Syllabus Book

Master of Science
Data Science & Machine Learning
Offered under School of Sciences

P P Savani University

Host Institute: School of Engineering

Effective From: 2021-22

Authored by: P P Savani University

Teaching Scheme
Semester – 1

Sem	Course Code	Course Title	Offered By	Teaching Scheme					Examination Scheme						
				Contact Hours				Credit	Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
1	SESH7020	Mathematical Methods for Data Science	SH	3	0	2	5	5	40	60	0	0	20	30	150
	SSDS7010	Programming with Python	DS	3	4	0	7	5	40	60	40	60	0	0	200
	SSDS7020	Data Structures & Algorithms	DS	3	2	0	5	4	40	60	20	30	0	0	150
	SSDS7030	Excel for Data Analysis	DS	1	2	0	3	2	50	0	20	30	0	0	100
	SEPD7010	Academic Writing & Communication Skills	SEPD	2	2	0	4	3	0	0	100	0	0	0	100
	SSDS7910	Project-I	DS	6			6	6	0	0	50	50	0	0	100
				Total			**30**	**25**							**800**

Teaching Scheme
Semester – 2

Sem	Course Code	Course Title	Offered By	Teaching Scheme					Examination Scheme						
				Contact Hours				Credit	Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
2	SESH7030	Statistical Methods for Data Science	SH	3	2	0	5	4	40	60	20	30	0	0	150
	SSDS7040	R Programming	DS	3	4	0	7	5	40	60	40	60	0	0	200
	SSDS7051	Data Mining with Big Data	DS	3	2	0	5	4	40	60	20	30	0	0	150
	SSDS7061	Introduction to Data Science	DS	3	4	0	7	5	40	60	40	60	0	0	200
	SSDS7070	Data Visualization	DS	1	2	0	3	2	50	0	20	30	0	0	100
	SSDS7920	Project-II	DS	6			6	6	0	0	50	50	0	0	100
				Total			**33**	**26**							**900**

Teaching Scheme
Semester – 3

Sem	Course Code	Course Title	Offered By	Teaching Scheme					Examination Scheme						
				Contact Hours				Credit	Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
3	SSDS8012	Machine Learning	DS	3	2	0	5	4	40	60	20	30	0	0	150
	SSDS8021	Data Analytics	DS	3	2	0	5	4	40	60	20	30	0	0	150
	SSDS8030	Research Methodology	DS	3	0	0	3	3	40	60	0	0	0	0	100
		Elective - I	DS	2	2	0	4	3	40	60	20	30	0	0	150
		Elective - II	DS	2	2	0	4	3	40	60	20	30	0	0	150
	SSDS8910	Project-III	DS	7			7	7	0	0	50	50	0	0	0
				Total			**28**	**24**							**800**
4	SSDS8920	Dissertation	**DS**	**25**			**25**	**25**	0	0	200	300	0	0	500
				Total			**25**	**25**							**500**
				Grand Total			**116**	**100**							**3000**

Teaching Scheme
Elective Subjects

Course Code	Course Title	Offered By	Teaching Scheme					Examination Scheme						
			Contact Hours				Credit	Theory		Practical		Tutorial		Total
			Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
SSDS8511	Natural Language Processing	DS	2	2	0	4	3	40	60	20	30	0	0	150
SSDS8520	Digital Image Processing	DS	2	2	0	4	3	40	60	20	30	0	0	150
SSDS8530	Cloud Computing	DS	2	2	0	4	3	40	60	20	30	0	0	150
SSDS8540	Computer Vision	DS	2	2	0	4	3	40	60	20	30	0	0	150
SSDS8550	Blockchain Technology	DS	2	2	0	4	3	40	60	20	30	0	0	150
SSDS8560	Artificial Intelligence	DS	2	2	0	4	3	40	60	20	30	0	0	150
SSDS8571	Deep Learning	DS	2	2	0	4	3	40	60	20	30	0	0	150

CONTENTS

Semester 1

Semester 2

Semester 3

Semester 4

Elective Course

P P Savani University
School of Sciences

Department of Science & Humanities

Course Code: SESH7020
Course Name: Mathematical Methods for Data Science
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	02	05	40	60	00	00	20	30	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- To summarize concepts of calculus to enhance ability of analyzing mathematical problems.
- To learn about and work with vector space, linear transformation and inner product space.

Course Content:

Module No.	Content	Hours	Weightage in %
	Section I		
1.	**Introduction to Limit, Continuity & Differentiation** Limits, Continuity, Discontinuity, Types of discontinuity, Successive Differentiation, Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem	06	15
2.	**Sequence and Infinite Series** Convergence, Divergence of sequence, Divergence of infinite series, Tests for convergence of series (Comparison, Integral, Ratio and Root), Alternating series, Absolute and Conditional convergence, Power series with applications, Taylor's and Maclaurin's series, Indeterminate forms(0/0, /, .0, ∞-∞, 0, 0 & 1).	10	20
3.	**Partial Derivatives** Function of several variables, Partial differentiation, Directional derivatives, Gradient, Chain rule, Tangent planes and Linear approximations, Maxima and Minima, Total differentiation.	07	15
	Section II		
4.	**Vector Space** Real vector spaces, Subspaces, Linear Dependence, Linear Independence, Span, Basis and Dimension, Row space, Column space and Null space, Rank and Nullity	08	18
5.	**Linear Transformation** Introduction Linear Transformation, Kernel and Range, Inverse Linear Transformation, Matrix representation of Linear Transformation	07	16

6.	**Inner Product Space** Real inner products, Angle and Orthogonality, Orthogonal projection, Orthonormal bases (Gram-Schmidt Process, QR-Decomposition), Least Square Approximation, Change of basis.	07	16

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Limit, Continuity & Differentiation-1	02
2.	Limit, Continuity & Differentiation-2	02
3.	Sequence and Infinite Series-1	02
4.	Sequence and Infinite Series-2	02
5.	Sequence and Infinite Series-3	02
6.	Partial Derivatives-1	02
7.	Partial Derivatives-2	02
8.	Vector Space-1	04
9.	Vector Space-2	02
10.	Linear Transformation-1	04
11.	Linear Transformation-2	02
12.	Inner Product Space-1	02
13.	Inner Product Space-2	02

Text Book (s):

Title	Author/s	Publication
Thomas' Calculus	George B. Thomas Maurice D. Weir Joel Hass	Pearson
Elementary Linear Algebra Applications Version	Howard Anton Charis Rorres	Wiley India Edition

Reference Book (s):

Title	Author/s	Publication
Advanced Engineering Mathematics	Erwin Kreyszig	Wiley India Edition
Linear Algebra and its Applications	David C. Lay	Pearson
Engineering Mathematics-1(Calculus)	H. K. Dass Dr. Rama Verma	S. Chand
Introduction to Linear Algebra with Application	Jim Defranza Daniel Gagliardi	Tata McGraw Hill

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 15 marks and 1 hour of duration.
- Submission of assignments which consists of 10 questions to be answered under each module and it carried of 10 marks of continuous evaluation.
- End Semester Examination will consist of 60 marks.

