D. Y. Patil Education Society

Deemed to Be University

School of Engineering and Management

KASABA BAWADA, KOLHAPUR

Accredited by NAAC with

'A++' Grade

Second Year B. Tech

Structure and Curriculum (as per NEP 2020)

Department of Data Science Engineering

Revised w. e. f. A. Y. 2025-26

D. Y. PATIL DEEMED TO BE UNIVERSITY
SCHOOL OF ENGINEERING AND MANAGEMNET
Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)
B. Tech. Data Science Engineering (SEMESTER- III)

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	24DSEU3P01	PCC	Probability & Statistics	**3**	3	-	-	20	30	50	-	-	100
2	24DSEU3P02	PCC	Data Structures	**3**	3	-	-	20	30	50	-	-	100
3	24DSEU3P03	PCC	Data Structures Laboratory	**1**	-	2	-	-	-	-	25	25	50
4	24DSEU3P04	PCC	Programming Lab - I	**3**	2	2	-	-	-	-	50	50	100
5	24DSEU3M05	MDM-I	Fundamentals of Data Science	**2**	2	-	-	-	-	50	-	-	50
6	24DSEU3O06	OEC-I $	Data Science for Engineers	**3**	3	-	-	20	30	50	-	-	100
7	24DSEU3O07	OEC-I $	Data Science for Engineers Lab	**1**	-	2	-	-	-	-	25	-	25
8	24DSEU3F08	CEP/FP	Domain Specific Mini Project	**2**	-	4	-	-	-	-	25	25	50
9	24DSEU3V09	VEC	Environmental Studies-I	**2**	2	-	-	-	-	50	-	-	50
10	24DSEU3H10	HSSM	Economics and Management for IT	**2**	2	-	-	-	-	50	-	-	50
11	24DSEU3D11	AC	Liberal Learning	-	2*	-	-	-	-	-	50*	-	
12	24DSEU3D12	AC	Finishing School Training - III	-	2*	-	-	-	-	-	50*	-	
			Total	**22**	**17**	**10**	**0**						**675**

Note:
$ - Open & Distance Learning
* - Values are not included in total marks
Min. Marks for Passing: 40% of total marks of individual course



Course Code:	24DSEU3P01
Course Name:	**Probability and Statistics**

L	T	P	Credit
3	0	0	3

Course Prerequsites:

Basic Probability Theory

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 probability theory, probability distribution, testing hypothesis, curve fitting , linear programming and
Optimization techniques and recurrence relation.

Course Outcomes:	After the completion of the course the student will be able to -	**SDGs**
CO1	**Apply** the fundamental concepts of probability theory.	4,9
CO2	**Solve** basic problems in probability theory, including problems involving the binomial, Poisson and normal distributions.	4,9,17
CO3	**Understand** tests for hypothesis and its significance.	4,8,9,17
CO4	**Apply** the recurrence relation to solve the counting problems and program analysis problems.	4,8,9,17
CO5	**Make** use of method of least squares to fit the curves for bivariate data.	4,8,9,12

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	2			1									
CO2	3	2			1									
CO3	2	2			1									
CO4	2	2			1									
CO5	2	2			1									

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents



Course Contents:

Unit 1	Probability Theory	6 Hours	SDGs
Introduction to Probability Set Theory and Events Axioms and Properties of Probability Conditional Probability Bayes' Theorem			4,9
Unit 2	**Probability Distribution Functions**	**6 Hours**	
Introduction, Elementary theory of probability, Random variable Discrete probability distribution, Continuous probability distribution Binomial distribution Poisson distribution Normal distribution			4,9,17
Unit 3	**Testing of hypothesis**	**6 Hours**	
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 t- distribution			4,9,17
Unit 4	**Recurrence Relation**	**6 Hours**	
Introduction, Definition of recurrence relation, Linear recurrence relation with constant coefficients Construction of recurrence relation Solution of Homogeneous recurrence relation Solution of non-homogeneous recurrence relation			4,9
Unit 5	**Curve Fitting**	**6 Hours**	
Fitting of curve by method of lest squares Fitting of straight lines Fitting of exponential curve Fitting of second degree parabolic curve			4,8,9,17
Unit 6	**Linear Programming and Optimization Techniques**	**6 Hours**	
Introduction to Linear Programming Problems, Formulations of LPP Basic Concepts and Terminology Graphical Solution Method (for two variables) Simplex Method Big M-Method Duality in Linear Programming, Dual Simplex Method Solving the Primal using the Dual			4,8,9,12

Text Books:

1. Probability and Statistics for Engineers and Scientists– 8th Edition – Walpole, Myers, Myers, Ye (Pearson Education Inc.)
2. Numerical Methods in Engineering and Science – 11th Edition- Dr. B. S. Grewal – Khanna Publishers, Delhi
3. Advanced Engineering Mathematics- 7th Edition- H. K. Dass, S Chand – S. Chand ublishing
4. Operations Research - 11th Edition – S. D. Sharma – Kedar Nath & Ram Nath

Reference Books:

1. Applied statistics and Probability for Engineers - 4th Edition – Douglas C Montgomery, George C Runger, Wiley Asia Student Edition
2. Statistics for Management - 6th Edition – Richard I Levin, David S Rubin – Prentice Hall India
3. Probability and Statistics - 5th Edition – Purna Chandra Biswal – PHI Learning Private Limited, Eastern Economy Edition
4. Operations Research - 9th Edition – H. A. Taba – Pearson

D Y PATIL EDUCATION SOCIETY KOLHAPUR

Course Code:	24DSEU3P02
Course Name:	Data Structures

L	T	P	Credit
3	0	0	3

Course Prerequsites:

1. Basic Knowledge of C
2. Basic mathematical Approach

Course Description:

The course is designed to develop skills to design and analyze 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 Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Illustrate the concepts of Data Structures	4
CO2	Identify the appropriate data structure for specific application	4, 9
CO3	Choose appropriate sorting and searching algorithms.	9
CO4	Outline the solution to the given software problem with appropriate data structure	8, 9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2	2	3	2	2	2				1					1
CO3	1	1	2	2	2				1					1
CO4	1	3	1	2	1				1					3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Contents:			SDGs
Unit 1	**Basic of Data Structures**	**5 Hours**	4
Data structure- Definition, Types of data structures, Data Structure Operations, Algorithms: Complexity, Time and Space complexity.			
Unit 2	**Stacks and Queues**	**6 Hours**	4, 9
Stack: Definition, operations, Array representation of stack, applications Queue: Definition, operations, Array representation of queue, applications, Circular queue, Priority queue, Deque.			
Unit 3	**Linked Lists**	**8 Hours**	9
Definition, representation, operations, implementation and applications of singly, doubly and circular linked lists. Linked representation of stack and Queue.			
Unit 4	**Trees**	**8 Hours**	9
Terminology, representation, binary tree, traversal methods, binary search tree, AVL tree (Introduction), Heaps- Operations and their applications			
Unit 5	**Graphs**	**8 Hours**	9
Basic concept of graph theory, storage representation, graph traversal techniques- BFS and DFS			
Unit 6	**Searching and Sorting Techniques**	**8 Hours**	8, 9
Searching: Linear search, Binary search Sorting: Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Heap Sort Complexity and analysis of Searching and Sorting Algorithms			

