcontroller architectures are analyzed on comparative basis. Advanced microprocessor designs are introduced along with case study. Parallelism at various levels in microprocessor for performance enhancement is explained.

Course Objectives:

1. To make aware about various generation of computers.
2. To introduce different architectural designs.
3. To provide a knowledge of fundamental logic circuits.
4. To provide an understanding of Architecture of basic Microprocessor, Microcontroller and Advanced Microprocessor.
5. To introduce Enhanced Architectural Provisions in Microprocessors.

Course Outcomes (COs):

At the end of the course, students will be able to:

C203.1	Compare various generation of computers.
C203.2	Explain functioning of processor organizations.
C203.3	Make use of basic combinational logic circuits for basic arithmetic operations.
C203.4	Explain Architectural details of basic Microprocessor, Microcontroller and Advanced Microprocessor.
C203.5	Outline advanced features of Microprocessor.

Prerequisite:	Computer and Programming, Fundamentals of Electrical and Electronics Engineering

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C203.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C203.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C203.3	3	1	1		2	-	-	-	-	-	-	1	-	-	3
C203.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C203.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Contents	Hours
Unit 1: Introduction to Structured Computer Organization Languages, Levels and Virtual Machines, Contemporary Multilevel Machines, Evolution of Multilevel Machines, The Zeroth Generation**,** The First Generation, The Second Generation , The Third Generation, The Fourth Generation,The Fifth Generation	5
Unit 2: Computer Systems Organization Processors: CPU Organization, Instruction Execution, RISC versus CISC, Design Principles of Modern Computers, Instruction-Level and Processor-Level Parallelism. Types of Memory: Primary Memory, Secondary Memory, Input/Output: Buses,DMA.	5
Unit 3: Combinational logic design Design of fast Adders: Carry Look Ahead adder, Ripple carry adder, Fast Multiplication: Booths array Multiplier, Bit pair Recoding of Multiplier, Carry-save addition of sum ands,Integer Division.	6

Unit 4: Microprocessor Architecture & Programming 8085 Microprocessor Architecture, The Microprocessor Based Personal Computer System, Internal Architecture, Instruction execution, Classification of Instructions Memory Addressing, Microcontroller, A single chip Microcontroller, Microprocessor Vs. Microcontroller, 8/16 Bit Microcontrollers. **CASE STUDY: Learning model of 8051 microcontroller.**	8
Unit 5: Pentium Microprocessors Pentium Microprocessor, The memory System, Pentium Registers , Pentium Memory Management, Pentium Pro Microprocessor, Internal Structure of the Pentium Pro, The Memory System, The Pentium 4 and Core2, Pentium i3/i5/i7.	6
Unit 6: Parallel Computer Architectures On-Chip Parallelism: Instruction-Level Parallelism, On-Chip Multithreading, Single-Chip Multiprocessors. Coprocessors: Network Processors, Media Processors, Cryptoprocessors, Grid Computing.	6

Text Books

1. Andrew s. tanenbaum, Structured Computer Organization, Pearson, 6th Edition (July 25, 2012) [UNIT 1,2,3 & 6]
2. Barry B. Brey, The INTEL Microprocessors - Architecture, Programming and Interfacing PHI Ltd, 7th Edition (1 Jan. 2006) [UNIT 4&5].
3. Ramesh Gaonkar, Microprocessor Architecture, programming and application with 8085, PENRAM International publishing, 6th Edition (1 Oct. 2013) [UNIT4].

Reference Books:

1. John D.Carpinelli, Computer Systems Organization & Architecture, Pearson Education, (20 October2000).
2. Douglas Hall, Microprocessors and Interfacing, Tata McGraw-Hill Education, (31 Dec. 1899).
3. John UffenBeck, The 8086/8088 Family: Design, Programming, and Interfacing, Pearson Publication, Hardcover Edition, (1 Oct.1986).

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105163/
2. https://nptel/courses/video/108105102/L01.html

Course Plan

Course Title: Data Structures	
Course Code: 201DSL204	**Semester : III**
Teaching Scheme: L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20 + 30	**ESE Marks :50**

Course Description:

This course will introduce the fundamentals of data structures and will provide understanding of how to systematically organize data in a computer system. Also, includes topics which focus on searching and sorting techniques, linked list, tress and graphs. This course is helpful in many areas of electrical engineering, computational biology, computational finance etc. They are used in a variety of applications today including search engines (e.g., Google, Bing), social networking applications (e.g. Facebook, Twitter), embedded systems (e.g., cell phones, robots), and DNA analysis.

Course Objectives:

1. To make the students familiar with basic data structures
2. To select appropriate data structures in computer applications.
3. To provide the students with the details of implementation of various data structures.

Course Outcomes (COs):

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

204.1	Understand the basic concepts and applications of data structures as well as algorithms that operate on them.
204.2	Compare various data structures, searching and sorting techniques and recognize the advantages and disadvantages of them.
204.3	Understand the details of implementation of various data structures.
204.4	Select appropriate data structures, searching and sorting techniques in computer applications.

Prerequisite:	Basic knowledge of algorithms and C programming

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C204.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C204.2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
C204.3	3		-	-	-	-	-	-	-	-	-	-	-	-	2
C204.4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	3

Content	Hours
Unit 1. Basic of Data Structures Data structure- Definition, Types of data structures, Data Structure Operations, Algorithms: Complexity, Time and Space complexity.	4
Unit 2. Searching and Sorting Techniques Linear search, Binary search,Sentinel search, Fibonacci search, Hashing – Definition, hash functions, Collision, Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Radix sort, Tim sort, Complexity and analysis.	7
Unit 3. Stacks and Queues Stack: Definition, operations, Array representation of stack, applications Queue: Definition, operations, Array representation of queue, applications, Circular queue, Priority queue, Deque.	7
Unit 4. Linked Lists Definition, representation, operations, implementation and applications of singly, doubly and circular linked lists. Linked representation of stack and Queue, Dynamic memory management, Memory efficient doubly linked list, unrolled Linked List,Skip List	6
Unit 5. Trees Terminology, representation, binary tree, traversal methods, binary search tree, XOR Tree, AVL search tree, B tree, B+ tree, Heaps- Operations and their applications, Heap sort.	8
Unit 6. Graphs Basic concept of graph theory, storage representation, graph traversal techniques- BFS and DFS, Graph representation using sparse matrix, Transpose of sparse matrix.	6

Text Books:

1. Seymour Lipschutz (MGH), Data Structures; McGraw Hill publications, Third Edition, [1 July 2017].
2. Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft , Addison-Wesley Series, Data Structures and Algorithms; [1983].
3. NarasimhaKarumanchi, Data Structure and Algorihmic Thinking with Python, CareerMonk Publication,[2016].

Reference Books:

1. Jean-Paul Tremblay, Paul. G. Soresan, "An introduction to data structures with Applications" - Tata Mc-Graw Hill International Editions, 2nd edition .
2. Richard F. Gilberg and Behrouz A., Data Structures- A Pseudo code Approach with C, 2nd Edition [15 Nov. 2007].
3. A. M. Tanenbaum, Y. Langsam, Data Structure using C; M. J. Augenstein, PHI publication, 2nd Edition, [1996].