Tutorial:

- Continuous evaluation consists of performance of tutorial which should be evaluated out of 10 marks for each tutorial in the next turn and average of the same will be converted to 30 marks.
- MCQ based examination of 10 marks.
- Internal Viva component of 10 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- make use of concepts of limit, continuity and differentiability for analyzing mathematical problems.
- examine series for its convergence and divergence.
- to demonstrate understanding of the concepts of Vector Space, Linear Transformation and inner product space.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7010
Course Name: Programming with Python
Prerequisite Course(s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	04	00	05	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand importance of practical oriented approach.
- develop ability to implement real life programming problems.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** Introduction to Python, History, Features and Applications of Python, Python Input Output, Python basic Operators.	03	06
2.	**Python Data Types and Program Flow Control** Different Data Types in Python: Numeric, String and Sequential, Variables in Python, Conditional blocks using if, else and else if, Simple for loops in Python, for loop using ranges, use of while loops in Python,Loop manipulation using pass, continue, break and else.	04	04
3.	**Python String, List, Tuple, Set and Dictionary Manipulation** String in Python and its built-in methods, List & Dictionary manipulation, Functions & methods for Tuple and Sets, Functions as Object.	05	12
4.	**Python Functions Modules and Packages** Organizing Python codes using functions, organizing Python projects into Modules, importing own Module as well as external Modules, understanding Packages, Programming using functions, Modules and external packages.	05	14
5.	**Files in Python** Introduction to file input and output, Writing Data to a File, Reading Data from a File, using loops to process files.	05	14
Section II			
6.	**Python Object Oriented Programming** Introduction to Oops Concept of class and its attributes, objects	04	14

	and instances, Inheritance and Polymorphism, Constructor and destructors, Python programming using OOP concepts.		
7.	**Exception Handling in Python** Introduction to Exception and Errors, The Exception Handling mechanism in Python Types of testing-Black box and Glass-box.	04	14
8.	**Simple Algorithms and Data structures** Search Algorithms, Sorting Algorithms, Hash Tables, MD5	04	06
9.	**Advanced Topics I** Regular Expressions – REs and Python, Plotting using PyLab, Networking and Multithreaded, Programming – Sockets, Threads and Processes, Chat Application	06	06
10.	**Advance Topics II** Security – Encryption and Decryption, Classical Cyphers Graphics and GUI Programming – Drawing using Turtle, Tkinter and Python, Other GUIs	05	10

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Installation and Introduction to Python Environment.	02
2.	Learning Input and Output in Python.	02
3.	Working with different Data types in Python.	02
4.	Implementation of flow control statements.	04
5.	Implementation of Lists, Dictionaries, Sets, Tuples.	02
6.	Implementation of Strings in Python.	04
7.	Implementation of functions and Modules.	04
8.	Working with Packages and use different Packages available to work with Python	04
9.	Working with files in Python.	04
10.	Implementation of OOP features.	04
11.	Basics of Exception handling, Exception handling mechanism.	02
12.	SQL Database connection using Python, Creating and searching tables, Reading and storing information on database, Programming using database connections.	04
13.	Implement classical ciphers using python.	02
14.	Learn to plot different types of graphs using PyPlot.	02
15.	Python Regular Expressions Email, URL validation and Pattern finding using regular expression.	06
16.	Developing mini application using Python.	06
17.	Develop programs to learn GUI programming using Tkinter. Draw graphics using Turtle.	06

Text Book(s):

Title	Author/s	Publication
Learning to Program with Python	Richard L. Halter man	Pearson
Python Programming: A modular Approach	Sheetal Taneja, Naveen Kumar	Pearson

Reference Book(s):

Title	Author/s	Publication
Python Cookbook	David Ascher, Alex Martelli	O Reilly
Introduction to Computation and Programming Using Python	John V Guttag	Prentice Hall of India

Web Material Link(s):

- https://www.python.org/
- https://www.w3schools.com/python
- https://www.youtube.com/watch?v=rfscVS0vtbw
- https://inventwithpython.com/hacking/chapters
- https://www.youtube.com/watch?v=ayi5_yx61Zg

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical, which will be evaluated out of 10 marks per each practical and average of the entire practical will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during End Semester Examination.
- Viva/Oral performance consists of 30 marks during End Semester Examination.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the syntax and semantics of the Python language.
- to be able to draw various kinds of plots using PyLab.
- develop efficient programs with their own logic & capabilities.
- learn added features of using Python in real life applications.
- learn and develop small application.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7020
Course Name: Data Structures & Algorithms
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- develop logic building and problem solving skills.
- learn to optimize programmatic aspect to solve real-time problems.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** Data types – Primitive and Non-primitive, Types of Data Structure Algorithm: characteristics, specifications, Writing Pseudo-code Algorithm vs Program , Analysis of Algorithm, Methods to measure Time and Space Complexity of Algorithm, Asymptotic Notations to represent Time complexity & Space complexity of an algorithm	06	13
2.	**Linear Data Structure** Array: Representation of arrays, Insert and Delete Operations on Array, Applications of arrays, Stack: Representation of Stack, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion, Tower of Hanoi, Queue: Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue, Linked List: Singly Linked List, Doubly Linked list, Applications of linked list.	06	12

3.	**Nonlinear Data Structure** Tree : Definitions and Concepts, Representation of binary tree, Binary tree traversal, Binary search trees, Heap, AVL trees,2-3 Trees, Applications of Tree, Graph : Matrix Representation Of Graphs, Graph operations , Graph traversal with BFS and DFS, Applications of Graph	05	10
4.	**Sorting and Searching** Searching algorithms: Sequential and Binary search and its Analysis , Min-Max Problem & its Analysis, Concept of Internal and External Sorting, Sorting methods : Bubble, Insertion, Selection, Heap , Quick and Merge Sort, Analyze each sorting method for Best, Average and worst case	06	15
Section II			
5.	**Greedy Method** Basic algorithm and characteristics, Coin change problem, Fractional Knapsack Problem, Job Sequencing with deadline Minimum Spanning tree using Prim's and Kruskal's Algorithm Dijkstra's Single source shortest path algorithm, Measure Complexity of listed Problems	07	15
6.	**Dynamic Programming Method** Basic algorithm and characteristics, 0/1 Knapsack Problem , Travelling Salesman Problem, Calculate complexity of listed Problems	06	15
7.	**Backtracking Method** Basic algorithm and characteristics, Solving n-queens problem, Graph coloring, Hamiltonian cycle (TSP)	06	13
8.	**String Matching** Concept of String Pattern Match , The naive string-matching algorithm , The Rabin Karp algorithm	03	7

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Implement Insertion and Deletion operation on Array.	02
2.	Implement Stack and Queue operations using Array.	02
3.	Implement Singly and doubly Linked list.	02
4.	Implement Stack and Queue with Linked List.	02
5.	Implement Binary Tree and perform Insert, Delete and Traversal Operations.	02
6.	Implement Graph Traversal Techniques.	02
7.	Implement and Time analysis of Searching Algorithms.	02
8.	Implement and Time analysis of Min-Max problem.	02
9.	Implement and Time analysis of Bubble, Insertion, Selection, Heap Sort, Quick and Merge Sort.	06
10.	Implement Greedy approach for Implementing Dijkstra's Single source shortest path algorithm.	02
11.	Implement solution for 0/1 Knapsack problem using Dynamic Programming approach.	02
12.	Implement Backtracking Method for Solving N-Queen Problem.	02

13.	Implementation of Naïve String matching algorithm and Rabin-Karp algorithm.	02

Text Book(s):

Title	Author/s	Publication
An Introduction to Data Structures with Applications	Jean-Paul Tremblay, Paul G. Sorenson	Tata McGraw Hill
Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein	MIT Press

Reference Book(s):

Title	Author/s	Publication
Design and Analysis of Algorithm	S. Sridhar	Oxford Higher Education
C & Data Structures	P S Deshpande, O. G. Kakde	Charles River Media
Data Structures using C & C++	Yedidyah Langsam,Moshe J. Augenstein, Aaron M. Tenenbaum	Prentice-Hall

Web Material Link:

- https://nptel.ac.in/courses/106102064/

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 20 marks.
- Practical performance/quiz/test consists of 15 marks during End SemesterExam.
- Viva/Oral performance of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- design and apply appropriate data structures for solving computing problems.
- analyze algorithms and algorithm correctness.
- understand how asymptotic notation is used to provide a rough classification of algorithms.
- design Time and space efficient algorithms using different techniques.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7030
Course Name: Excel for Data Analysis
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
01	02	00	02	50	00	20	30	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- to minimize as much manual labor as possible in data analysis
- to use the most overlooked Excel formulas that will make your life easier
- to learn powerful functions built into Excel that streamline your analysis
- to explores various advanced graphing and charting techniques available in Excel