Text Books:

1. Schaum's Outlines Data Structures – Seymour Lipschutz (MGH)
2. Data Structures- A Pseudo code Approach with C – Richard F. Gilberg and Behrouz A. Forouzon 2nd Edition

Reference Books:

1. Data Structure using C- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein (PHI)
2. Fundamentals of Data Structures - Horowitz, Sahani (CBS India)

D.Y. PATIL EDUCATION SOCIETY
Kasba Bawada, Kolhapur
KOLHAPUR

Course Code:	24DSEU3P03
Course Name:	Data Structures Lab

L	T	P	Credit
		2	1

Course Prerequsites:

1. Basic Knowledge of C
2. Basic mathematical Approach

Course Description:

The course is designed to develop skills to design and analyze 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 Outcomes:	After the completion of the course the student will be able to -	SDG
CO1	Implement the Various Data Structures	4,9
CO2	Implement the various sorting and searching algorithms.	4,8,9
CO3	Compare the complexities of various algorithms	4,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1		1	1							1	2
CO2	3	1	1		1	1								1
CO3	3	3	2	3	3				1	1	1		1	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE)	50%	Practical Oral Exam



List of Experiments:	SDG
1. Write a C program to implement operations on Stack using array 2. Write a C program to implement operations on Linear Queue using array 3. Write a C program to implement operations on Circular Queue using array 4. Write a C program to implement operations on Singly Linked list 5. Write a C program to implement operations on Doubly Linked list 6. Write a C program to implement operations on Circular Linked list 7. Write a C program to implement Searching Techniques 8. Write a C program to implement Bubble sorting Techniques 9. Write a C program to implement Selection Sort Technique 10. Write a C program to implement Insertion Sort Technique 11. Write a C program to implement BST and its traversal 12. Write a C program to implement BFS and DFS	4,8,9

Text Books:

1. Schaum's Outlines Data Structures – Seymour Lipschutz (MGH)
2. Data Structures- A Pseudo code Approach with C – Richard F. Gilberg and Behrouz A. Forouzon 2nd Edition

Reference Books:

1. Data Structure using C- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein (PHI)
2. Fundamentals of Data Structures - Horowitz, Sahani (CBS India)

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Code:	24DSEU3P04
Course Name:	Programming Lab - I

L	T	P	Credit
2	0	2	3

Course Prerequsites:

Procedural Programming Language (C Language)

Course Description:

This course introduces students to the principles of object-oriented programming using C++. Students will develop practical skills through hands-on coding exercises and projects, learning to design and implement efficient, reusable, and maintainable code using OOP concepts.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO-1:	explain object oriented concepts, principles and techniques.	4
CO-2:	create well-structured classes with appropriate data members and member functions, demonstrating proper encapsulation principles.	4, 9
CO-3:	apply various object-oriented features to solve real-life problems using C++ language.	4 8 9
CO-4:	demonstrate an understanding of generic programming concepts.	4, 9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									1	1		3		
CO2	1	1	2		3			2	1	2			3	3
CO3	1	2	2		3			2	1	1		3	3	3
CO4	1				3				1				2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:			SDGs
Unit 1	**Pointers & Structures in C**	**6 Hours**	
Pointers: What Are Pointers?, Pointer Variables, The Pointer Operators, Pointer Expressions, Pointers and Arrays, Array of Pointers, Initializing Pointers, Pointers to Functions and structures, C's Dynamic Allocation Functions. Structures: Structures, Arrays of Structures, Passing Structures to Functions, Structure Pointers, Unions, Macro expansion.			4
Unit 2	**Fundamentals of C++ Programming**	**8 Hours**	
C++ Program Structure, variables, operators, Input/output – I/O streams and standard I/O devices, cin and associated functions, cout and formatted output. User Defined function - declaration, definition & calling function, storage classes, scope rules, function - default arguments. Reference and reference arguments to the function. Pointer variables, new and delete operator, dynamic arrays. Class & Objects: Object Oriented fundamentals, Class and object - concept and need, Class declaration, Class members - member variables and functions, access specifiers, implementation of member functions. Object Declaration, Accessing class members, class scope, . Constructors, invoking a constructor, constructors and default parameters, array of objects and constructor, destructor. this pointer, static members, constant objects and member function, Data abstraction, structure and class, information hiding			4, 9
Unit 3	**Inheritance**	**4 Hours**	
Inheritance: concept, implementation, base classes and derived classes, members in base classes and derived classes, overriding base class members, UML notations for inheritance, constructors of derived and base classes, destructor in derived class, Inheritance as public, protected and private Composition (Aggregation) and association – concept, implementation and UML Notation			9
Unit 4	**Polymorphism**	**4 Hours**	
Polymorphism: Need, concept, implementation using function overloading, Multiple Inheritance, function overriding, virtual function, pure virtual function, abstract classes, Friend function and friend classes, accessing base class functions from derived class objects, accessing derived class functions from base class objects. Operator overloading: fundamentals of operator overloading, overloading binary operators, overloading unary operator			9
Unit 5	**Generic Programming with Templates**	**4 Hours**	
Introduction to Generic Programming, Concept and benefits, Type-independent code Function Templates: Syntax and basic usage, Multiple template parameters, Explicit instantiation and specialization Class Template: Syntax and implementation			4, 9

Text Books:
1. Object oriented Programming in C++ 3rd Edition-R.Lafore (Galgotia Publications) 2. C++programming – John Thomas Berry(PHI) 3. Object –Oriented Analysis & Design: Understanding System Development with UML 2.0 , Docherty, Wiley India Ltd.
Reference Books:
1. C++ Programming with Language - Bjarne Stroustrup, AT & T

List of Assignments		SDGs
1	Understanding and Implementing Structures in C/C++	4
2	Dynamic Memory in C++	4, 9
3	Function Overloading and Default Arguments in C++	4
4	Implementing Class & Object	4, 9
5	Understanding and Implementing Static Members in C++	4
6	Implementing Inheritance.	9
7	Implement Operator overloading for user defined data type.	9
8	Write porgram for run-time polymorphism	9
9	Generic Programming using Function Template	9
10	Generic Programming using Class Template	9



Course Code:	24DSEU3M05
Course Name:	Fundamentals of Data Science

L	T	P	Credit
2			2

Course Prerequsites:

Basic knowledge of computer, Basic knowledge of Mathematics

Course Description:

The aim of the course is to get basic knowledge about data science and its processes. This course also aims to visualize the complex data using different data visualization tools. It also provides different statistical methods to perform data analysis.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Summarize the basic concepts in data science.	4
CO2	Identify the data science process for the problem solving.	4,9
CO3	Choose the appropriate data visualization technique for the given problem.	4,9
CO4	Use different statistical methods for data analysis.	4,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2	2	1		1									2	
CO3	1	2			2								3	
CO4	2			1										