Online Resources:

1. NPTEL videos: https://nptel.ac.in/courses/106/102/106102064/

Course Plan

Course Title: Fundamentals of Networking	
Course Code: 201DSL205	**Semester: III**
Teaching Scheme: L-T-P: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks: 20 + 30	**ESE Marks: 50**

Course Description:

This course provides a comprehensive introduction to computer networks and networking aspects which will be of help to all Computer Science Engineering Streams. Course includes computer networking fundamentals, network layered architectures, descriptive study of different layers of networking models, network protocols and tools.

Course Objectives:

1. To perceive fundamental concepts of Computer Networks.
2. To understand layered architecture and basic networking protocols.
3. To understand the Client server model & socket interface.

Course Outcomes:

Upon successful completion of this course, the student will be able to –

C205.1	Describe the concepts of Computer Networks and Network layered architecture.
C205.2	Understand the protocols, algorithms and the addressing model used in networking.
C205.3	Demonstrate different networking protocols using socket programming.
C205.4	Understand the functionality of Domain Name System in networking.

Prerequisite:	Basic knowledge of computers

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C205.1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	2
C205.2	2	3	-	3	-	-	-	-	-	-	-	-	-	-	2
C205.3	2	3	2	3	-	-	-	-	-	-	-	-	1	-	3
C205.4	2	2	-	3	-	-	-	-	-	-	-	-	2	-	2

Content	Hours
Unit 1. Introduction to Computer Network: Overview of OSI layer Model and TCP/IP protocol model, Addressing, Underlying technologies for LANs, WANs, and Switched WANs.	5
Unit 2. Data Link Layer: Design issues for Data Link Layers, framing methods, Error control: detection and correction, Flow control, Elementary Data Link protocols, Sliding window Protocols Go back n, Selective repeat.	6
Unit 3. Network Addressing: IPv4 Addresses: Classful Addressing Other Issues, Sub-netting and Super netting, Classless Addressing, Delivery, Forwarding and routing. IPv4: Datagram, Fragmentation, Options, Checksum. IPv6 Addressing: Introduction, IPv6 packet format: Base Header, Flow Label, Extension Headers, Transaction from IPV4 to IPV6, Comparison between IPv4 and IPv6	7
Unit 4. Routing and Congestion Control techniques: Routing methods: shortest path, Link state, Distance vector routing and broadcast routing, Congestion control algorithms: Principles, Congestion prevention policies, congestion control in datagram subnet, Load Shedding, Jitter Control.	5
Unit 5. Transport Layer: The Transport service primitives, UDP: Process to Process communication, User Datagram Format, Operation and uses of UDP. TCP: TCP Services and Features, TCP segment format, TCP Connections.	6

Unit 6. Application Layer: Principles of Network Applications: Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application-Layer Protocols. The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, Web Caching. FTP, TFTP. DNS—The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages. DHCP. Telnet. Socket Programming: Socket Programming with UDP, Socket Programming with TCP.	7

Text Books:

1. Behrouz A. Forouzan, TCP/IP protocol Suit, Tata Mag. Hill, 4thEd. [Unit 1 – 5]
2. Kurose James F., Ross Keith W., Computer Networking: A Top-Down Approach, Sixth Edition, By Pearson. [Unit 6]

Reference Books:

1. Peter L Dordal, An Introduction to Computer Networks, Release 1.9.15.
2. Andrew S. Tanenbaum (PHI), Computer Networks.
3. W. Richard Stevens (PHI), Unix Network Programming.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs18/preview

Course Plan

Course Title: Python Programming Laboratory	
Course Code:201DSP206	**Semester: III**
Teaching Scheme: L-T-P: 2-0-2	**Credits: 3**
Evaluation Scheme: ISE Marks:25	**ESE(POE) Marks: 25**

Course Description:

Python is a high-level programming language that helps in developing a wide variety of applications, including web applications, network programming, graphical user interfaces (GUIs), scientific and numeric applications. It also has a strong community around machine learning, data modeling, data analysis and artificial intelligence (AI), with extensive resources and libraries built for these purpose.

Course Objective:

1. To make the student learn basics of python programming language.
2. To expose the students to various data structures.
3. To make the students aware of various Object Oriented concepts.
4. To expose the students to advanced concepts in Python.

Course Outcomes (COs):

COs	Course Outcomes
	Upon successful completion of the course, student will be able to…
206.1	Summarize the basic concepts in python.
206.2	Identify the data structures to solve a problem.
206.3	Demonstrate the use of Object Oriented concepts in problem solving.
206.4	Apply Python concepts in web application using Django framework.
206.5	Use networking and multithreading concepts to solve a problem.

Prerequisite:	Knowledge of some programming language like C/C++

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes(PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C206.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C206.2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3
C206.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
C206.4	2	-	-	-	2	-	-	-	-	-	-	-	-	-	3
C206.5	2	-	2	-	2	-	-	-	-	-	-	-	1	-	3

Content	Hours
Unit 1:Getting started with Python: Python Installation and Working of it, Data types in python, Operators in python, Input and Output,detail study of python blocks, control statements, Branching statements.	3
Unit 2: Basics of Python Programming: String and Character in python, List and Tuples, Dictionaries, Arrays in python, Functions.	5
Unit 3:OOP Concepts in Python: Procedural and Object-Oriented Programming, Objects, class, Method overloading, Polymorphism, Inheritance, hands on with Lamba function in python coding with the use of functions, modules and external packages.	4
Unit 4: Files in Python: Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.	5
Unit 5: Python Integration Primer: Graphical User interface, Networking in Python	4
Unit 6: Advanced Python: Introduction to Django, Introduction to Multithreading and security in Python.	3

Text Books:

1. "Beginning Python: Using Python 2.6 and Python 3.1"., Wrox Publication
2. Anurag Gupta, G. P. Biswas, "Python Programming", McGraw-Hill
3. E. Balagurusamy, "Introduction to computing and problem-solving using python", McGraw Hill Education

Reference Books:

1. "Learn Python the Hard Way, 3rd Edition, Zed Shaw's Hard Way Series
2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication

Online Resources:

1. https://nptel.ac.in/courses/106/106/106106182/

List of Experiments			
Expt. No.	**Name of Experiments**	**S/O**	**Hours**
1	Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples)	O	2
2	Program for Implementation of control statements.	O	2
3	Creating functions, classes and objects using python. Demonstrate exception handling	O	2
4	Program for implementation of inheritance.	O	2
5	a. Python program to display file available in current directory b. Python program to append data to existing file and then display the entire file	O	2
6	Python program to count number of lines, words and characters in a file.	O	2
7	Creating Calculator GUI with python.	O	2
8	Menu driven program to create a phone directory	O	2
9	Creation of simple socket for basic information exchange between server and client.	O	2

10	Creating web application using Django web framework to demonstrate functionality of user login and its validation using regular expression	O	2
11	Programs on Threading using python.	O	2
12	Program to implement data pre-processing technique using Python.	O	2

❖ **S-Study, O-Operational**

Note: Students should perform minimum 10-12 experiments based on above list

Textbooks:

1. David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler "Python Basics: A Practical Introduction to Python 3", Realpython
2. Samuel Dauzon, AidaBendoraitia, ArunRavindran,"Django:Web Development with Python".

Reference Books:

1. Learn Python the Hard Way,Zed Shaw's Hard Way Series, 3rd Edition
2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication

Online Resources:

1. Virtual Lab
   https://python-iitk.vlabs.ac.in/
2. NPTEL videos[Joy of Computing]
   https://nptel.ac.in/courses/106/106/106106182/

Course Plan

Course Title :Data Structures Laboratory	
Course Code :201DSP207	Semester : III
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE(POE) Marks: 50

Course Description: The course is designed to develop skills to design and analyse simple linear and non-linear data structures. It strengthen the ability to the students to identify and apply the suitable data structure for the given real world problem. It enables them to gain knowledge in practical applications of data structures.