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Excel** Reading data into Excel using various formats Basic functions in Excel, arithmetic as well as various logical functions Formatting rows and columns Functionality using Ranges Using formulas in Excel and their copy and paste using absolute and relative referencing	04	25
2.	**Advance Formulas** IF and the Nested IF functions, Concatenate, Vlookup and Hlookup, RANDBETWEEN, Match, Countif, Text, Trim	04	25
Section II			
3.	**Introduction to Filtering, Pivot Tables, and Charts** VLOOKUP across worksheets Data filtering in Excel Use of Pivot tables with categorical as well as numerical data Introduction to the charting capability of Excel	03	25
4.	**Advanced Graphing and Charting** Line, Bar and Pie charts, Pivot charts, Scatter plots, Histograms	04	25

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Reading Data into Excel. Basic Data Manipulation in Excel, Arithmetic Manipulation in Excel, Basic Functions in Excel, Functions Using Absolute and Relative References	06
2.	The "IF" Command in Excel, The "IF" Command in Excel Using Numerical Data, The "Nested IF" Command in Excel, The "VLOOKUP" Function in Excel The "HLOOKUP" Function in Excel, Spreadsheet Functions to Organize Data	08
3.	Using the "VLOOKUP" Function Across Worksheets, Data Filtering in Excel Use of Pivot Tables in Excel, Application of Pivot Tables to Numeric Data4m Introduction to Charts in Excel, Introduction to Filtering, Pivot Tables, and Charts	08
4.	Constructing various Line, Bar and Pie charts. Using the Pivot chart features of Excel. Understanding and constructing Histograms and Scatterplots	08

Reference Book(s):

Title	Author/s	Publication
Excel 2019 Bible	Michael Alexander Richard Kusleika John Walkenbach	WILEY
Excel Data Analysis For Dummies 4th Edition	Paul McFedries	dummies

Web Material Link:

- https://www.excel-easy.com/data-analysis.html

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted out of 30 marks.
- Faculty evaluation consists of 20 marks as per guidelines provided by the Course Coordinator.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 20 marks.
- Practical performance/quiz/drawing/test/submission of 15 marks during End Semester Exam.
- Viva/Oral performance of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to,

- to effectively and efficiently utilize Microsoft Excel for data analysis.
- to minimize as much manual labor as possible, thereby saving time and performing more detailed analysis quickly

P P Savani University
School of Sciences

Centre for Skill Enhancement & Professional Development

Course Code: SEPD7010
Course Name: Academic Writing & Communication Skills
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	00	00	100	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand multidimensional Professional verbal and nonverbal communication Process.
- provide an outline to effective Organizational Communication.
- establish credibility with your audience with effective presentation.
- impart the correct practices of the strategies of Effective Academic writing.
- inculcate and represent the employability skills

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Basics of Communication Skills** Concept and Process of Communication Types of Communication Principles of Effective Communication Barriers to Communication	04	13
2.	**Organizational Communication** Interpersonal Organizational Communication Team Building & Group Dynamics Concept & Traits of Effective Leadership	06	20
3.	**Presentation skills** Effective Presentation strategies Power point skills Nonverbal cues in Presentation Audience Analysis Managing Question and Answers in Presentation Online Presentation Etiquettes	05	17
Section II			
4.	**Academic Writing** Content Development for Academic Writing	07	24

	Report Writing Preparing Effective Dissertation Referencing and Citation Plagiarism and Intellectual Property Rights		
5.	**Candidate Recruitment skills** Group Discussion Interview skills Cover letter & Resume Building	08	26

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction to Communication: An Ice Breaker	02
2.	Verbal/ Non-Verbal Communication Pros and Cons	02
3.	Interpersonal Communication	02
4.	Organizational Communication	02
5.	Team Building	02
6.	Orientation to Presentation & PPT skills	02
7.	Presentation Skills	02
8.	Presentations	02
9.	Cover Letter	02
10.	Resume Building - I	04
11.	Academic Writing - I	04
12.	Group Discussion	02
13.	Interview	02

Reference Book(s):

Title	Author/s	Publication
Professional Communication	Sheekha Shukla	2010, WordPress
Professional Communication Skills	Rajesh Kariya	Paradise Publication, Jaipur
Soft Skills and Professional Communication	Petes S. J., Francis.	Tata McGraw-Hill Education, 2011
Effective Communication and Soft Skills	Nitin Bhatnagar	Pearson Education India
Behavioural Science: Achieving Behavioural Excellence for Success	Dr. Abha Singh	John Wiley & Sons, 2012
The Hard Truth about Soft Skills	Klaus, Peggy, Jane Rohman & Molly Hamaker	London: Harper Collins

Course Evaluation:

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 40 marks.
- Practical performance/quiz/drawing/test/submission of 30 marks during End Semester Exam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the importance of professional and organizational communication.
- Understand and apply knowledge of human communication and its processes as they occur across various contexts, e.g., interpersonal, group, organizational etc. from multiple perspectives.
- implement effective presentation strategies.
- know strategies of Effective Academic writing.
- learn the nuances of content writing.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7910
Course Name: Project-I
Prerequisite Course(s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
06			06	00	00	50	50	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- identify, analyze and articulate projects with a comprehensive and systematic approach.
- develop creative thinking.
- perform in a team.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Selection of Title** Select a topic of interest to work upon which can be from any domain. After selecting the topic and proposing the title, get approval from the concerned faculty	10	10
2.	**Literature Review** Study in detail about the topic chosen.	10	10
3.	**Project Proposal** Prepare the proposal on the aspect of the selected area to work upon.	20	20
4.	**Implementation** Implementation of the proposal in any of the programming languages	30	40
5.	**Report Writing** The report must be prepared as per suggested guidelines consisting of Preamble, Objectives, Scope, Introduction, Conclusions, Recommendations and Annexure.	20	10
6.	**Presentation & Question-Answer** At the end of the semester, the student/group of students shall give a presentation of their work followed by a viva-voce examination.	10	10

Course Evaluation:

Sr. No	Evaluation Criteria	Marks
1.	Selection of the topic (Within first 20 Days of commencement of semester)	10
2.	Initial Presentation of the topic	10
3.	An actual work carried out.	10
4.	Report writing as per guidelines.	10
5.	Project and report submission	10
6.	Presentation & Question-Answer session.	50
	Total	**100**

Course Outcome(s):

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

- get information about various existing and future technologies.
- learn the technology of choice and apply that knowledge in solving real life problems
- develop skills to work in a team

P P Savani University
School of Sciences

Department of Science & Humanities

Course Code: SESH7030

Course Name: Statistical Methods for Data Science

Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- demonstrate understanding of statistical methods in support of the analysis, design and application for problem solving in the field of Data Science.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Data & Descriptive Statistics** Elements, Variables, and Observations, Scales of Measurement , Categorical and Quantitative Data, Cross-Sectional and Time Series Data, Summarizing Categorial Data and Quantitative Data, Frequency Distribution, Relative Frequency and Percentage Distributions, Bar Charts and Pie Charts, Dot Plot, Histogram, Cumulative Distributions, Ogive, Measures of Location: Mean, Median, Mode, Percentiles and Quartiles, Measures of Variability: Range, Interquartile Range, Variance, Standard Deviation, Coefficient of Variation.	10	25
2.	**Exploratory Data Analysis** Distribution Shape, $z-$Scores, Chebyshev's Theorem, Empirical Rule, Outliners, Five Number Summary, Box Plot.	7	15
3.	**Correlation Analysis** Type and properties of Correlation, Karl-Pearson's coefficient.	5	10
Section II			
4.	**Introduction to Probability** Experiments, Counting Rules, Assigning Probabilities, Events and their Probabilities, Relationships of Probabilities, Conditional Probability, Bayes' Theorem	6	10