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents



Course Contents			SDGs
Unit 1	**Data Science and its scope**	**6 Hours**	4,9
What is 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.			
Unit 2	**Data Science Process**	**8 Hours**	4,9
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.			
Unit 3	**Data Visualization**	**6 Hours**	4,9
Introduction to data visualization, Visual encoding, Data visualization software, Data visualization libraries, Basic data visualization tools, Specialized data visualization tools, Advanced data visualization tools, Visualization of geospatial data, Data visualization types			
Unit 4	**Statistical Data Analysis**	**8 Hours**	4,9
Role of statistics in data science, Kinds of statistics - Descriptive statistics, Inferential statistics, Probability theory - Random variables, Independence, Sample space, Odds and risks, Expected values, Standard errors, Bayesian probability, Probability distribution			

Text Books:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications.
2. DR. Gypsi Nandi, DR. Rupam Kumar Sharma, "Data Science Fundamentals and Practical Approaches", BPB Publications, India , ISBN 978-93-89845-662

Reference Books:

1. DR. Amar Sahay, "Essentials of Data Science and Analytics", O'REILLY Publication.
2. https://onlinecourses.nptel.ac.in/noc21_cs23/preview



Course Code:	24DSEU3O06
Course Name:	Data Science for Engineers

L	T	Credit	Credit
3			3

Course Prerequsites:

1. Fundamentals of Data Science

Course Description:

This course introduces students to data analysis and visualization in the field of exploratory data science.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Describe a flow process for data science problems and classify them into standard typology .	4,9
CO2	Use R codes for data science solutions and correlate results to the solution approach followed .	4,9
CO3	Construct use cases to validate approach and identify modifications required.	8,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3	3								2
CO2	1	2	2	3	3	1							3	3
CO3	1	1	1	2	2								2	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:			SDGs
Unit 1	**Introduction to R**	**6 Hours**	4,9
R Studio, Variables and datatypes in R, Data frames, Arithmetic,Logical and Matrix operations in R, Advanced programming in R _ Functions, Control structures, Data visualization in R Basic graphics.			
Unit 2	**Linear algebra for data science**	**8 Hours**	4,9
Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse) Geometric view - vectors, distance, projections, eigenvalue decomposition.			
Unit 3	**Statistics**	**8 Hours**	4,9
Descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates.			
Unit 4	**Optimization**	**6 Hours**	8,9
Optimization, Typology of data science problems and a solution framework.			
Unit 5	**Logsitic Regression**	**6 Hours**	8,9
Classification using logistic regression.			
Unit 6	**Classification and clustering**	**6 Hours**	8,9
Classification using kNN and k-means clustering			

Text Books:

1. R for Data Science - Hadley Wickham & Garrett Grolemund (O'Reilly Media) - Units 1, 3
2. Linear Algebra and Its Applications - Gilbert Strang (Wellesley-Cambridge Press) - Unit 2
3. Introduction to Statistical Learning with R - James, Witten, Hastie, Tibshirani (Springer) - Units 4, 5, 6

Reference Books:

1. The Art of R Programming - Norman Matloff (No Starch Press) - Unit 1
2. Matrix Computations - Gene H. Golub & Charles F. Van Loan (Johns Hopkins University Press) - Unit 2
3. All of Statistics - Larry Wasserman (Springer) - Unit 3
4. Numerical Optimization - Jorge Nocedal & Stephen J. Wright (Springer) - Unit 4
5. Applied Logistic Regression - David W. Hosmer Jr. & Stanley Lemeshow (Wiley) - Unit 5
6. Pattern Recognition and Machine Learning - Christopher M. Bishop (Springer) - Unit 6



Course Code:	24DSEU3O07
Course Name:	Data Science for Engineers Lab

L	T	P	Credit
0	0	2	1

Course Prerequsites:

1. Fundamentals of Data Science

Course Description:

This course introduces students to practical data analysis and visualization techniques in the field of exploratory data science through hands-on laboratory experiments using R programming language.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Implement data science workflows in R environment and demonstrate proficiency in data manipulation, visualization, and basic statistical operations.	4,8,9
CO2	Apply linear algebra concepts, statistical methods, and optimization techniques to solve data science problems using R programming.	4,8,9
CO3	Design and execute classification and clustering algorithms, evaluate their performance, and validate results through comprehensive case studies.	4,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	3								3	3
CO2	3	2	2	3	3								3	3
CO3	3	3	3	3	3	3							3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal	50%	Practical performance and internal POE
2	ESE	50%	POE

Course Contents:			SDGs
Experiment 1:	Introduction to R and RStudio Environment	2 Hours	4,8,9
Experiment 2	Data Structures and Data Frames in R	2 Hours	4,9
Experiment 3:	Functions and Control Structures	2 Hours	4,8,9
Experiment 4:	Data Visualization using R Graphics	2 Hours	4,9
Experiment 5:	Linear Algebra Operations for Data Science	2 Hours	4,9
Experiment 6:	Descriptive Statistics and Probability Distributions	4 Hours	4,9
Experiment 7:	Logistic Regression for Classification	4 Hours	4,8,9
Experiment 8:	Implement k-NN classification	2 Hours	4,8,9
Experiment 9:	Implement k-means clustering	2 Hours	4,8,9

Text Books:

1. R for Data Science - Hadley Wickham & Garrett Grolemund (O'Reilly Media)
2. The Art of R Programming - Norman Matloff (No Starch Press)
3. Introduction to Statistical Learning with R - James, Witten, Hastie, Tibshirani (Springer)

Reference Books:

1. R in Action - Robert Kabacoff (Manning Publications)
2. Data Mining with R - Luis Torgo (Chapman & Hall/CRC)



Course Code:	24DSEU3F08	L	T	P	Credit
Course Name:	Domain Specific Mini Project			4	2

Course Prerequsites:

1. Data Structures
2. Problem Solving Using C
3. Software Engineering

Course Description:

This course emphasis on a problem-based learning approach. It is a group activity 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 design, implementation, 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 requirement analysis, system designing, coding, testing and report writing.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Define appropriate problem statement for real world problems.	4, 11
CO2	Organize an effective project plan with clear objectives and prepare a synopsis.	4, 8
CO3	Design the various modules of the project to provide a solution to the problem with the help of various design tools.	9
CO4	Develop the proposed system using suitable development platform.Able to present their work and prepare technical project report.	8

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		1				1	1		3			
CO2	3	3		1	1	1	1	1	3	3	2	2	2	
CO3		1	2		2			1	3	2	3	3	3	3
CO4		1	2		2			1	3	3	2	3	3	2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	50%	Problem identification and Design
2	End Semester Examination (ESE)	50%	Coding, Testing and Creating Repository



Course Contents:

1. The Project should be undertaken preferably by a group of 3-4 students.
2. These students will jointly work and implement the project.
3. The group will select a project with the approval from the domain expert panel and submit the name of the project with a synopsis.
4. The Project should consist of defining the problem and analyzing it, designing the solution and implementing it using a suitable programming language.
5. Presentation and demonstration based on the above work is to be given by the group for ISE.
6. The work will be jointly assessed twice in a semester by an internal domain expert panel. No externally implemented projects work will be allowed. Student has to follow every project phase himself in a group.
7. 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:

a. Real world applications in Data Analytics
b. Probability and Statistics
c. Data Preprocessing
d. Web Page design
e. Web Scrapping
f. Healthcare Analytics
g. Analytics using modern tools & techniques.