Course Objectives:

1. To teach the students to identify appropriate data structures.
2. To provide the students with the details of implementation of various data structures.
3. To select appropriate data structures in computer applications.

Course Outcomes (COs):

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

C207.1	Outline the solution to the given software problem with appropriate data structure.
C207.2	Identify appropriate data structure for specific application.
C207.3	Formulate the problem statement and implement to solve that statement.
C203.4	Choose appropriate sorting & searching algorithms.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs)

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C207.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
C207.2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C207.3	-	3	3	-	2	-	-	-	-	-	-	-	1	-	3
C207.4	3	-	2	-	-	-	-	-	-	-	-	2	-	-	3

List of Assignments			
Ass. No.	**Name of Assignment**	**S/O**	**Hours**
1	Write a program to find an element in matrix using search technique.	O	2
2	Role play activity on searching techniques.	O	2
3	Programs to implement sorting techniques to sort an array of 0s, 1s and 2s.	O	2
4	Role play activity on sorting techniques.	O	2
5	Programs to implement stack using array and linked list.	O	2
6	Programs to implement queue using array and linked list.	O	2
7	Programs to implement various operations on linked list.	O	2
8	Programs to implement Memory efficient linked list.	O	2
9	Programs to implement BFS and DFS.	O	2
10	Case Study- 1. Garbage Collection. 2. Priority queue in bandwidth management. 3. Null Terminated or Cyclic Node. 4. Use of sparse matrix in Social Networks and Maps.	S	2

- **S-STUDY, O-OPERATIONAL**
- **Note: The instructor should take all ten experiments from list.**

Text Books:

1. Data Structures using C – Seymour Lipschutz (MGH), McGraw Hill publications, Revised 1st Edition. [1 July 2017]
2. C- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein, Data Structure using; PHI publications, 2nd Edition, [2017].

Reference Books:

1. Ellis Horowitz, S. Sahni, D. Mehta, Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi 1995 ISBN 16782928.
2. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to data structures with Applications, Tata Mc-Graw Hill International Editions, 2nd edition 1984, ISBN-0-07-462471-7.

Online Resources:

1. Virtual Lab: https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
2. NPTEL videos: https://nptel.ac.in/courses/106/102/106102064/

Course Plan

Course Title: Networking Laboratory	
Course Code: 201DSP208	Semester: III
Teaching Scheme: L-T-P: 0-0-2	Credits: 1
Evaluation Scheme: ISE Marks: 25	ESE Marks: Not Applicable

Course Description:

This course provides a practical implementation of the computer networking theoretical aspects, studied during the lecture hours. Course includes computer networking fundamentals, demonstrations and implementation of network setup using networking tools &layered architectures, descriptive study of different layers of networking models, network protocols and algorithms.

Course Objectives:

1. To understand the fundamental concepts of Computer Networks.
2. To understand the different network connectivity and analyzing tools.
3. To implement the networking protocols and algorithms.
4. To implement the Client server model.

Course Outcomes:

Upon successful completion of this course, the student will be able to –

C208.1	Demonstrate use of Network Models and its Components.
C208.2	Implement the protocols and algorithms used in different layers of the network.
C208.3	Apply the principles of socket programming using TCP & UDP in the networks.
C208.4	Demonstrate the DNS and network analysing tools.

Prerequisite:	Basic knowledge of computers, C / C++ Programming Language, Linux, and Windows OS

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs)

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C208.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C208.2	2	1	2	2	-	-	-	-	-	-	-	-	-	-	3
C208.3	3	2	1	1	-	-	-	-	-	-	-	-	2	-	3
C208.4	3	1	-	1	-	-	-	-	-	-	-	-	1	-	3

Sr. No.	Title	S/O	Hours
01	Study of various Computer Networking models and connectivity devices.	S	2
02	Implementation of cross-wired cable and straight through cable using crimping tool.	O	2
03	Study of IP address configuration & following connectivity test tools with all its options – ifconfig, arp, traceroute, nmap, netstat, finger.	O	2
04	Implementing Framing method: Bit Stuffing	O	2
05	Implementing Elementary data link protocol (Stop & wait protocol)	O	2
06	Implementation of Error detection Code (CRC / Hamming)	O	2
07	Implementation of sliding window protocol.	O	2
08	Implement the routing algorithm (any one).	O	2
09	Programs for connection oriented (TCP) client-server using socket programming	O	2
10	Programs for connection less (UDP) client-server using socket programming	O	2
11	Study of following DNS Tools with all its options. nslookup, dig, host, whois.	O	2

12	Study of network protocol analyzer (Wire-Shark) and understanding packet formats for UDP, TCP & Application Layer protocols.	O	2

S- Study, O-operational

Instructions for practical examinations and termwork:

It should consist of 10-12 experiments based on the syllabus and should be implemented by using Socket Programming. The study experiments should consist of some practical work and observations.

Student's activities to be conducted:

1. Group-play activities for demonstration of data-link layer protocols.
2. Industrial visit to a networking-based industry.
3. Group/Individual Presentation activity after a visit to a networking-based industry or laboratory.
4. Implementation and Configuration of the TFTP / FTP Client-Server model, in a group (2-5 students per group).
5. Seminar / Webinar / Workshop for students by an Industrial expert.

Textbooks:

1. Behrouz A. Forouzen, TCP/IP protocol Suit, Tata Mag.Hill, 4thEd.
2. W. Richard Stevens (PHI), Unix Network Programming
3. Kurose James F., Ross Keith W., Computer Networking: A Top-Down Approach, Sixth Edition, By Pearson.
4. Peter L Dordal, An Introduction to Computer Networks, Release 1.9.15.

Reference Books:

1. Andrew S. Tanenbaum (PHI), Computer Networks
2. D. E. Comer, David L. Stevens (Pearson Ed.), Internetworking with TCP/IP, Vol. III, Client-Server Programming and Application (2nd Ed.)

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs18/preview

Course Plan

Course Title : Soft Skills Laboratory	
Course Code : 201DSP209	**Semester : III**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks: 25	**ESE(OE) Marks : 25**

Course Description:

Soft skills are character traits and interpersonal skills that characterize a person's relationships with other people. This course includes Communication skills, Writing skills, Techniques for self-development, Teamwork and group discussions, Time and stress management, Professional skills for overall development of an Engineer.

Course Objectives:

1. To make the engineering students aware of the importance, the role and the content of soft skills.
2. To develop and nurture soft skills of the students through individual and group activities.
3. To expose students to right attitudinal and behavioral aspects and to build the same through activities.
4. To encourage overall development of students by focusing on soft skills.

Course Outcomes (COs):

At the end of the course, students will be able to:

C209.1	Effectively use skills to communicate clearly and improve listening and writing skills.
C209.2	Make use of techniques for self-awareness and self-development.
C209.3	Understand the importance of teamwork and group discussion skills.
C209.4	Apply time management and stress management skills.
C209.5	Apply professional skills and ethics effectively being an Engineer.