5.	**Discrete and Continuous Probability Distribution** Random Variables, Discrete Probability Distributions, Expected Values and variance, Binomial Probability Distribution, Poisson Probability Distribution, Uniform Probability Distribution, Normal Probability Distribution.	10	25
6.	**Testing of Hypothesis** Introduction, Sampling, Tests of Significance, Null Hypothesis, Alternative Hypothesis, Type 1 and Type 2 errors, Level of Significance, Chi-square test, Student's *t*-test, Seducer's *F*-test.	7	15

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction to Data & Descriptive Statistics-1.	02
2.	Introduction to Data & Descriptive Statistics-2.	02
3.	Introduction to Data & Descriptive Statistics-3.	04
4.	Exploratory Data Analysis.	04
5.	Correlation Analysis	04
6.	Introduction to Probability	04
7.	Discrete and Continuous Probability Distribution-1.	02
8.	Discrete and Continuous Probability Distribution-2.	02
9.	Discrete and Continuous Probability Distribution-3.	02
10.	Testing of Hypothesis	04

Text Book:

Title	Author/s	Publication
Statistics for Business and Economics	David R. Anderson Dennis J. Sweeney Thomas A. Williams	Cengage Learning

Reference Book:

Title	Author/s	Publication
Understandable Statistics Concepts and Methods	Charles Henry Brase Corrinne Pellillo Brase	Houghton Mifflin Company

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous evaluation consists of performance of tutorial which will be evaluated out of 10 Marks for each tutorial and average of the same will be converted to 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 Marks.

Course Outcomes(s):

After completion of this course, student will be able to

- understand Introduction to Data & Descriptive Statistics in real life usage.
- calculate Mean, Median and Mode in real life data.
- box Plot, which data are appropriate.
- learn how to use probability in real world related problem.
- understand which methods are appropriate for different kind of data.
- use Hypothesis in different manner, solve the problem in better way.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7040

Course Name: R Programming

Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	04	00	05	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand the basics in R programming in terms of constructs, control statements, string functions etc.
- design and write efficient programs using R, to perform routine and specialized data manipulation/management and analysis tasks.
- identify and use available R packages and associated Open Source software to meet given scientific objectives.
- handle all aspects of Data analysis (exploring, summarizing, statistical analyzing, visualizing).

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** History and Overview of R, Features of R, Install R , R Environment , R Objects, R Variables, R Operators Work with Base and Contributed R Packages	6	14
2.	**R Datatypes** Atomic Datatypes , Creating Vectors, Vectorized Operations, Working with List and its Operations, Create Matrices and Array, Create Factors, Working with Data Frame , Merging Data Frames, Data Frame Operations, Data Reshaping Functions : cbind(), rbind(), cast(), melt(), Handling Date in R, NA and NULL Values, Conversion of Datatypes, R Decision making and R Loops, Loop Functions	8	19
3.	**R Functions** Basic Inbuilt Functions , Operations on Date and Time String Operations , Work with Packages to handle Date and String , Creating user defined Function Calling Function, Arguments matching, Lazy Evaluation	8	17
Section II			

4.	**Managing Data** Reading Data Files with read.table(), Work with readr Package , Removing NA Values, Reading data into R : CSV, Excel, JSON, Saving data in R, Managing Data with dplyr Package	8	18
5.	**Data Visualization** Grammar of Graphics, Work with : Bar Chart, Pie Chart, Histogram, Box plot, Scatter plot, Line Chart, Multiple Charts on Single Layout, Save Graphs in Files, Data Visualization with ggplot2	8	16
6.	**Statistics and Debugging** Basic Statistics , Linear Models and Non-Linear Models, Time Series and Autocorrelation, Clustering Debugging tools in R	7	16

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Install R and R studio. Understand R Environment.	02
2.	Install base packages. Import Distributed Packages in R workspace.	02
3.	Write R code to demonstrate Variables, Objects, Comments, print (), cat (), class (), readline ().	04
4.	Write R code to demonstrate Vector and List with required operations.	02
5.	Write R code to demonstrate Matrices and Array.	02
6.	Write R code to demonstrate Decision making statement and Loops.	02
7.	Write R code to demonstrate Factor and Data Frame with its basic operations.	02
8.	Write R code to demonstrate Data reshaping functions.	02
9.	Write R code to demonstrate basic inbuilt functions in R.	02
10.	Write R code to demonstrate Date and Time. Also install other suitable packages to handle Date and Time.	02
11.	Write R code to demonstrate String Manipulation. Install other suitable packages to handle String.	02
12.	Write code to demonstrate User-defined Functions in R.	02
13.	Write R code to manage data from various types of Files with suitable example.	06
14.	Write R code to demonstrate data manipulation with dplyr package.	04
15.	Write R code to plot different charts with suitable example. Also use ggplot2 package.	08
16.	Write R code to demonstrate Linear models and Non-linear Models.	06
17.	Write R code to demonstrate Time Series forecasting with suitable example.	04
18.	Understand Debugging tools and R Profiler.	06

Text Book(s):

Title	Author/s	Publication
The Art of R Programming: A Tour of Statistical Software Design	Norman Matloff	No starch Press
R for Everyone: Advanced Analytics and Graphics	Jared P. Lander	Addison-Wesley

Reference Book(s):

Title	Author/s	Publication
Beginning R – The Statistical Programming Language	Mark Gardener	Wiley
R Programming for Data Science	Roger D. Peng	Leanpub

Web Material Link:

- **https://nptel.ac.in/courses/111/104/111104100/**

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 40 marks.
- Practical performance/quiz/test consists of 30 marks during End SemesterExam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to,

- access online resources for R and import new function packages into the R workspace.
- create and edit visualizations with R.
- import, review, manipulate and summarize data-sets in R.
- appreciate and apply the R programming from a statistical perspective.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7051
Course Name: Data Mining with Big Data
Prerequisite Course(s): Data Structures & Algorithms (SSDS7020)

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	2	0	4	40	60	20	30	0	0	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- identify the key processes of data mining and knowledge discovery process
- discover the knowledge from the high dimensional system
- apply data mining techniques to solve real time problems

Course Content:

Section I			
Module. No.	Content	Hours	Weightage In %
1.	**Introduction** Motivation and importance, different kinds of data, data mining functionalities, classification of data mining systems, major issues in data mining	03	10
2.	**Data Pre-processing** Data summarization, data cleaning, data integration and transformation, data reduction, data discretization and concept hierarchy generation, feature extraction , feature transformation, feature selection, introduction to Dimensionality Reduction, CUR decomposition	06	10
3.	**Mining Frequent Patterns, Associations and Correlations** Basic concept, efficient and scalable frequent item-set mining methods, mining various kind of association rules, from association mining to correlation analysis, Advanced Association Rule Techniques, Measuring the Quality of Rules.	06	10
4.	**Classification and Prediction** Classification vs. prediction, linear regression, nonlinear regression ,Issues regarding classification and prediction, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques, accuracy and error measures, evaluation of	07	20

	the accuracy of a classifier or predictor		
Section II			
5.	**Cluster Analysis** Types of data in cluster analysis, a categorization of major clustering methods, partitioning methods, hierarchical methods, density-based methods, grid-based methods, model-based clustering methods, clustering high dimensional data, outlier analysis. Current Problems in Machine Learning	07	15
6.	**Introduction to Big Data** What Is Big Data?, Driving the growth of Big Data, Differentiating between Big Data and traditional enterprise relational data, Challenges of Bid Data, Hadoop, MapReduce Why Is MapReduce Necessary?, How Does MapReduce Work?, Real-World MapReduce Examples	08	20
7.	**Hadoop Implementation and Deployment** Introducing Hadoop, Hadoop cluster components, Hadoop Architecture, Hadoop Ecosystem, Evaluation criteria for distributed MapReduce runtimes, Enterprise-grade Hadoop Deployment, Hadoop Implementation	08	15