Course Code:	24DSEU3V09
Course Name:	Environmental Studies - I

L	T	P	Credit
2			2

Course Prerequsites:

1. Understanding of Environmental Education course

Course Description:

The main objective of course is to create awareness among students regarding environmental issues and its impact on society. Knowledge regarding environmental components, its degradation and protection of environment is need for sustainable future ahead.

Course Outcomes:	After the completion of the course the student will be able to -	**SDGs**
CO1	Understand the scope and importance of Environmental awareness and Sustainable development	4,13
CO2	Understand various Environmental issues due to development.	13,15,6
CO3	Understand various modes of Environmental management through techno and legislation	11,12
CO4	Acquire problem solving attitude through actual field experience and report it in the form of a field report.	4,17

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1						2							
CO2							2							
CO3							2							
CO4							2							

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
	Mid Semester Exam	30%	50%ofcourse contents
	In Semester Evaluation (ISE)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE)	50%	100%course contents

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Course Contents:			SDGs
Unit 1	**Our Environment**	**5 Hours**	
Introduction to Environment, Scope of Environmental Studies, Importance of Environmental Awareness, Concept of Sustainability, Sustainable development : History and Goals, Environmental Ethics and Sustainability Ethics, Population Growth and its Impact on Environmental Health			4,13
Unit 2	**Development and Environmental Health**	**8 Hours**	
Natural resources: Natural Resources: Types (Renewable and Non-renewable), Developmental Benefits, Forest: Benefits and Problems (Deforestation), Biodiversity: Importance, Threats, Conservation, Ecosystems: Importance, Problems, Ecological Restoration, Air: Benefits and Problems (Pollution, Climate Change), Water: Benefits and Problems (Depletion, Pollution), Soil/Land: Benefits and Problems (Degradation, Fertility Loss, Desertification), Minerals: Benefits and Problems (Mining, Overexploitation, Pollution), Energy Resources: Benefits and Problems (Depletion, Energy Crisis), Urbanization and Environmental Health, Urban Problems and Solid Waste: MSW Effects, Plastic, Hazardous Waste, E-Waste			6,7,13,15
Unit 3	**Environmental Management**	**8 Hours**	
Renewable Energy Technologies (Biogas, Biofuel, Hydrogen, etc.), Pollution Abatement: 5R, ZLD, Carbon Credit, Bio Remedies, Soil/Land Reclamation and Sustainable Agriculture, Environmental Impact Assessment (EIA), Environmental Audit, ISO 14001 Certification, Role of CPCB and MPCB in Environmental Protection, Emerging Environmental Technologies: GIS, Remote Sensing, IoT, Smart Bins, Waste-to-Energy, Recycling Automation, Circular Economy Practices, Sustainable Packaging, Community Engagement, Decentralized Waste Treatment, Zero-Waste Initiatives, Environmental Legislation: Environmental Protection Act, Air Act, Water Act, Solid Waste Management Act, Hazardous Waste Management Rules, E-Waste (Management) Rules, 2022.			7,12,9
Unit 4	**Field Project Work**	**5 Hours**	
Case studies based on field visit (Each student must complete a project on an environmental issue and propose solutions)			4,17

Text Books:

1. Erach Bharucha – Textbook of Environmental Studies for Undergraduate Courses
   Publisher: University Grants Commission / Orient Blackswan
   ISBN: 9788173715402
2. Benny Joseph – Environmental Science and Engineering
   Publisher: McGraw Hill Education
   ISBN: 9789339221266
3. Anubha Kaushik & C.P. Kaushik – Perspectives in Environmental Studies
   Publisher: New Age International Publishers
   ISBN: 9788122439802

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Reference Books:

1. Rajagopalan – Environmental Studies: From Crisis to Cure
   Publisher: Oxford University Press
   ISBN: 9780198067691
2. S.K. Dhameja – Environmental Studies
   Publisher: S.K. Kataria & Sons
   ISBN: 9789350141014
3. A.K. De – Environmental Chemistry
   Publisher: New Age International Publishers
   ISBN: 9788122419460
4. P.D. Sharma – Ecology and Environment
   Publisher: Rastogi Publications
   ISBN: 9788171337033
5. S.C. Santra – Environmental Science
   Publisher: New Central Book Agency
   ISBN: 9788173810732
6. N. Basak – Environmental Engineering
   Publisher: McGraw Hill Education
   ISBN: 9789339205181
7. Ministry of Environment, Forest and Climate Change (MoEFCC) – Reports and Surveys
   (Available at: https://moef.gov.in)

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KOLHAPUR

D. Y. PATIL DEEMED TO BE UNIVERSITY
SCHOOL OF ENGINEERING AND MANAGEMNET
Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)
B. Tech. Data Science Engineering (SEMESTER- IV)

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/ PoE	
					L	P	T						
1	24DSEU4P01	PCC	Discrete Mathematical Structure	**3**	3	-	-	20	30	50	-	-	100
2	24DSEU4P02	PCC	Design and Analysis of Algorithm	**3**	3	-	-	20	30	50	-	-	100
3	24DSEU4P03	PCC	Programming Lab - II	**4**	2	4	-	-	-	-	50	50	100
4	24DSEU4M04	MDM-II	Data Analysis and Visualization	**2**	2	-	-	-	-	50	-	-	50
5	24DSEU4O05	OEC-II	Introduction to Data Engineering	**2**	2	-	-	-	-	50	-	-	50
6	24DSEU4A06	AEC	Soft Skill	**2**	-	4	-	-	-	-	25	25	50
7	24DSEU4N07	VSEC	Web Application Development - I	**2**	1	2	-	-	-	-	25	25	50
8	24DSEU4V08	VEC	Environmental Studies-II	**2**	2	-	-	-	-	50	-	-	50
9	24DSEU4H09	HSSM	Leveraging Technologies for Project Management and Startup Ventures	**2**	1	2	-	-	-	-	50	-	50
10	24DSEU4D10	AC	Liberal Learning	-	2*	-	-	-	-	-	50*	-	
11	24DSEU4D11	AC	Finishing School Training - IV	-	2*	-	-	-	-	-	50*	-	
			Total	**22**	**16**	**12**	**0**						600

HONORS

Sr. No.	Course Code	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/	
1	23DSEU4Z01	Honors	Fundamentals of Cyber Security	3	3	-	-	20	30	50	-	-	100
2	23DSEU4Z02	Honors	Fundamentals of Cyber Security Lab	1	-	2	-	-	-	-	25	-	25

Note:
$ - Open & Distance Learning
* - Values are not included in total marks
Min. Marks for Passing: 40% of total marks of individual course



Course Code:	24DSEU4P01
Course Name:	Discrete Mathematical Structures

L	T	P	Credit
3			3

Course Prerequsites:

1. Mathematics - Probability theory, Set theory, functions

Course Description:

This Course consists of concepts of Discrete mathematical structures such as mathematical logic, Sets, relations, functions, lattices and Boolean algebra, combinatorics and graph theory.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Explain the basic concepts of discrete mathematical structures	4
CO2	Demonstrate the applications of discrete structures in different fields of computer science.	4,9
CO3	Solve problems using the concepts of Discrete structures.	4,9
CO4	Apply the mathematical proofs and techniques to prove the theorems in computer science.	4,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				1									
CO2	2			1	2	1						1	1	
CO3	2	2	2	1	1									
CO4	2	1	1	1	1	1								
CO5														

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:

Unit 1	Mathematical logic	9 Hours	SDGs
1.1 Statements and Notations 1.2 Connectives , Statement formulas and truth tables, well formed formulas, Tautologies, Equivalence of formulas, Duality law, Tautological implications, functionally complete sets of connectives, other connectives 1.3 Normal and principal normal forms, completely parenthesized infix and polish notations 1.4 Theory of Inference for statement calculus – validity using truth table, rules of inference, consistency of Premises and indirect method of proof, Predicate calculus			4
Unit 2	**Set theory**	**8 Hours**	
2.1 Basic concepts of set theory, Operations on sets, Ordered pairs, Cartesian Products 2.2 Representation of discrete structures 2.3 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, Recurrence relations, Composition of Binary relations,Partial ordering , POSET and Hasse diagram. 2.4 Functions – types, composition of functions, Inverse functions.			4,9
Unit 3	**Algebraic systems**	**6 Hours**	
3.1 Algebraic systems, properties and examples 3.2 Semigroups and Monoids, properties and examples, Homomorphism of Semigroups and Monoids 3.3 Groups: Definition and examples, Subgroups and homomorphism			4,9
Unit 4	**Lattices and Boolean algebra**	**5 Hours**	
4.1 Lattice as POSETs , definition , examples and properties 4.2 Lattice as algebraic systems, Special lattices 4.3 Boolean algebra definition and examples 4.4 Boolean functions			4,9
Unit 5	**Permutations, Combinations and Probability theory**	**7 Hours**	
5.1 The Basics of Counting 5.2 The Pigeonhole Principle 5.3 Permutations and Combinations 5.4 Generalized Permutations and Combinations 5.5 Discrete Probability 5.6 Conditional probability 5.7 Bayes' Theorem			4,9
Unit 6	**Graphs**	**7 Hours**	
6.1 Introduction to Graphs 6.2 Graph Terminology 6.3 Representing Graphs and Graph Isomorphism 6.4 Connectivity 6.5 Euler and Hamilton Paths 6.6 Planar Graphs 6.7 Introduction to Trees			4,11

Text Books:

1. Discrete Mathematical Structures with Application to Computer Science - J. P. Tremblay & R. Manohar (MGH International)
2. Discrete Mathematics and its Applications - Kenneth H. Rosen (AT&T Bell Labs) (mhhe.com/rosen)

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KOLHAPUR

Reference Books:

1. Discrete Mathematics - SemyourLipschutz, MarcLipson (MGH), Schaum's outlines.
2. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", SiE Edition, TataMcGrawHill, 2008,ISBN 10:0-07-066913-9
3. Schaums Solved Problem Series – Lipschutz.
4. Discrete Mathematical Structures – Bernard Kolman, Robert Busby, S.C.Ross and NadeemurRehman (Pearson Education)

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Course Code:	24DSEU4P02
Course Name:	Design and Analysis of Algorithms

L	T	P	Credits
3			3

Course Prerequsites:

1. Problem Solving Approch
2. Data Structures

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 analyzing 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 Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	demonstrate an understanding of algorithms, their properties, and design techniques.	4, 9
CO2	evaluate algorithm performance using asymptotic notations.	8, 9
CO3	select the most appropriate algorithmic strategy for solving complex computational problems.	8, 9, 11
CO4	classify problems into polynomial, NP-Hard, and NP-Complete categories.	4, 9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1				1			1					1	
CO2	2	1		1				1		1	1			
CO3		2	2	1	1					1		2	1	1
CO4	1	1		1						1	1	2		

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

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Course Contents:			SDGs
Unit 1	**Introduction to Algorithms**	**8 Hours**	4, 8, 9
Definition, Properties of Algorithms, Expressing Algorithm- Pseudocode; Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations, Recursion			
Unit 2	**Divide and Conquer**	**7 Hours**	4, 8, 9
The general method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, Analysis of Divide and Conquer algorithms.			
Unit 3	**Greedy Algorithms**	**7 Hours**	8, 9, 11
Introduction to Greedy Technique, General Greedy Method, Knapsack Problem, Job Sequencing with Deadline, Optimal Merge Patterns, Minimum Spanning Tree - Prim's Algorithm, Kruskal's algorithm, Single-Source Shortest Path Algorithm			
Unit 4	**Dynamic Programming**	**7 Hours**	8, 9, 11
The general method, Longest Common Sub-sequence, Bellman Ford, All pair shortest paths, 0/1 knapsack, Traveling Salesperson problem.			
Unit 5	**Backtracking**	**7 Hours**	4, 9
Backtracking Concept, N–Queens Problem, Sum of Subsets Problem, Graph Coloring Problem, Hamiltonian Cycle			
Unit 6	**NP Hard and NP Complete Problems**	**6 Hours**	4, 9
Introduction, Polynomial Complexity Class, Non Polynomial Complexity Class- NP-Hard, NP-Complete			

Text Books:

1. Ellis Horowitz, Satraj Sahani, Saguthevar Rajasejaran, 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 Code:	24DSEU4P03
Course Name:	Programming Lab - II

L	T	P	Credit
2	0	2	3

Course Prerequsites:

1. Procedural Programming Language

Course Description:

This course introduces students to the principles of object-oriented programming using Java. Students will develop practical skills through hands-on coding exercises and projects, learning to design and implement efficient, reusable, and maintainable code using OOP concepts.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Understand the fundamentals of Object-Oriented Programming (OOP) and Java language constructs.
CO2	Apply various object-oriented features to solve real-life problems using Java Programming language.
CO3	Make use of file I/O operations and exceptions in Java to create robust and error-resilient programs.
CO4	Utilize appropriate collection classes to solve real-world programming problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	SDG's
															4
CO1	1								1	1		3	1		4, 9
CO2	1	1	2		3			2	1	2			3	2	4, 9
CO3	1	1	2		3			2	1	1		3	3	2	4, 9
CO4					3				1				2		4, 9

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	Internal Assessment	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	POE	50%	Practical/Oral Examination