Prerequisite:	Basic communication and writing skills in English.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C209.1	-	-	-	-	-	-	-	-		3	-	-	-	-	3
C209.2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3
C209.3	-	-	-	-	-	-	-	-	2	2	-	-	-	-	2
C209.4	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3
C209.5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3

Contents	Hours
Unit 1: Getting Started with Soft Skills Introduction to Soft Skills, Communication Basics, Official Communication, Online Meetings, Comprehension, Reading Research Papers.	4
Unit 2: Behavioral Skills and Self Development Confidence Improvement, Positive Attitude, Positive Thinking, Personal Accountability, Diversity Awareness, Empathy, Emotional Intelligence, Emotional Quotient, Self-Management: Self-Evaluation, Self-Discipline, Self-Awareness.	4
Unit 3: Leadership and Team Building Culture and Leadership: Salient Features of Corporate Culture, Leadership Styles, Leadership Trends, Team Building: Types of Teams, Team Development Stages, Attributes of a Successful Team, Barriers involved, Role of Team leader.	4
Unit 4: Developing Writing skills Writing Proposals, Project Synopsis, Report Writing, Technical Paper Writing, Writing for Employment: Job Search, Cover Letter, Functional and Chronological Resumes, Professional Correspondence.	4
Unit 5: Stress and Time Management Stress in Today‘s Time, Positive Stress, Negative Stress, Types of Stressors, Identify the Stress Source, Reasons and Effects, Identifying Stress, The four A's of Stress Management, Approaches: Action-oriented, Emotion-oriented and Acceptance-oriented. Time Management, Time Management Techniques.	4

Unit 6: Professionalism Goal Setting, Planning and Managing Carrier, Developing Work Ethics, Presenting yourself Professionally: Dressing Etiquettes, Corporate Grooming and Dressing, Etiquette and Mannerism: All types of Etiquettes. Technology Etiquette: Email and Telephone Etiquette, Interview Etiquette. Job Interview: Types of Interviews as Telephonic, Face to Face and Online Interview.	4

Text Books:

1. Krishna Mohan and MeeraBanerji- Developing Communication Skills by MacMillan India Ltd., Delhi
2. Gajendra Singh Chauhan, Sangeeta Sharma- Soft Skills – An Integrated Approach to Maximize Personality, WILEY INDIA, ISBN:13:9788126556397.
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education, Edition 1, 2013.
4. PriyadarshiPatnaik- Group Discussions and Interview Skills, Cambridge University Press.

Reference Books:

1. Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.
2. Francis Sounderaj- Basics of Communication In English, MacMillan India Ltd.
3. Simon Sweeney—English for Business Communication, Cambridge University Press, ISBN13:978-0521754507.
4. Barun K. Mitra- Personality Development & Soft Skills, Oxford Publishers, Third Impression, 2017.
5. ShaliniVerma- Development of Life Skills and Professional Practice, First Edition; Sultan Chand (G/L) & Company, 2014.
6. Remesh S, Vishnu R. G.- Life Skills for Engineers, Ridhima Publications, First Edition, 2016.

List of Sessions			
Expt. No.	**Name of Session**	**S/O**	**Hours**
1	Role Play and Drama Play	O	2
2	Attitude Activity	O	2
3	Emotional Intelligence and Emotional Quotient Test Activity	O	2
4	Leadership and Team Building Activity	O	2
5	Group Discussion Activity	O	2
6	Debate Activity	O	2
7	Presentation Skills	O	2
8	Functional and Chronological Resume writing	O	2
9	Professional Correspondence	O	2
10	Stress Management Activity	O	2
11	Time Management Activity	O	2
12	Professional Etiquettes	S	2
13	Interview Activity	O	2

- **S-Study, O-Operational**
- **Note: The instructor may choose minimum 10 Sessions from Session No. 1 to 13.**

Term work:

1. Various activities to be taken based on assignments like self-introduction, role play, group discussions, presentations and team activity etc.
2. Multiple set of activity based assignments can be prepared to allow multiple skills exposure for team building, value sharing, leadership and role play.

3. Faculty may arrange one or more sessions from following: yoga and meditation, stress management, relaxation exercises and fitness exercises. Time management and personal planning sessions.
4. Continuous assessment of laboratory work is to be done based on overall performance and lab assignment performance of the student.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Course Plan

Course Title: Probability and Statistics	
Course Code: 201DSL210	**Semester: IV**
Teaching Scheme: L-T-P: 3-1-0	**Credits:4**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks:50**

Course Description:

This course plays important role in Data Science. This course provides fundamentals of probability and statistics which required for Data Science .This course focuses on dispersion and measure of central tendency, testing hypothesis, correlation and regression, probability distribution and recurrence relation.

Course Objectives:

1. To introduce students to understnd, explain and apply the fundmental probability and statistical concepts at the core of computer science
2. To understand use of concepts of stataistics, measures of dispersion
3. To learn the fundamental theory of testing hypothesis and sample tests
4. To learn the concepts of correlation, regression and curve fitting
5. To understand use of recurrence relation

Course Outcomes COs: At the end of this course students will be able to

C210.1	Apply the knowledge to study the data given with respect to dispersion and measure of central tendency.
C210.2	Understand tests for hypothesis and its significance.
C210.3	Describe the statistical data numerically by using correlation, regression and curve fittings.
C210.4	Solve basic problems in probability theory, including problems involving the binomial, poisson, and normal distributions.
C210.5	Apply the recurrence relation to solve the counting problemms and programme analysis problems.

Prerequisite	Basic Probability Theory

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C210.1	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C210.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C210.3	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C210.4	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3
C210.5	3	2	-	-	2	-	-	-	-	-	-	-	-	-	3

Content	Hours
Unit 1 Frequency distribution and measure of central Tendency Frequency distribution, Continuous frequency distribution, Graphical representation of a Frequency distribution- Histogram, frequency polygon, Measure of central tendency- Arithmetic mean, median and mode, Range, Quartile deviation, Mean deviation, Standard deviation	6
Unit 2 Testing of hypothesis Introduction, Statistical hypothesis (Simple and Composite), Null hypothesis, Alternative hypothesis, Critical region, Type I and Type II errors, Level of significance, Test for goodness of fit of chi square distribution	6
Unit 3 Correlation and Regression Introduction, Types of correlation, Karl Pearson's coefficient of correlation, Interpretation of the coefficients of corrections, Computation of coefficient of correlation for ungroup data, Lines of regression , Calculations of equations of the lines of regression	6
Unit 4 Probability Distribution Functions Introduction, Elementary theory of probability, Random variables.Discrete probability distribution,Continuous probability distribution, Binomial distribution, Poisson distribution, Normal distribution.	6
Unit 5 Recurrence Relation: Introduction, Definition of recurrence relation, Linear recurrence relation with constant coefficients, Construction of recurrence relation,	6

Solution of recurrence relation- Homogeneous and non-homogeneous, Solution of homogeneous and non-homogeneous recurrence relation	
Unit-6 Curve Fitting Fitting of curve by method of lest squares, Fitting of straight lines, Fitting of exponential curve, Fitting of second degree parabolic curve	6

Text Books:

1. Walpole, Myers, Myers, Ye, Probability and Statistics for Engineers and Scientists, Pearson Education Inc., 8th Edition, 2007, ISBN: 978-81-317-1552-9.
2. Numerical Methods in Engineering and Science, by Dr. B. S. Grewal

Reference Books:

1. Douglas C Montgomery, George C Runger, Applied statistics and Probability for Engineers, Wiley Asia Student Edition, 4th Edition, 2007, ISBN: 978-81-265-2315
2. Richard I Levin, David S Rubin, Statistics for Management, Prentice Hall India, 7th Edition, 1997, ISBN: 9780134762920.
3. Purna Chandra Biswal, Probability and Statistics, PHI Learning Private Limited, Eastern Economy Edition, 2007, ISBN: 978-81-203-3140-2

List of Tutorial		
Sr. No	**Title of Tutorial**	**Hours**
1.	Measure of Central Tendency	1
2.	Testing of Hypothesis	1
3.	Computation of Correction	1
4.	Lines of Regression	1
5.	Probability Distribution- Binomial Distribution and Poisson Distribution	1
6.	Probability Distribution- Normal Distribution	1
7.	Recurrence Relation	1
8.	Curve Fitting	1
9.	Fitting of First and Second Degree Curve Using SCILAB/MATLAB	1
10.	Measure of Central Tendency Using SCILAB/MATLAB	1

Course Plan

Course Title: Operating Systems	
Course Code: 201DSL211	Semester: IV
Teaching Scheme: L-T-P: 3-0-0	Credits: 3
Evaluation Scheme: ISE + MSE Marks: 20 + 30	ESE Marks: 50

Course Description:

This course provides comprehensive overview of computer operating systems. It covers the foundation components, classical internal algorithms, and structures of operating systems, including process scheduling, memory management and IO management.

Course Objectives:

1. To learn the basic concepts of operating system, services and operations in the operating system.
2. To expose the students to various functions of the operating system and their usage.
3. To make the students understand process management, memory management and I/O device Management.
4. To provide knowledge to the students about the fundamental architecture of UNIX and operating system kernel.

Course Outcomes (COs):

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

C211.1	Understand the structure, functions and services of an operating system.
C211.2	Describe the methods of process management, process synchronization and deadlocks.
C211.3	Demonstrate the various memory management and I/O management techniques in effective execution of programs.
C211.4	Analyse the process scheduling, memory management and I/O management techniques.

Prerequisite:	Fundamental knowledge of computer, C programming, Data Structure

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C211.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C211.2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1
C211.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
C211.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	4

Content	Hours
Unit 1. Introduction Evolution of operating systems, Types of operating systems, Different views of the operating system, The journey of a command execution, Overview of design and implementation of operating systems.	5
Unit 2. Process Management & Synchronization Process Concept, Operations on Processes, Interprocess Communication, Threads, Process Synchronization - Race Conditions, Critical Sections, Synchronization Approaches, Classic Process Synchronization Problems, Semaphores, Monitors.	6
Unit 3. Process Scheduling & Deadlock Scheduling Terminology and Concepts, Nonpreemptive Scheduling Policies, Preemptive Scheduling Policies, Process Scheduling - Case Studies, Deadlocks - Deadlocks in Resource Allocation, Handling Deadlocks, Deadlock Detection and Resolution, Deadlock Prevention, Deadlock Avoidance.	7
Unit 4. Memory Management Managing the Memory Hierarchy,Static and Dynamic Memory Allocation, Memory Allocation to a Process, Contiguous Memory Allocation,Noncontiguous Memory Allocation, Paging, Segmentation, Virtual Memory-Demand Paging, Page Replacement Policies.	6
Unit 5. File Systems and I/O Management Overview of File Processing,Files and File Operations,Fundamental File Organizations and Access Methods,Directories, Layers of the Input-Output Control System, Overview of I/O Organization, I/O Devices, Device Drivers.	7

Unit 6. Unix Operating System (Case Study) System structure, User perspective, Architecture of the UNIX operating system, Introduction to system concepts, Kernel data structures, system administration, System calls for the file system-introduction, Network based Operating Systems.	5

Text Books:

1. Milan Milenkovic, Operating systems concepts and design, McGRAW-Hill, 2nd edition. [Unit 1]
2. Silberschatz, Galvin, Gagne, Operating system concept, Wiley India, 8thedition.[Unit 2, 6]
3. Dhananjay M Dhamdhere, Operating systems - A Concept Based approach, Mc-Graw Hill, 3rd Edition. [Unit 3 to 5]
4. Maurice J. Bach, The design of Unix Operating System, PHI. [Unit 6]

Reference Books:

1. William Stallings, Operating Systems: Internals and Design Principles, Pearson,7th edition
2. Andrew S. Tanenbaum, Modern Operating Systems, Pearson Education International, 4th edition.
3. Achyut S. Godbole, Operating System with case studies in UNIX, Netware and Windows NT, TMGH.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105214/#
2. https://nptel.ac.in/courses/106/102/106102132/
3. https://www.cse.iitb.ac.in/~mythili/os/

Course Plan

Course Title: Computer Algorithms	
Course Code: 201DSL212	**Semester: IV**
Teaching Scheme: L-T-P: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE+MSE Marks: 20+30	**ESE Marks:50**

Course Description:

This course introduces basic methods for the design and analysis of efficient algorithms. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures.It introduces the fundamental techniques for designing and analysing algorithms, including asymptotic analysis, divide-and-conquer algorithms, greedy algorithms, dynamic programming, traversal methods and even backtracking approach. It also provides introduction to NP-completeness.

Course Objectives:

1. To introduce algorithm design methods / techniques with analysis.
2. To devise algorithm for given problem statement and compute its complexity
3. To introduce complex computational problems

COs	**Course Outcomes**
	Upon successful completion of the course, student will be able to…
C212.1	Understand and demonstrate algorithm design methods with analysis.
C212.2	Devise algorithm for given problem statement and analyse its space and time complexity by using recurrence relation.
C212.3	Categorize the problem to determine polynomial and non-polynomial based on its nature.

Prerequisite:	Data Structures, Discrete Mathematics, Engineering Mathematics, Programming Concepts.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C212.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C212.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C212.3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	4

Contents	Hours
Unit 1: Divide and Conquer: What is algorithm, Algorithm Specification, Recurrence relations, Performance Analysis, Randomized Algorithms, Divide and Conquer: The general method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, DC Selection Algorithm, analysis of Divide and Conquer algorithms.	8
Unit 2. The Greedy Method: The general method, Knapsack problem, Job sequencing with deadlines, minimum-cost spanning trees – Prim's and Kruskal's Algorithms, Optimal storage on tapes, Optimal merge Patterns, Single source shortest paths.	6
Unit 3. Dynamic Programming: The general method, Multistage graphs, All pair shortest paths, 0/1 knapsack, Reliability design, Traveling Sales person problem.	6
Unit 4 : Basic Traversal and Search Techniques: Techniques for Binary Trees, Game Tree; Techniques for Graphs – Breadth First Search & Traversal, Depth First Search & Traversal, AND/OR graphs; Connected components and Spanning Trees; Bi-connected components and depth first search.	6
Unit 5: Backtracking: The general method, 8-queen problem, sum of subsets, Knapsack Problem, Hamiltonian Cycle, and Graph Coloring.	5
Unit 6: NP Hard and NP Complete Problems: Basic Concepts, Introduction to NP Hard Graph Problems.	5
Case Study: Study of two Machine Learning Algorithms along with the time and space complexities of the two.	3

Text Books:

1. Ellis Horowitz, SatrajSahani, SaguthevarRajasejaran, Fundamentals of Computer Algorithms Universities Press, Second Edition (All Units)

Reference Books:

1. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, Pearson Education
2. Kyle Loudon, Mastering Algorithms with C, SPD O'Reilly
3. Allen Van Gelder , Sara Baase, Computer Algorithms- Introduction to Design and Analysis, Pearson Education

Course Plan

Course Title: Fundamentals of Data Science	
Course Code: 201DSL213	**Semester: IV**
Teaching Scheme: L-T-P: 3-0-0	**Credits :3**
Evaluation Scheme: ISE+ MSE Marks: 20+30	**ESE Marks: 50**

Course Description:

This course is for students with basic programming and data structure background. The aim is to make them abreast with common tools used for Data Science application development. It serves as an introduction to the basics of data science including programming for data analytics.