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction to various data mining tools	05
2.	Solve classification problems using WEKA	05
3.	Solve clustering problems using WEKA	05
4.	Introduction to HADOOP	05
5.	Introduction to Hadoop	02
6.	To setup Hadoop	03
7.	To run sample program using Hadoop	05

Text Book(s):

Title	Author/s	Publication
Data Mining concepts and Techniques	Jiawei Han, Micheline Kamber	Elsevier
Understanding Big data	Chris Eaton, Dirkderooset al	McGraw Hill

Reference Book(s):

Title	Author/s	Publication
Data Mining	Arun K. Pujari	University Press
Data Warehousing Fundamentals	PaulrajPonnian	John Willey
Introduction to Data Mining	Tan, Steinbach, Kumar	Addison-Wesley

Web Material Link:

- https://nptel.ac.in/courses/106/104/106104189/

Course Evaluation:

Theory:

- Continuous Evaluation consists of one test of 60 marks and 2 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- discover interesting patterns from large amounts of data to analyze for predictions and classification.
- develop a data mining application for data analysis using various tools.
- understand big data and tools for systematically organizing and use their data to make strategic decisions.

P P Savani University
School of Sciences
Master of Science (Data Science & Machine Learning)

Course Code: SSDS7061
Course Name: Introduction to Data Science
Prerequisite Course (s): Mathematical Method for Data Science (SESH7020)

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	04	00	05	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand the role of data scientist.
- understand data collection and preprocessing models.
- perform model development and visualization.

Course Content:

Module No.	Content	Hours	Weightage in %
	Section I		
1.	**Introduction:** Introduction to Data Science; Evolution of Data Science; Data Science Roles; Stages in a Data Science Project; Applications of Data Science in various fields; Data Security Issues.	08	15
2.	**Data Collection and Data Pre-Processing:** Data Collection Strategies; Data Pre-Processing Overview; Data Cleaning; Data Integration and Transformation; Data Reduction; Data Discretization.	10	15
3.	**Exploratory Data Analytics:** Descriptive Statistics; Mean, Standard Deviation, Skewness and Kurtosis; Box Plots; Pivot Table; Heat Map; Correlation Statistics; ANOVA.	04	20
	Section II		
4.	**Model Development:** Simple and Multiple Regression; Model Evaluation using Visualization; Residual Plot; Distribution Plot; Polynomial Regression and Pipelines; Measures for In-sample Evaluation; Prediction and Decision Making	13	25
5.	**Model Evaluation:** Generalization Error; Out-of-Sample Evaluation Metrics; Cross Validation; Overfitting; Under Fitting and Model Selection; Prediction by using Ridge Regression; Testing Multiple Parameters by using Grid Search.	10	25

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction to Jupyter Notebook	02
2.	Basic Statistics and Visualization in Python	04
3.	K-means Clustering	04
4.	Association Rules	06
5.	Linear Regression	06
6.	Logistic Regression	06
7.	Naive Bayesian Classifier	06
8.	Decision Trees	06
9.	Simulate Principal component analysis	10
10.	Simulate Singular Value Decomposition	10

Reference Book(s):

Title	Author/s	Publication
Python Data Science Handbook: Essential Tools for Working with Data	Jake VanderPlas	O'Reilly
Doing Data Science: Straight Talk from the Frontline	Rachel Schutt, Cathy O'Neil	O'Reilly
Storytelling with Data: A Data Visualization Guide for Business	Cole Nussbaumer Knaflic	Wiley

Web Material Link:

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

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 40 marks.
- Practical performance/quiz/drawing/test/submission of 30 marks during End SemesterExam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to,

- understand the role of data scientist.
- understand data collection and preprocessing models.
- perform model development and visualization.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS7070
Course Name: Data Visualization
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
01	02	00	02	50	00	20	30	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- study important approaches in the field of data visualization and its techniques.
- understand why visualization is an important part of data analysis.
- develop skills to both design and critique visualizations.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** What is visualization, the visualization process, Types of Data: numerical data, non-numerical data, continuous data, sampled data, discrete data, etc., Data visualization foundation	04	25
2.	**Visualization Techniques** Visualization techniques for spatial data: 1D, 2D and 3D, Dynamic data, Visualizing Point, Line and Area data, Visualization techniques for Multivariate data, Visualizing graphs, texts and documents	04	25
Section II			
5.	**Data Visualization using Tableau** **Introduction to Tableau**: data import and management, data types and operations **Charts:** Bar chart, Line chart, Pie chart, Scatter chart, Gantt chart, Histogram, Motion chart, Box chart, Tree map, etc.	04	25
6.	**Advanced Data Visualization** Making charts interactive and animated, Information Dashboard design with sample case study	03	25

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Getting familiar with Tableau Interface.	02
2.	Data import and management within Tableau.	02
3.	Create visualization charts/dashboards from structured data.	04
4.	Create visualization charts/dashboards from semi-structured data.	04
5.	Create visualization charts/dashboards from live streaming data.	04
6.	Implement Interactive charts.	04
7.	Implement Animated charts.	04
8.	Develop a complete Information Dashboard using all the features covered in the syllabus.	06

Text Book(s):

Title	Author/s	Publication
Interactive Data Visualization Foundation, Techniques and Applications	Mathew Ward, Georges Grinstein, Daniel Keim	A K Peters 2010
Practical Tableau	Ryan Sleeper	O'Reilly

Reference Book(s):

Title	Author/s	Publication
Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software	Daniel G. Murray	Wiley
Handbook of Data Visualization	Chun-houh Chen, Wolfgang Hardle, Antony Unwin	Springer

Web Material Link:

- https://www.coursera.org/learn/datavisualization

Course Evaluation:

Theory

• Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.

• Faculty evaluation consists of 20 marks as per the guidelines provided by Course Coordinator.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 20 marks.
- Practical performance/quiz/test consists of 15 marks during End SemesterExam.
- Viva/Oral performance of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- prepare data for visualization.
- apply visualization techniques for various data analysis tasks.
- design information dashboard.

P P Savani University
School of Sciences
Master of Science (Data Science & Machine Learning)

Course Code: SSDS7920
Course Name: Project-II
Prerequisite Course(s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
06			06	00	00	50	50	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- identify, analyze and articulate projects with a comprehensive and systematic approach.
- develop creative thinking.
- perform in a team.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Selection of Title** Select a topic of interest to work upon which can be from any domain. After selecting the topic and proposing the title, get approval from the concerned faculty	10	10
2.	**Literature Review** Study in detail about the topic chosen.	20	10
3.	**Project Proposal** Prepare the proposal on the aspect of the selected area to work upon.	20	20
4.	**Implementation** Implementation of the proposal in any of the programming languages	30	40
5.	**Report Writing** The report must be prepared as per suggested guidelines consisting of Preamble, Objectives, Scope, Introduction, Conclusions, Recommendations and Annexure.	10	10
6.	**Presentation & Question-Answer** At the end of the semester, the student/group of students shall give a presentation of their work followed by a viva-voce examination.	10	10

Course Evaluation:

Sr. No	Evaluation Criteria	Marks
1.	Selection of the topic (Within first 20 Days of commencement of semester)	10
2.	Initial Presentation of the topic	10
3.	An actual work carried out.	10

4.	Report writing as per guidelines.	10
5.	Project and report submission	10
6.	Presentation & Question-Answer session.	50
	Total	**100**

Course Outcome(s):