Course Contents:			SDG's
Unit 1	**Introduction to OOPs concepts and Java Programming**	**3 Hours**	
Introduction to procedural & object-oriented programming, Limitations of procedural programming, Need of object-oriented programming, **Fundamentals of object-oriented programming:** objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. **Introduction to Java Programming:** The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Big Numbers, ArraysJagged Array.			4, 9
Unit 2	**Classes and Objects**	**5 Hours**	
Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members(Access specifiers – public, private, protected,), Static Fields and Methods, this keyword, Object Cloning, use of the new keyword, Method overloading, array of objects, passing objects to functions, returning object.			4, 9
Unit 3	**Inheritance, Interface and Packaging**	**6 Hours**	
Inheritance: Definition, Superclasses, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, Design Hints for Inheritance, Nested classes & Inner Classes. **Interfaces:** Defining an Interface, Implementing an Interface, Using an Interface as a Type, Evolving Interfaces, Default Methods. **Packages:** Class importing, Creating a Package, Naming a Package, Using Package Members, Managing Source and Class Files			4, 9
Unit 4	**Exception Handling and File I/O**	**6 Hours**	
I/O Streams: Byte Stream – InputStream, OutputStream, DataInputStream, DataOutputStream, FileInputStream, FileOutputStream, Character Streams, BufferedStream, Scanner, File, RandomAccesFile. **Exception:** Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, Re-throwing and Chaining Exceptions, finally clause, Advantages of Exceptions, Tips for Using Exceptions.			4, 9
Unit 5	**Collections IN Java**	**6 Hours**	
Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework.			4, 9

Text Books:

1. "Core Java Volume I – Fundamentals" by Cay S. Horstmann and Gary Cornell
2. "Java: The Complete Reference" by Herbert Schildt

Reference Books:

1. "Head First Java" by Kathy Sierra and Bert Bates



List of Experiments:	SDG's
1. Write a Java program to implement data types, operators	4
2. Write a Java program to implement simple class and objects	4, 9
3. Write a Java program to implement Contructor overloading	4, 9
4. Write a Java program to implement Method overloading	4, 9
5. Write a Java program to implement different types of inheritance	4, 9
6. Write a Java program to implement abstract class	4, 9
7. Write a Java program to implement interface	4, 9
8. Write a Java program to implement package	4, 9
9. Write a Java program to implement File Handling	4, 9
10. Write a Java program to implement Exception Handling	4, 9
11. Write a Java program to implement Multithreading	4, 9
12. Write a Java program to implement different collection	4, 9



Course Code:	24DSEU4M04
Course Name:	Data Analysis and Visualization

L	T	P	Credit
2	0	0	2

Course Prerequsites:

Fundamentals of Data Science

Course Description:

This course introduces students to data analysis and visualization in the field of exploratory data science.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Demonstrate proficiency in Python libraries for exploratory data analysis.	4,9
CO2	Implement comprehensive data preprocessing workflows	4,9
CO3	Apply data manipulation techniques and create effective visualizations to solve real-world data analysis problems.	4,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	1							3	3
CO2	2	3	2	3	2	1							3	3
CO3	2	3	3	3	1	1							3	3

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE)	100%	100% course contents



Course Contents:			SDGs
Unit 1	**Introduction**	**6 Hours**	4,9
Introduction to Data Science, Exploratory Data Analysis and Data Science Process. Motivation for using Python for Data Analysis, Introduction of Python shell iPython and Jupyter Notebook. Essential Python Libraries: NumPy, pandas, matplotlib, SciPy, scikit-learn, statsmodels.			
Unit 2	**Getting Started with Pandas**	**8 Hours**	4,9
Arrays and vectorized conputation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics. Data Loading, Storage and File Formats. Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, Interacting with Web APIs, Interacting with Databases Data Cleaning and Preparation. Handling Missing Data, Data Transformation, String Manipulation			
Unit 3	**Data Wrangling and Data Visualization**	**8 Hours**	4,9
Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting. Data Visualization matplotlib: Basics of matplotlib, plotting with pandas and seaborn, other python visualization tools.			
Unit 4	**Data Aggregation and Group operations**	**6 Hours**	4,9
Group by Mechanics, Data aggregation, General split-apply-combine, Pivot tables and cross tabulation, Categorical Data, Advanced GroupBy Use, Techniques for Method Chaining.			

Text Books:

1.McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media

Reference Books:

1. O'Neil, C., & Schutt, R. (2013). Doing Data Science: Straight Talk from the Frontline O'Reilly Media



Course Code:	24DSEU4O05
Course Name:	Introduction to Data Engineering

L	T	P	Credit
2			2

Course Prerequsites:

Fundamental of Data Science

Course Description:

This course is about the understanding of fundamental techniques involved in the data engineering and will provide understanding of data engineering life cycle. Also, includes topics which focus on source systems of data engineering, storage, ingestion, Security, data Management, Data modelling and Design. They are used in a variety of applications today including Business Intelligence and Analytics, smart cities, healthcare, fraud detection

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Describe the basic principles, foundation and building blocks of Data Engineering.	4,9
CO2	Define the data engineering lifecycle and ETL model.	9,12,17
CO3	Explain the need of basic architecture in data engineering.	9,11
CO4	Summarize the technologies used for implementation of data engineering lifecycle	8,9,17

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1								2	1
CO2	1	2	1	1	1								2	2
CO3	1	2	2	2	2	1							3	3
CO4	1	1	2	3	2	1							3	2

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	End Semester Examination (ESE) [50 marks]	100%	100% course contents

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Course Contents:			SDGs
Unit 1	**Foundation and Building Blocks of Data Engineering**	**6 Hours**	4,8,9
What is Data Engineering - Data Engineering Defined, Data Engineering Lifecycle, Evolution of the Data Engineer, Data Engineering and Data Science. Data Engineering Skills and Activities - Data Maturity and the Data Engineer, The Background and Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities. Data Engineers Inside an Organization - Internal-Facing Versus External-Facing Data Engineers, Data Engineers and Other Technical Roles, Data Engineers and Business Leadership.			
Unit 2	**The Data Engineering Life Cycle**	**6 Hours**	9,12,16, 17
What is data engineering life cycle - The data lifecycle vs the data engineering lifecycle, source systems,storage, ingestion, Batch vs streaming, push vs pull, Transformation, serving Data, Analytics, Machine Learning, Reverse ETL.Major undercurrents across the Data Engineering Lifecycle - Security, data Management, Data modelling and Design, Data Lineage, Data Integration and interoperability, Data Lifecycle management, DataOps			
Unit 3	**Designing good data architecture**	**6 Hours**	9,11,17
What is data architecture, enterprise architecture, Good data architecture, principles of good data architecture,Major architecture concepts, tight vs loose coupling, examples and types of Data architecture			
Unit 4	**Choosing technologies across Data Engineering Lifecycle**	**6 Hours**	8,9,12,17
Team size and capabilities, Speed to market, Interoperability, Cost optimization and business value, Today versus the future: immutable versus transitory technologies, Location (cloud, on premises, hybrid cloud, multi cloud), Build versus buy, Monolith versus modular, Serverless versus servers, Optimization, performance and the benchmark wars, The undercurrents of the data engineering lifecycle			

Text Books:

1. Fundamentals of Data Engineering, Joe Reis &Matt Housley, O'REILLY

Reference Books:

1. Designing Data-Intensive Applications, Martin Kleppmann, O'REILLY

Useful Links:

1.https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-data-engineering-usingazure/?v=c86ee0d9d7ed



Course Code:	24DSEU4A06
Course Name:	Soft Skill

L	T	P	Credit
		4	2

Course Prerequsites:

Basic English Knowledge

Course Description:

1. 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 overalldevelopment of an Engineer.