Course Objectives:

1. To provide the students with the basic knowledge of Data Science.
2. To make the students develop solutions using Data Science tools.
3. To introduce them to Python packages and their usability.

Course Outcomes (COs):

COs	Course Outcomes
	Upon successful completion of the course, student will be able to…
C213.1	Summarize the basics of data science and its process.
C213.2	Construct solution to a given problem using knowledge of tools for Data Science.
C213.3	Build a solution to a given problem using NumPypackage-e.
C213.4	Explain functions of Python libraries.

Prerequisite:	Knowledge of Statistics, Data Structures and Algorithms.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C213.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C213.2	3	2	1	-	1	-	-	-	-	-	-	-	-	-	3
C213.3	3	-	1	-	2	-	-	-	-	-	-	-	-	-	3
C213.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Content	Hours
Unit 1.Data Science and Its Scope: What Is Data Science, Data Science and Statistics, Role of Statistics in Data Science, A Brief History, Difference between Data Science and Data Analytics, Knowledge and Skills for Data Science Professionals, Some Technologies used in Data Science, Benefits and uses of data science, Facets of data.	5
Unit 2. The data science process: Overview, Defining research goals and creating a project charter, Retrieving data, Cleansing, integrating, and transforming data, Exploratory data analysis, Build the models, Presenting findings and building applications on top of them.	6
Unit 3: Data Analysis Tools for Data Science and Analytics: Data Analysis Using Excel: Introduction, Getting Started with Excel, Format Data as a Table, Filter and Sort, Perform Simple Calculations, Data Manipulation Sorting and Filtering Data Derived Data, Highlighting Data, Aggregating Data: Count, Total Sum Basic Calculation using Excel, Analyzing Data using Pivot Table/Pivot Chart, Descriptive Statistics using Excel, Visualizing Data using Excel Charts and Graphs, Visualizing Categorical Data: Bar Charts, Pie Charts, Cross Tabulation, Exploring the Relationship between Two and Three Variables: Scatter Plot Bubble Graph and Time-Series Plot.	7
Unit 4. Introduction to NumPy: Creating Arrays from Scratch, NumPy Standard Data Types, The Basics of NumPy Arrays, Array Indexing, slicing, reshaping, Concatenation, splitting, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, Comparison operator, Boolean arrays.	6

Unit 5. Data Manipulation with Pandas: Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing. Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping, Pivot Tables	6
Unit 6. Visualization with Matplotlib: General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Bindings, and Density.	6

Text Books:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science",Manning Publications.[Unit 1 and 2]
2. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'REILLY Publication.[Unit 3,4,5]
3. DR.AmarSahay, "Essentials of Data Science and Analytics", O'REILLY Publication.[Unit 1 and 3]

Reference Books:

1. Data Science from Scratch: First Principles with Python, O"Reilly Media, 2015.
2. Glenn J. Myatt John, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, Wiley Publishers, 2000.

Online Resources:

1. https://nptel.ac.in/courses/106/106/106106212/

Course Plan

Course Title: Theory of Computations	
Course Code: 201DSL214	**Semester: IV**
Teaching Scheme: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE+MSE Marks:20+30	**ESE Marks: 50**

Course Description:

The course introduces some fundamental concepts in automata theory including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. It also aims to expose the students to the concepts of Entropy, Randomness and few compression techniques. The word automaton itself is closely related to the word "automation" which denotes automatic processes carrying out the production of specific processes. Simply stated, automata theory deals with the logic of computation with respect to simple machines, referred to as automata. Through automata, computer scientists are able to understand how machines compute functions and solve problems.

Course Objectives:

1. To expose the students to the mathematical foundations of computation, the theory of formal languages and grammars.
2. To analyze and design finite automata, pushdown automata, grammar for formal languages & Turing machines.
3. To strengthen the students' ability to carry out formal and higher studies in computer science.

Course Outcomes (COs):

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

C214.1	Understand the concept of abstract machines and their power to recognize the languages.
C214.2	Design context free grammars for formal languages and simplify using normal forms and design parsers
C214.3	Understand the concepts of push down automata and properties of RL and CFL
C214.4	Design the computational and acceptor machines using FA, PDA and Turing machines
C214.5	Understand concepts of Entropy, Randomness, and Compression Techniques

Prerequisite:	Discrete Mathematical Structures

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C214.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C214.2	-	1	1	-	-	-	-	-	-	-	-	1	-	-	3
C214.3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	3
C214.4	2	2	2	-	-	-	-	-	-	-	-	1	2	-	3
C214.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Content	Hours
Unit 1. Introduction to Regular Languages and Finite Automata **Regular Languages**: Regular Language, Recursive definition of Regular Expressions, Examples on writing Regular Expressions for Regular Languages, Closure Properties of Regular Language. **Finite Automata:** Definition, Designing DFA, Union, Intersection &Complement of Regular Languages and DFA, Applications of FA, Introduction to Output producing FAs: Mealy and Moore machine	8
Unit 2. Nondeterminism and Kleene's Theorem Nondeterministic finite automata and NFA with null transition along with corresponding extended transition function, Examples on designing NA and NFA- null, Equivalence of FA's,Kleene's Theorem Part I along with its proof, Examples on constructing NFA – null using Kleene's theorem, Kleene's Theorem Part II (only introduction to statement), MinimalState Finite Automata	7
Unit 3.Grammar Formalism Definition, Types of Grammar (Chomsky Hierarchy), Derivation trees and ambiguity, Union, Concatenation and Kleene *'s of CFLs to construct Grammar, Properties of CFL: Union,	7

Concatenation and Kleene *'s of CFLs, intersections and complements of CFLs, Simplified Forms and Normal Forms i.e., Converting CFG to CNF,Introduction to GNF, BNF	
Unit 4-Push Down Automata and Parsing Definition and Examples of Pushdown Automata, Applications of PDA, Deterministic PDA, NPDA, Equivalence of CFG's & PDA's, Top-down parsing, Bottom-up parsing.	6
Unit 5– Turing Machines Definition, TM as language acceptors, Computing partial function with a TM, Variants of TM and Universal TM, Applications of Turing Machine.	3
Unit 6–Entropy, Randomness, and Information The Entropy Function, Entropy and Binomial Coefficients Entropy: A Measure of Randomness,Compression Coding.	5

Term work:

- It should consist of minimum10 assignments based on topics of syllabus which are included in exercise problems from the textbooks or reference books
- Carry out any 8 assignments from assignment no. 1 to 13 listed below.
- Assignment no. 14 and 15 are compulsory.
- Assignments can be given on the basis of following guidelines:

Sr. No.	Title	O/S
1	Examples on Regular Languages and writing regular expressions	O
2	Designing DFAs and Extended Transition function of DFA	O
3	Designing NFA, NFA-null and corresponding extended transition function	O
4	Problems on equivalence of FAs and union, intersection and complements of DFAs	O
5	Designing NFA- null using Kleene's Theorem Part I	O
6	Minimal state DFA and Examples	O
7	Writing grammar for given formal language, problems on left most and right most derivation along with parse tree, ambiguous grammar	O
8	Simplified Forms and Normal Forms: Examples on converting CFG to CNF	O
9	Examples on designing DPDA for the given language.	O
10	Parser: Examples on constructing top-down parser and bottom-up parser for the given Grammar	O
11	Designing Turing Machine as language acceptors and computable TM for the given language.	O
12	Study of Entropy	S

13	Implementation of lossless data compression(Huffman code)	O
14	Use of Simulation tool to design DFA, NFA and NFA^	O
15	A group of 3 students to design a DFA and write a program to implement it in C programming Language.	O

S: Study based assignment O: Operational assignment

Text Books:

1. John C. Martin, Introduction to Languages & the Theory of Computations - (Tata MGH 3rd Edition)**(Unit 1 to 5)**
2. Michael Mitzenmacher,Eli Upfal Probability and Computing Randomiozed Algorithms & Probabilistic Analysis (Cambridge)**(Unit 6)**

Reference Books:

1. Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekaran, 2nd edition, PHI.
2. Michael Sipser, Introduction to theory of Computations - (Thomson Books/Cole)
3. Vivek Kulkarni, Theory of Computation

Online Resources

1. https://nptel.ac.in/courses/111/103/111103016/
2. https://nptel.ac.in/courses/106/106/106106049/
3. https://automatonsimulator.com/
4. https://onlinecourses.nptel.ac.in/noc20_ee96/

Evaluation Guidelines:

ISE-I (10 Marks)

10 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc) by the subject in-charge.

- ISE- I will be conducted before MSE

ISE –II (10 Marks)

10 Marks will be based on activity conducted (quiz, case study, problem solving, pedagogy activity etc) by the subject in-charge.

- ISE- II will be conducted after MSE

Course Plan

Course Title : R Programming Laboratory	
Course Code :201DSP215	**Semester : IV**
Teaching Scheme: L-T-P : 2-0-2	**Credit : 3**
Evaluation Scheme: ISE Marks : 25	**ESE(POE)Marks: 25**

Course description:

R is a well-developed, simple and effective programming language, which includes conditional loops, user defined recursive functions, input and output facilities, graphical facilities for data analysis, effective data handling and storage facility. It is a very flexible language. It provides an extensive, coherent and integrated collection of tools for data analysis and it is actively used for statistical computing and design.

Course Objectives:

1. To make aware the features of R.
2. To provide a knowledge of various packages & functions used in R.
3. To interpret and apply the R programming from a statistical perspective.

Course Outcomes:

After successful completion of the course, students will be able to-

CO's	Course Outcomes
C215.1	Use the features of R to implement data structures & data frames in their application.
C215.2	Apply different packages & functions to create the application.
C215.3	Perform data manipulation & statistical tests on dataset.
C215.4	Perform graphical analysis using plotting commands & functions.

Pre-requisite:-Python programming

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C215.1	2		2	-	-	-	-	-	-	-	-	-	-	-	3
C215.2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	3
C215.3	2	2	3	-	2	-	-	-	-	-	-	-	2	-	3
C215.4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	4

Contents	Hours
Unit-I: Introduction to R programming What is R? Basic Features of R, Programming features of R, Installing R and RStudio, RStudio Overview, Working in the R Console, Getting Help in R and Quitting RStudio.	2
Unit-II: R Data structures and Manipulation Creating Variables, expressions, R data types and objects, Numeric, Character and Logical Data, Vectors, Scalars, Declarations, Common Vector operations, Conditional statements and loops, Arithmetic Operators, Logical Operations. Reading datasets and exporting data from R, Manipulating and processing data in R.	4
Unit-III: R packages and functions Building R Packages, Installing and loading packages, Running and Manipulating Packages, Setting up your working directory, Downloading and importing data, working with objects, Viewing Objects within Objects, Constructing Data Objects, Functions in R, Creating functions, calling functions, Writing R scripts.	4
Unit-IV: Matrices, Arrays and Lists Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, Vector/Matrix Distinction, Avoiding Dimension Reduction, Higher Dimensional arrays. Lists – Creating lists, General list operations, Accessing list components and values, applying functions to lists, recursive lists.	4
Unit-V: Data Frames Creating Data Frames, Matrix-like operations in frames, Merging Data Frames, Applying functions to Data frames, Factors and Tables, factors and levels, Common functions used with factors, Working with tables, functions are objects, Environment and Scope issues, Writing Upstairs, Recursion, Replacement functions, Tools for composing function code.	4

Unit-VI: Introduction to Graphical Analysis and plots Using Plots (Box Plots, Scatter plot, Pie Charts, Bar charts, Line Chart), Plotting variables, Designing Special Plots, Histograms. Statistical functions for central tendency, variation, handling of bivarite data through graphics, Simple Liner Regression, Multiple Regression, Interactive reporting with R markdown.	6

Text Books:

1. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series.
2. Norman Matloff , "The Art of R Programming".
3. Big Data (Black Book)- DT Editorial Services- Dreamtech Press.

Reference Books:

1. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.
2. Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013.
3. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016.

Online Resources:

1. https://www.coursera.org/learn/r-programming
2. https://onlinecourses.nptel.ac.in/noc19_ma33/preview

List of Experiments			
Expt. No.	**Name of Experiment**	**S/O**	**Hours**
1	Installation of R and RStudio.	O	2
2	Demonstration of declaring R variables, objects, expressions, vectors and assigning values & Perform program for reading data from R and writing data into R.	O	2
3	Implementation of package in R & create a program for calling functions in R.	O	2
4	Perform various matrix operations &Implement the higher dimensional array in R.	O	2
5	Create list in R and perform various list operations to access list elements in R.	O	2
6	Create Data Frame in R and perform various operations on data frame &Demonstrate the common functions on factors and tables in R	O	2

7	Demonstration of plots in R as Box Plots, Pie Charts, Bar charts, Line Chart and histogram.	O	2
8	Study of Simple Liner Regression and Multiple Regression in R.	S	2
9	Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.	O	2
10	Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not.	O	2
11	Case study on How to calculate the correlation between two variables. How to make scatter plots. Use the scatter plot to investigate the relationship between two variables	S	2
12	Case Study on Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions	S	2

- **S-STUDY, O-OPERATIONAL**

ISE- In Semester Evaluation:

- Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student.

Course Plan

Course Title : Data Science Laboratory	
Course Code : 201DSP216	**Semester: IV**
Teaching Scheme : L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme: ISE Marks:25	**ESE (POE) Marks:25**

Course Description:
This course is for students with basic programming and data structure background. The aim is to make them abreast with common tools used for Data Science application development. It serves as an introduction to the basics of data science including programming for data analytics.

Course Objective:
1. To make students familiar with Data Science tools.
2. To introduce various Python Libraries.
3. To make use of online data sets for understanding of preprocessing the data.