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

- get information about various existing and future technologies.
- learn the technology of choice and apply that knowledge in solving real life problems.
- develop skills to work in a team

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8012
Course Name: Machine Learning
Prerequisite Course(s): Mathematics for Data Science (SESH7020), Data Mining with Big Data (SSDS7051)

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- Master the concepts of supervised and unsupervised learning, recommendation engine, and time series modeling.
- Implement models such as support vector machines, kernel SVM, naive Bayes, decision tree classifier, random forest classifier, logistic regression, K-means clustering and more in Python.
- Comprehend the theoretical concepts and how they relate to the practical aspects of Machine Learning.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Artificial Intelligence and Machine Learning** Learning Problems, designing a learning system, Issues with machine learning. Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias.	04	10
2.	**Supervised learning** Decision Tree Representation, Appropriate problems for Decision tree learning, Algorithm, Hypothesis space search in Decision tree learning, inductive bias in Decision tree learning, Issues in Decision tree learning, Radial Bases, Functions, Case Based Reasoning.	10	20
3.	**Artificial Neural networks and genetic algorithms** Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptron, Multilayer Networks and Back Propagation Algorithms, Remarks on Back Propagation Algorithms. Case Study: face Recognition.	09	20
Section II			
Module No.	Content	Hours	Weightage in %
4.	**Bayesian Learning** Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and Least squared Error Hypothesis, Maximum likelihood hypothesis for Predicting probabilities, Minimum Description Length Principle, Bayes Optimal	09	20

	Classifier, Gibbs Algorithm, and Naive Bayes Classifier. Case Study: Learning to classify text.		
5.	**Unsupervised Learning** Unsupervised learning, applications, challenges, EM Algorithm, Apriori algorithm, SVM, K-mean, DBSCAN, EM Algorithm.	08	20
6.	**Overview** Typical application areas, such as Recommender System.	05	10

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction	02
2.	Classifying with distance measures	02
3.	Constructing Decision trees	02
4.	Classification using Decision Trees	02
5.	K-means	02
6.	Classification with k-Nearest Neighbors	02
7.	Random Forest	02
8.	Support vector machines	02
9.	Expectation Maximization	02
10.	Page Rank	04
11.	Naive Bayes Classification	04
12.	CART	04

Text Book(s):

Title	Author/s	Publication
Machine Learning	Tom M Mitchell	McGraw Hill

Reference Book(s):

Title	Author/s	Publication
Pattern Recognition and Machine Learning	Christopher Bishop	Springer-Verlag New York Inc.
Real-World Machine Learning	Henrik Brink, Joseph Richards, Mark Fetherolf	DreamTech
Machine Learning in Action	Peter Harrington	DreamTech

Web Material Link(s):

- https://nptel.ac.in/courses/106/105/106105152/
- https://in.mathworks.com/campaigns/offers/machine-learning-with-matlab.html?gclid=EAIaIQobChMIrv2dqpOh5wIVkoiPCh0t9g8CEAAYASAAEgKl-fD_BwE&ef_id=EAIaIQobChMIrv2dqpOh5wIVkoiPCh0t9g8CEAAYASAAEgKl-fD_BwE:G:s&s_kwcid=AL!8664!3!281794527296!b!!g!!%2Bmachine%20%2Blearning&s_eid=psn_57384022552&q=+machine%20+learning
- https://wqu.org/programs/data-science/?utm_source=datawrkz&utm_medium=search&utm_campaign=datascience&gclid=EAIaIQobChMIr_TK5ZOh5wIVzQorCh0YdQBvEAAYASAAEgLb5PD_BwE

Course Evaluation:
Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:
- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):
After completion of the course, the student will be able to
- the concept of Machine learning and range of problems that can be solved by machine learning.
- They will be able to compare different types of learning algorithms and apply machine learning concepts in real life problems.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8021

Course Name: Data Analytics

Prerequisite Course (s): Statistical Methods for Data Science (SESH7030)

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- find a meaningful pattern in data.
- learn to analyze the data using intelligent techniques.
- make better business decisions by using advanced techniques in data analytics.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction, Data Definitions and Analysis Techniques** Introduction to Data Analytics, Types of Data Analytics, Process of Data Analytics, Importance and Challenges of Big Data Analytics Elements, Variables, Data Categorization, Levels of Measurement, Data Management and Indexing.	11	25
2.	**Statistics for Data Analytics** Introduction, Statistical Hypothesis Generation and Testing, Descriptive Statistics, Inferential Statistics through Hypothesis Tests, Chi-Square Test, T-Test, Analysis of Variance, Correlation Analysis, Maximum Likelihood Test	12	25
Section II			
1.	**Data Analysis Techniques** Regression Analysis and its types, K Nearest Neighbors Regression & Classification Techniques, Clustering, Association Rules Analysis	12	35
2.	**Prescriptive Analytics** Creating Data for Analytics through Designed Experiments, Active Learning and Reinforcement Learning, Visual Data Analysis Techniques, Interaction Techniques	10	15

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Importing and exporting data in python	02
2.	Python packages for data analytics	02
3.	Preprocessing of data (Data formatting, data normalization, missing values	02

	etc.) in python	
4.	Analysis of variance and correlation	02
5.	Mathematical computing using NumPy	02
6.	Data manipulation with pandas	02
7.	Data visualization with python (matplotlib, seaborn etc.)	02
8.	Model building using Scikit-Learn library	02
9.	Linear Regression	02
10.	Association Rule Analysis	04
11.	Data Visualization Using Tableau	04
12.	Case Study	04

Text Book(s):

Title	Author/s	Publication
Data Mining and Business Analytics with R	Johannes Ledolter	Wiley

Reference Book(s):

Title	Author/s	Publication
Intelligent Data Analysis	Michael Berthold, David J. Hand	Springer, 2007
Mining of Massive Datasets	Anand Rajaraman, Jeffrey David Ullman	Cambridge University Press

Web Material Link(s):

- https://www.coursera.org/learn/data-analytics-business
- https://nptel.ac.in/courses/110106072/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- optimize business decisions and create competitive advantage with data analytics.
- handle large scale analytics projects from various domains.
- build a complete business data analytics solution.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8030
Course Name: Research Methodology
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme(Hours/Week)				Examination Scheme(Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- formulate a research problem for a given engineering domain.
- analyze the available literature for given research problem.
- develop technical writing and presentation skills.
- comprehend concepts related to patents, trademark and copyright

Course Content:

Section I			
Module No.	Content	Hours	Weightage in%
1.	**Introduction** Introduction to research problem, sources of finding a research problem, characteristics of a research problem, pitfalls in selecting a research problem, scope and objectives of research problem, approaches of investigation of solutions for research problem.	04	10
2.	**Finding Good Literature** **Decide which sources you will need** Differentiate between journals, conferences, books, magazines and their quality Understand how to establish their quality and authenticity **Finding Information** How to conduct effective searches How to find relevant papers related to your area of research How to capture critical information **Identify main ideas in scholarly literature** Understand and identify the bias, theoretical position and evidence produced **Write notes to organize your ideas** Compare ideas and concepts from different papers	09	20