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Effectively use the principles of communication.	4,8,16,17
CO2	Make appropriate use of interviews techniques.	4,8
CO3	Develop skills to conduct meetings & conferences.	4,8,16,17
CO4	Make effective presentations & technical report writing.	4,8,9,16, 17
CO5	Actively participate in group discussion by following its etiquettes.	4,8,16,17
CO6	Effectively manage time and stress.	3,4,8

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1			3	3		3		
CO2									1	1		3		
CO3						1			3	1		3	2	
CO4	1				2	1			3	2		3	3	
CO5						1			2	2		3		
CO6						1			3	1		3	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	INT [25 Marks]	50.00%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE) [25 Marks]	50.00%	Oral Examination

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Course Contents:

Unit 1	Communication Skills	SDGs
Process of communication, Flows of Communication in organization, Barriers to communication (Formal Flow – Upward, Downward, lateral and diagonal, Strategies to improve Organizational Communication,Effectiveness in Managerial Communication, and importance of technical communication, Nonverbal communication.		4,8,16,17
Unit 2	**Interviews Skills**	
Types of interview, General preparation for interview, gathering information about the company, knowing about the role/job position, Types of interviewing questions, Non-verbal communication to win the interview		4,8
Unit 3	**Meeting & Conferences**	
Planning a meeting (Agenda and notice), Conducting a meeting, Post meeting actions (Minutes), Planning & Conducting a Conference (anchoring and Report writing), and Video/web conferences, Identifying Strengths and Weakness.		4,8,16,17
Unit 4	**Presentation Skills**	
Effective Presentation strategies: Purpose, analyzing the audience and locale, organizing the content Oral presentation, Graphic presentation, Presentation aids, Personality Development. Newsletters, technical article and business letters. Technical Reports, characteristics, Importance, objectives, categories of report, format structure of reports, types of reports		4,8,9,16, 17
Unit 5	**Group Discussion**	
Qualities needed for effective group discussion. Email etiquettes, Telephone Etiquettes, Role and responsibility of engineer, Work culture in jobs. Work place, rights and responsibilities.		4,8,16,17
Unit 6	**Time and Stress Management**	
Concept & Importance of Time Management, Techniques of Time Management, and Concept & Importance of Stress Management, Techniques of Stress Management, and Overcoming Stage fear and Interpersonal Relationships		3,4,8

Text Books:

1. G.S.B.K Babu Rao, "Business Communication and Soft Skill", Himalaya Publishing house (1st Edition)
2. Diane Hacker, "Pocket Style Manual", Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, "You Can Win", Macmillan Books, New York, 2003.

Reference Books:

1. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.
2. "Ethics in Engineering practice and research" (2nd Edition) by Caroline Whit beck Cambridge
3. Sharma, R. and Mohan, K. "Business Correspondence and Report Writing", TMH New Delhi 2002.

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR Kasba Bawada, Kolhapur

Course Code:	24DSEU4N07
Course Name:	Web Application Development – I

L	T	P	Credit
1		2	2

Course Prerequsites:

Basic Knowledge of Computer

Course Description:

This course is about the understanding and application development using the front end technologies. This aims to equip the students with different front end technologies needed to design and develop the applications of different problems related to UI interface

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Develop structured and styled web pages using HTML and CSS	9
CO2	Design responsive and user-friendly websites using Responsive Web Design principles	9
CO3	Implement dynamic and interactive web functionalities using JavaScript and jQuery	9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1		2	1		1				1	2	
CO2	1	1	1		2	1		1				1	2	
CO3	1	1	2		2	1		1				1	2	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	POE	50%	100% course contents

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Course Contents:			SDGs
Unit 1	**HTML & CSS**	**3 Hours**	
HTML: HTML Structure, Block Elements, Inline Elements, Class and ID Attributes, HTML Whitespaces. CSS SELECTOR: Type, Class and ID Selector, Position and Group Selectors, Attribute Selectors, Pseudo-element Selectors, Pseudoclass Selectors. Box Model: Display, Box Model, Inline Box, Inline-Block Box.			**9**
Unit 2	**Responsive Web Designing**	**3 Hours**	
Responsive Web Designing: Introduction, Viewport, Grid View, Image, Video, Media Queries, RWD frameworks. Twitter Bootstrap : Grid Basics, Typography, Tables, Images, Alerts, Button, Button Group, Borders, Labels, Progress bar, Pagination, Tabs, Navbar, Forms, Inputs, Input sizing, Carousel, Scrollspy.			**9**
Unit 3	**JavaScript**	**4 Hours**	
Introduction, Data types and Variables, Operators, Expressions and Statements, Functions and Scope, Document Object Model, Event Handling, Form handling and validations.			**9**
Unit 4	**jQuery**	**3 Hours**	
Introducing jQuery, jQuery selector, Animation effects, Event handling, DOM, jQuery DOM traversing, DOM manipulation.			**9**

Experiment List:	SDGs
1. Create Web Page structure using HTML5.	**9**
2. Create Web Pages with Class and ID attributes using HTML5.	**9**
3. Apply CSS to web pages created after developing the HTML5 pages.	**9**
4.Apply different CSS selectors to HTML5 web pages.	**9**
5. Create a responsive web page using media queries.	**9**
6. Create a responsive web page using bootstrap.	**9**
7. Write a JavaScript to compute mathematical operations on client side.	**9**
8. Write a JavaScript to handle event generated by client.	**9**
9. Write a JavaScript to perform form validation.	**9**
10. Write a jQuery script to provide animations effects in web pages.	**9**
11. Write a jQuery script to handle event generated by client.	**9**
12. Write a jQuery script to manipulate DOM	**9**

Text Books:

1. Pro HTML5 and CSS3 Design Patterns by Michael Bowers, Dionysios Synodinos and Victor Sumner, Apress edition
2. Twitter Bootstrap Development How to by David Cochran, Packt Publication
3. JavaScript: The Definitive Guide by David Flanagan, O'Reilly Media
4. jQuery in Action by Bear Bibeault, Manning Publication

Reference Books:

1. Beginning with HTML5 and CSS3 The Web Evolved by Murphy, Apress
2. JavaScript: The Complete Reference by Thomas A Powell, Fritz Schneider, Tata McGraw Hill
3. Head First jQuery by Ryan Benedetti, O'reilly Publication



Course Code:	24DSEU4V08
Course Name:	Environmental Studies - II

L	T	P	Credit
2			2

Course Prerequsites:

1. Understanding of Environmental Education course

Course Description:

The main objective of course is to create awareness among students regarding environmental issues and its impact on society. Knowledge regarding environmental components, its degradation and protection of environment is need for sustainable future ahead.