Course Outcomes (COs):

Cos	**Course Outcomes**
	Upon successful completion of the course, student will be able to…
C216.1	Recognize different Data Science process and their application areas.
C216.2	Apply Data Science tools to provide solution to engineering problems.
C216.3	Apply different Python Libraries to provide solution to problems.
C216.4	To demonstrate the use of skills for proper usage of online data sets for data preprocessing.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	**POs**												**PSOs**		**BTL**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	
C216.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
C216.2	3	2	1	-	2	-	-	-	-	-	-	-	-	-	3
C216.3	3	2	1	-	2	-	-	-	-	-	-	-	-	-	3
C216.4	3	2	1	-	2	-	-	-	1	1	-	-	1	-	3

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	Study assignment on Data science Process.	S	2
2	Implementation of data manipulation using Excel.	O	2
3	Implementation of Data Visualization using Excel.	O	2
4	Study assignment on Kaggle.	S	2
5	Implementation of Array operations using Numpy.	O	2
6	Implementation of universal function in Numpy.	O	2
7	Implementation of data Operation in Pandas.	O	2
8	Implementation of dataset Operations in Pandas.	O	2
9	Implementations of Different graphs in Matplotlib.	O	2
10	Implementations of Different chart, plots in Matplotlib.	O	2
11	Implementations of Histogram in Matplotlib.	O	2
12	Implementation of data preprocessing on dataset in kaggle.	O	2

- **S-Study, O-Operational**
- **Note: The instructor may choose minimum ten experiments from experiment number 1 to 11. Experiment number 12 is mandatory. For experiment number 12 instructor has to form groups and give activity in the batch.**

Reference Books:

1. DR.AmarSahay, “Essentials of Data Science and Analytics”, O’REILLY Publication.
2. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’REILLY Publication.
3. Wes McKinney, “Python for Data Analysis”, O’REILLY Publication.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs23/preview

Course Plan

Course Title :Project-I	
Course Code : 201DSP217	**Semester : IV**
Teaching Scheme : L-T-P : 0-0-2	**Credits :1**
Evaluation Scheme : ISE Marks : 25	**ESE(OE) Marks :25**

Course Description

This course emphasis on a problem-based learning approach. It is a group activity / work where students have to present an idea/ solution for the problem chosen. Then requirement analysis and design specification of the system is to be developed by the students. This is followed by software implementation of the design, testing and finally demonstrate the results obtained. This course helps the students to learn how to analyze the demands of a customer and represent them in the form of software requirements specification (SRS Document) including quality requirements. Ultimately this course enhances students programming skills and enable them to learn how to perform requirements analysis, system designing, testing, coding and report writing.

Course Objectives

1. To formulate the problem statement.
2. To follow the SDLC model for development of project.
3. To learn the skills of team building and team work.
4. To develop the logical skills and use of appropriate data structures for solving the engineering problems.

Course Outcomes (COs)

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

C217.1	Frame appropriate problem statement for real time problem.
C217.2	Organize an effective project plan with clear objectives and prepare a synopsis.
C217.3	Design the various modules of the project to provide a solution to the problem with the help of various design tools.
C217.4	Develop the proposed system using suitable development platform.
C217.5	Able to present their work and prepare their project report.

Prerequisite:	Mathematics, Data Structures, Software Engineering and knowledge of Programming language.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

Cos	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C217.1	2	2	-	2	-	-	-	-	-	-	-	-	1	-	2
C217.2	2	3	-	-	-	-	-	-	-	-	-	-	1	-	3
C217.3	-	-	2	-	2	-	-	-	-	3	-	-	1	-	3
C217.4	3	-	3	-	3	-	-	-	3	3	-	3	2	-	3
C217.5	-	-	-	-	2	-	-	-	3	3	-	2	1	-	3

Course Contents

The Project-I should be undertaken preferably by a group of 3-4 students who will jointly work and implement the project. The group will select a project with the approval from the panel and submit the name of the project with a synopsis not more than 02 to 03 pages. The Project-I should consist of defining the problem and analyzing it, designing the solution and implementing it using a suitable programming language. A presentation and demonstration based on the above work is to be given by the group for ISE. The work will be jointly assessed twice in a semester by a panel of teachers of the department. A hard copy of project report of the work done is to be submitted along with the softcopy of the project during ESE.

Project topics may be selected from following domains:

1) Real world applications in Data Science
2) Probability and Statistics
3) Data Preprocessing
4) Web Page design
5) Networking
6) Operating System
7) Security Application
8) Simple Data Analysis

Course Plan

Course Title: Environmental Studies (Mandatory Course-I)	
Course Code: 201DSMC218	**Semester: IV**
Teaching Scheme: L-T-P: 2-0-0	**Credits: No Credit**
Evaluation Scheme: Not Applicable	**ESE Marks: 50**

Course Description:

Environmental Studies course enhance a student's knowledge in a variety of currently relevant topics related to environmental awareness and pollution. The course aims to identify environmental problems, come-up with suitable solutions and create awareness for a hygienic and eco-friendly environmental.

Course Objectives:

1. Recognize the structure and functions of ecosystems with their importance.
2. Understand the environmental and social problems with global concern.
3. Understand the importance of environmental management for its protection.
4. Acquire problem solving skills through visits to different locations, identifying the environmental problems, proposing the solution models and exhibiting to the society and government authorities.

Course Outcomes (COs):

	At the end of successful completion of course, the students will be able to…
C218.1	Understand the importance of ecosystem and biodiversity in view of its conservation.
C218.2	Understand the concept of hazardous waste and to promote healthier environment.
C218.3	Explain the importance of environmental management through pollution control boards.
C218.4	Propose solutions for problems related with environmental well beings through location visits and model exhibitions.

Prerequisite:	Understanding of Environmental Education course.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs):

COs	POs												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C218.1	-	-	-	-	-	1	3	2	-	-	-	-	-	-	2
C218.2	-	-	-	-	-	1	2	-	-	-	-	-	-	-	2
C218.3	-	-	-	-	-	1	3	-	1	1	-	-	-	-	2
C218.4	-	-	-	-	-	2	3	1	1	1	-	-	-	-	3

Course Content	Hours
Unit 1.Ecology and Biodiversity Definition, types, importance and examples of ecology, types of community relationships: Symbiosis, predation and competition. Ecosystem: structure and functions, biotic and abiotic components, energy flows, ecological succession, food chain, food web & ecological pyramid, types of ecosystems, degradation of ecosystems and its impact, Biodiversity hotspots: Western ghats, eastern Himalayas, threats to biodiversity and conservation of biodiversity, environmental ethics.	8
Unit 2.Environment and Health Air Pollution, water pollution. E-waste,waste minimization technology, Plastic waste,Population growth of the world and reduced health content of the environment, energy crisis,biofuels, Occupational health hazards, Concept of Carbon footprint.	7
Unit 3.Environmental Management Role of Central Pollution Control Board (CPCB) and Maharashtra Pollution Control Board (MPCB) in environmental protection of India.Concept of sustainability, ISO Certification.	5
Unit 4.Field Work Visit to a local area for documentation of environmental assets River/forest/grassland/hill/mountain	5

OR Visit to a local polluted site-Urban/Rural/Industrial/Agricultural OR Study of common plants,insects,birds OR Study of simple ecosystems- Ponds, Lakes, Rivers, Hill slopes,etc.	

Text Books:

1. Trivedi R.K. and P.K Goel, Introduction to Air Pollution, Tech-science Publications.
2. Mhaskar A.K, Matter Hazardous, Techno-Science Publication.

Reference Books:

1. Bharucha, Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad 380013, India
2. Hawkins R.E., Encyclopaedia of Indian Natural History, Bombay Natural History Society, Bombay.
3. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I &II, Environmental Media.
4. Miller T.G. Jr., Environmental Science, Wadsworth Publications Co.
5. Sharma B.K., Environmental Chemistry, Gokel Publ. House, Meerut.