3.	**Writing and Presenting your Work** **Effective technical writing** How to write Report, Paper, Developing a Research Proposal, Format of research proposal **Build your argument** Recognize the importance of emphasizing your point, Distinguish between your point and the evidence available, Acknowledge the evidence **Check the logistics of your presentation** Identify the key message of your presentation, Understand the expectations and what will be the key review points **Prepare for delivery of your Oral presentation** Rehearse and time your presentation, Prepare to answer questions from the audience: Fundamental concepts should be spoken from memory as reviewer will be looking for evidence of your thorough understanding.	10	20
	Section II		
4.	**Intellectual Property Rights** Introduction and significance of intellectual property rights, types of Intellectual Property Rights, copyright and its significance, introduction to patents and its filing, introduction to patent drafting, best practices in national and international patent filing, copyrightable work examples.	07	15
5.	**Patent Right** Patents and its basics, patentable items, designs, process of filing patent at national and international level, process of patenting and development, technological research and patents, innovation, patent and copyright international intellectual property, procedure for grants of patents, need of specifications, types of patent applications, provisional and complete specification, patent specifications and its contents, trade and copyright.	08	20
6.	**New Developments in Intellectual Property Rights (IPR)** Administration of patent system in India, India's stand in the world of IPs, new developments in IPR at national and international level, prosecution (filing) PCT / international filing, national phase filing, scope of patent rights, licensing and transfer of technology, patent information and databases, geographical indications, basic laws related to patent filing, case studies- IPR of Hardware, computer software.	07	15

Reference Book(s):

Title	Author/s	Publication
Resisting Intellectual Property	Halbert	Taylor & Francis Ltd
Introduction to Design	Rajesh Kariya	Prentice Hall
Research methodology: an introduction for science & engineering students	Stuart Melville and Wayne Goddard	Juta & Co Ltd
Intellectual Property Rights Under WTO	T. Ramappa	S. Chand, 2008
Research Methodology: A Step by Step Guide for Beginners	Ranjit Kumar	Pearson

Web Material Link:

- **https://onlinecourses.nptel.ac.in/noc19_ge21/preview**

Course Evaluation:
Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1hour of duration and average of the same will be converted out of 30 marks.
- Faculty Evaluation consists of 10 marks as per guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 Marks Exam.

Course Outcome:

After completion of the course, the student will be able,

- conduct a quality literature review and find the research gap.
- identify an original and relevant problem and identify methods to find its solution
- validate the model
- present and defend the solution obtained in an effective manner in written or spoken form.
- follow research ethics
- understand IPR protection for further research and better products

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8910
Course Name: Project-III
Prerequisite Course(s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
07			07	00	00	50	50	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- identify, analyze and articulate projects with a comprehensive and systematic approach.
- develop creative thinking.
- perform in a team.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Selection of Title** Select a topic of interest to work upon which can be from any domain. After selecting the topic and proposing the title, get approval from the concerned faculty	10	10
2.	**Literature Review** Study in detail about the topic chosen.	10	10
3.	**Project Proposal** Prepare the proposal on the aspect of the selected area to work upon.	20	20
4.	**Implementation** Implementation of the proposal in any of the programming languages	30	40
5.	**Report Writing** The report must be prepared as per suggested guidelines consisting of Preamble, Objectives, Scope, Introduction, Conclusions, Recommendations and Annexure.	20	10
6.	**Presentation & Question-Answer** At the end of the semester, the student/group of students shall give a presentation of their work followed by a viva-voce examination.	10	10

Course Evaluation:

Sr. No	Evaluation Criteria	Marks
1.	Selection of the topic (Within first 20 Days of commencement of semester)	10
2.	Initial Presentation of the topic	10
3.	An actual work carried out.	10
4.	Report writing as per guidelines.	10
5.	Project and report submission	10
6.	Presentation & Question-Answer session.	50
	Total	**100**

Course Outcome(s):

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

- get information about various existing and future technologies.
- learn the technology of choice and apply that knowledge in solving real life problems.
- develop skills to work in a team

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8920
Course Name: Dissertation
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
25			25	00	00	200	300	00	00	500

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- identify his or her own area of interest
- improve research ability
- explore a subject in depth

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Identifying Research Area** Identify the area of interest and available research scope in that area, Discuss the feasibility and get approval from concerned faculty	10	10
2.	**Literature Review** Perform survey of scholarly sources on a selected area, identify relevant theories, methods, and gaps in the existing research	20	20
3.	**Finalization of Topic** Based on Literature Review, Discuss the specific topic with concerned faculty and get approval	20	10
4.	**Implementation and Testing** Implement the proposal and verify the output with proposal.	30	30
5.	**Thesis Writing** Thesis must be prepared as per guidelines.	10	20
6.	**Evaluation (Presentation and Question-Answer)** Assessors will assess the whole work and award the marks based different parameters like Literature Review, Implementation, and Evaluation.	10	10

Course Evaluation:

- Continuous Evaluation consisting of 200 marks, will be cumulative of initial presentation, presentations of literature review and implementation of existing work. The literature review should include the reason for selecting particular topic, and existing related work.
- End Semester Exam evaluation consisting of 300 marks, will be cumulative of implementation of proposed system, testing, thesis writing and correction/modification done based on suggestion provided by assessors.

Course Outcome(s):

After completion of the course, the student will be able to

- carry out a comprehensive research project and critically interpret results in computer science and applications
- demonstrate independent learning skills
- write an extended scientific report and show research skills
- show good oral communication skill.

ELECTIVE COURSES

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8511
Course Name: Natural Language Processing
Prerequisite Course (s): Mathematics for Data Science (SESH7020)

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- comprehend the key concepts of NLP which are used to describe and analyze language
- illustrate computational methods to understand language phenomena of word sense
- design and develop applications with natural language capabilities.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** Introduction to NLP, History of NLP, Advantages of NLP, Disadvantages of NLP, Components of NLP, Applications of NLP, Phases of NLP, Challenges in NLP, NLP Libraries	7	25
2.	**Language Modelling and Text Representation** Unigram Language Model, Bigram, Trigram, N-gram, Applications of Language Modeling, Bag of Word Model, Skip gram, Continuous Bag-Of-Words, Embedding representations for words Lexical Semantics, Feature Weighing Techniques, Parts of Speech Tagging, Morphology.	8	25
Section II			
3.	**Word Sense Disambiguation** Word Sense Disambiguation, Knowledge Based and Supervised Word Sense Disambiguation, Introduction to WordNet.	7	25
4.	**Text Analysis, Summarization and Machine Translation** Sentiment Mining, Text Classification, Text Summarization, Information Extraction, Named Entity Recognition, Relation Extraction, Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR, Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge	8	25

	Based MT System, Statistical Machine Translation (SMT)		

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction to NLP and related packages in Python	02
2.	Text Normalization	02
3.	Part of Speech tagging experiments	02
4.	Root word conversion (stemming and Lemmatization)	04
5.	Morphological analysis of text	02
6.	N-gram analysis of text	02
7.	Implementation of Bag of word model with different weighing techniques	02
8.	Implementation of word sense disambiguation models	02
9.	WordNet usage based experiment	04
10.	Named Entity Recognition experiment	04
11.	Text Classification based experiment	04

Reference Book(s):

Title	Author/s	Publication
Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition,	Jurafsky, David, and James H. Martin	PEARSON
Foundations of Statistical Natural Language Processing.	Manning, Christopher D., and HinrichSchütze.	Cambridge, MA: MIT Press
Natural Language Understanding.	James Allen.	The Benjamin/Cummings Publishing Company Inc..
Handbook of natural language processing.	Dale, R., Moisl, H., & Somers, H.,	CRC Press.