Course Outcomes:	After the completion of the course the student will be able to -	**SDGs**
CO1	Understand the fundamentals of environmental chemistry and assess the impacts of toxic pollutants on ecosystems and human health.	3,6,15
CO2	Identify and evaluate green technologies and sustainable innovations for solving environmental problems.	7,9
CO3	Analyze global environmental challenges and climate change mitigation strategies, including national and international policy frameworks.	13,16
CO4	Acquire problem solving attitude through actual field experience and report it in the form of a field report.	4,17

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1						2							
CO2							2							
CO3							2							
CO4							2							

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
	Mid Semester Exam	30%	50%ofcourse contents
	In Semester Evaluation (ISE)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE)	50%	100%course contents

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Course Contents:			SDGs
Unit 1	**Environmental Chemistry & Toxicology**	**5 Hours**	
Basics of environmental chemistry (air, water, soil interactions), Chemical composition of the atmosphere, photochemical smog, Water chemistry: pH, DO, alkalinity, hardness, Soil chemistry: nutrients, contamination, pH ,Toxic pollutants: Pesticides, Heavy Metals (Hg, Pb, Cd, As), POPs, Industrial pollution sources and pathways, Health impacts of toxic substances on humans and ecosystems, Environmental standards by WHO, CPCB, BIS			3,6,15
Unit 2	**Green Technologies & Innovations**	**8 Hours**	
Introduction to Green Technologies: definitions, scope, principles, Green Buildings: features, LEED/IGBC ratings, case studies in India, Sustainable construction materials: fly ash bricks, bamboo, recycled concrete, Electric mobility: EVs, battery technologies, government policies (FAME), Renewable Energy Innovations: Solar PV, Wind, Bioenergy, LED systems, Smart energy solutions: energy metering, demand-side management, Energy-efficient appliances: BEE labeling, star ratings			7,9,11
Unit 3	**Global Environmental Issues & Climate Action**	**8 Hours**	
Climate change science: greenhouse gases , Major impacts of climate change: sea level rise, extreme events, biodiversity loss, International environmental treaties and protocols: Kyoto Protocol, Montreal Protocol, Paris Agreement: India's INDC goals, India's National Action Plan on Climate Change (NAPCC), Carbon footprint: measurement, tools, reduction strategies, Net-zero emissions :pathways and technologies, Role of youth and civil society in climate action.ISO 14001:2015 – standards, implementation process, audits, Effluent Treatment Plant (ETP) and Sewage Treatment Plant (STP) processes, Corporate Social Responsibility (CSR) :legal framework, case studies.			13, 12, 16
Unit 4	**Field Project Work**	**5 Hours**	
Case studies based on field visit (Each student must complete a project on an environmental issue and propose solutions)			4,17

Text Books:

1 Benny Joseph – Environmental Science and Engineering
Publisher: McGraw Hill Education,ISBN: 9789339221266.

2.Anubha Kaushik & C.P. Kaushik – Environmental Management, Publisher: New Age International Publishers, ISBN: 9788122419477.

3. S.M. Khopkar – Environmental Pollution Monitoring and Contro.
Publisher: New Age International Publishers, ISBN: 9788122404282



Reference Books:

4. Rajagopalan – Environmental Studies: From Crisis to Cure
   Publisher: Oxford University Press
   ISBN: 9780198067691
5. S.K. Dhameja – Environmental Studies
   Publisher: S.K. Kataria & Sons
   ISBN: 9789350141014
6. A.K. De – Environmental Chemistry
   Publisher: New Age International Publishers
   ISBN: 9788122419460
7. ISO 14001:2015 – Environmental Management Systems :Requirements with Guidance for Use
   Publisher: International Organization for Standardization (ISO), ISBN: 9789267102970.
8. David T. Allen & David R. Shonnard: Green Engineering: Environmentally Conscious Design of Chemical Processes,Publisher: Pearson Education, ISBN: 9789332550479.
9. N. Basak – Environmental Engineering
   Publisher: McGraw Hill Education
   ISBN: 9789339205181
10. MoEFCC & NAPCC Policy Documents : Government of India, Available at: https://moef.gov.in



Course Code:	24DSEU4H09
Course Name:	Leveraging Technology in project Management and Start-up ventures

L	T	P	Credit
1		2	2

Course Prerequsites:

Software Engineering, project Management Basic Concepts

Course Description:

This course explores the integration of technology with project management principles, emphasizing how computer engineering students can leverage advanced tools and strategies in managing projects and launching start-up ventures. The course covers project management methodologies, software tools, and real-world applications .

Course Outcomes:	After the completion of the course the student will be able to -	SDGs
CO1	Apply technology to optimize project planning, execution, and monitoring.	8,9
CO2	Dmonstrate practical skills in using project management tools and technologies	8,9
CO3	Learn the use of technology in start-up ventures and entrepreneurial projects	8,9

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			1		1						2			
CO2			1		3		3		2	2	2	2	3	
CO3			1		3		3		2	3	2	2	3	

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation	100%	Assignment, Test, Quiz, Seminar, Presentation, etc.

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Course Contents:			SDGs
Unit 1	**Introduction**	**3 Hours**	
Project Management (PM) Fundamentals, People, Process, and Product, Technology Classic mistakes, PMI Processes, Software project phases, Organizational structures, Project charter, Statement of Work **(SOW)**			8,9
Unit 2	**Project Management Methodologies**	**3 Hours**	
Development lifecycle models, Project plans Work Breakdown Structures (WBS), Agile and Scrum: Principles and Practices,Comparing Methodologies: When to Use Which.			8,9
Unit 3	**Project Planning and Scheduling Tools**	**3 Hours**	
Introduction to Project Planning Software (e.g., MS Project, Jira, Asana), Creating Project Plans and Gantt Charts, Resource Allocation and Budgeting.			8,9
Unit 4	**Vision and the Business Model & Innovation Strategies**	**4 Hours**	
The Vision, The Mission Statement,The Value Proposition, The Business Model, Business Model Innovation in Challenging Markets, Core Competencies, Sustainable Competitive Advantage.First Movers Versus Followers, Imitation,Creativity and Invention, Types and Sources of Innovation, Technology and Innovation Strategy, New Technology Ventures.			8,9

Text Books:

1. “Information Technology Project Management”, Kathy Schwalbe, Cengage Learning, 7/e, 2013.
2. "Technology Ventures From Idea to Enterprise",Thomas H. Byers, Richard C. Dorf, Andrew J., Nelson

Reference Books:

1. "Software Project Management", M. Cottrell and B. Hughes, McGraw-Hill, 5/e, 2009.
2. "Project Management Software Tools: A Guide to Choosing the Right Tools" by Michael S. Dobson
3. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries

List of Experiments	SDG
1. Explore the features and applications of project management tools.	9
2. Prepare a project charter with objectives, scope, and stakeholders.	8,9
3. Analyze different organizational structures and their impact on projects.	8
4. Create a Work Breakdown Structure (WBS) for a project.	8,9
5. Perform an Agile sprint simulation using Scrum practices.	8,9
6. Compare Waterfall, Agile, Scrum, and Hybrid methodologies.	8
7. Develop a Gantt chart for project scheduling and tracking.	9
8. Prepare a resource allocation plan and project budget.	8
9. Design a Business Model Canvas for a business idea.	8,9
10. Prepare an innovation strategy proposal for a project or business.	8,9