Web material link:

- https://nptel.ac.in/courses/106/105/106105158/
- http://www.nptelvideos.in/2012/11/natural-language-processing.html

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the importance of natural language processing.
- understand and apply lexical, syntactic, semantic knowledge of text to perform various tasks.
- develop advanced NLP tools and solving practical problems in the field.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8520
Course Name: Digital Image Processing
Prerequisite Course(s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help the learners to

- Understand the fundamentals of image processing.
- Apply various processes on images for image understanding.
- Understand the design aspects and realization of image processing applications.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction and Digital Image Fundamentals** Digital Image Fundamentals, Human visual system, Image as a 2D data, Image representation – Grayscale and Color images, image sampling and quantization.	02	10
2.	**Image enhancement in the Spatial domain** Basic gray level Transformations, Histogram Processing Techniques, Spatial Filtering, Low pass filtering, High pass filtering.	05	15
3.	**Filtering in the Frequency Domain** Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering.	04	15
4.	**Image Restoration and Reconstruction** Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) Filtering.	04	10
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Color Image Processing:** Color Fundamentals, Color Models, Pseudo color image processing.	03	10
2.	**Image Compression** Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, LZW coding, JPEG Compression standard.	03	10

3.	**Morphological Image Processing** Erosion, dilation, opening, closing, Basic Morphological Algorithms: hole filling, connected components, thinning, skeleton.	03	10
4.	**Image Segmentation** point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection, Hough transform.	03	10
5.	**Object Recognition and Case studies** Object Recognition- patterns and pattern classes, recognition based on decision-theoretic methods, structural methods, case studies – image analysis, Application of Image processing in process industries.	03	10

List of Practical(s):

Sr. No	Name of Practical	Hours
1	Introduction to Image Processing Toolbox.	02
2	Read an 8bit image and then apply different image enhancement techniques: (a) Brightness improvement (b) Brightness reduction (c) Thresholding (d) Negative of an image (e) Log transformation (f) Power Law transformation.	04
3	Implement different interpolation techniques using MATLAB/ Python / Scilab.	02
4	Read an image, plot its histogram then do histogram equalization and comment about the result.	02
5	(a) Implement Gray level slicing (intensity level slicing) in to read cameraman image. (b) Read an 8bit image and to see the effect of each bit on the image. (c) Read an image and to extract 8 different planes i.e. 'bit plane slicing."	02
6	Implement various Smoothing spatial filter	04
7	Read an image and apply (1) Gaussian 3x3 mask for burring (2) High pass filter mask with different masks (3) Laplacian operator with center value positive and negative (4) High boost filtering.	02
8	Write a program to implement various low pass filters and high pass filter in the frequency domain.	02
9	Write a program for erosion and dilation, opening & closing using inbuilt and without inbuilt function.	02
10	Implement and study the effect of Different Mask (Sobel, Prewitt, and Roberts)	02
11	Implement various noise models and their Histogram	02
12	Implement inverse filter and Wiener filter over image and comment on them	02
13	Implement Image compression using DCT Transform	02

Text Book(s):

Title	Author/s	Publication
Digital Image Processing	Rafael C. Gonzalez, Richard E. Woods	Pearson Education
Fundamentals Digital Image Processing	Jain Anil K.	Prentice Hall India Learning

Reference Book(s):

Title	Author/s	Publication
Image Processing, Analysis and Machine Vision	Milan Sonka, Vaclav Hlavac, Roger Boyle	CL Engineering
Biomedical Image Analysis	Rangaraj M. Rangayyan	CRC Press
Digital Image Processing	William K. Pratt	John Wiley & Sons

Web Material Link(s):

- https://nptel.ac.in/courses/106105032/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/test consists of 15 marks during End Semester Exam.
- Viva/oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- apply knowledge of mathematics for image understanding and analysis.
- design and analysis of techniques/processes for image understanding.
- design, realize and troubleshoot various algorithms for image processing case studies.
- select the appropriate hardware and software tools (Contemporary) for image analysis.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8530
Course Name: Cloud Computing
Prerequisite Course/s: Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help students to

- To understand the principles and paradigm of Cloud Computing
- To understand the Service Model with reference to Cloud Computing
- To appreciate the role of Virtualization Technologies
- Ability to design and deploy Cloud Infrastructure
- Understand cloud security issues and solutions

Course Content:

Section I			
Module	Content	Hours	Weightage in %
1.	**Introduction to Cloud Computing** Overview, Roots of Cloud Computing, Layers and Types of Cloud, Desired Features of a Cloud, Benefits and Disadvantages of Cloud Computing, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks	4	10
2.	**Cloud Architecture, Services and Applications** Exploring the Cloud Computing Stack, connecting to the Cloud, Infrastructure as a Service, Platform as a Service, Saas Vs. Paas, Using PaaS Application Frameworks, Software as a Service, Cloud Deployment Models, Public vs Private Cloud Cloud Solutions, Cloud ecosystem, Service management, Identity as a Service, Compliance as a Service	6	20
3.	**Virtualization, Abstraction and Cloud Platform** Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, Understanding Machine Imaging, Porting Applications, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Hypervisors	5	20
Section II			
Module	Content	Hours	Weightage in %
1.	**Cloud Security**	05	15

	Security Overview, Cloud Security Challenges and Risks, Software-as-a- Service Security, Cloud computing security architecture: Architectural Considerations, General Issues Securing the Cloud, Securing Data, Data Security, Application Security, Virtual Machine Security, Identity and Presence, Identity Management and Access Control, Autonomic Security Establishing Trusted Cloud computing, Secure Execution Environments and Communications, , Identity Management and Access control Identity management, Access control, Autonomic Security Storage Area Networks, Disaster Recovery in Clouds		
2.	**AWS Programming, management console and storage** Basic Understanding APIs - AWS programming interfaces, Web services, AWS URL naming, Matching interfaces and services, Elastic block store - Simple storage service, Define the AWS Cloud and its value proposition, Identify aspects of AWS Cloud economic, List the different cloud architecture design principles, Security and Compliance, Define the AWS shared responsibility model, Define AWS Cloud security and compliance concepts, Identify AWS access management capabilities, Identify resources for security support	05	20
3.	**AWS Technology, Billing and Pricing** Define methods of deploying and operating in the AWS Cloud, Define the AWS global infrastructure, Identify the core AWS services, identify resources for technology support, Compare and contrast the various pricing models for AWS, Recognize the various account structures in relation to AWS billing and pricing, Identify resources available for billing support	05	15

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Write pros and cons of Cloud Computing.	04
2.	Summarize Cloud service models with real time examples.	04
3.	Define Virtualization. Also list and explain different Hypervisors.	04
4.	Discuss performance evaluation of service over cloud.	04
5.	Software study on Hadoop, MapReduce and HDFS.	04
6.	Create an AMI for Hadoop and implementing short Hadoop programs on the Amazon Web Services platform.	06
7.	Create a scenario that use Amazon S3 as storage on cloud.	04

Text Book(s):

Title	Author/s	Publication
Cloud Computing Bible	Barrie Sosinsky	John Wiley & Sons

Reference Book(s):

Title	Author/s	Publication
Amazon Web Services For Dummies	Bernard Golden	Dummies
Amazon Web Services in Action	Michael Wittig and Andreas Wittig	Dreamtech Press
Building Applications in the Cloud: Concepts, Patterns and Projects	Christopher M. Moyer	Pearson Addison-Wesley Professional
Cloud Computing Design Patterns	Thomas Erl	Prentice Hall

Web Material Link(s):

- CloudSim 3.0.3
- http://www.cloudbus.org/

- https://aws.amazon.com/
- http://aws.amazon.com/documentation/
- http://docs.aws.amazon.com/IAM/latest/UserGuide/getting-started.html

Course Evaluation:
Theory:
- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted out of 30 marks.
- Faculty Evaluation consists of 10 marks as per guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks exam.

Practical:
- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/test consists of 15 marks during End Semester Exam.
- Viva/oral performance consists of 15 marks during End Semester Exam

Course Outcome(s):
After completion of the course, the student will be able to:
- explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
- apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost by Load balancing approach.
- discuss system virtualization and outline its role in enabling the cloud computing system model.
- illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.
- analyze various cloud programming models and apply them to solve problems on the cloud.
- understand various management and other distinguish services of AWS.
- analyze the billing of resources and other paradigm: how to deal with disasters.
- understand security and compliances for AWS.
- deploy applications over commercial cloud

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8540
Course Name: Computer Vision
Prerequisite Course/s: Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand the principles of image processing
- understand extraction of features from images and analyze images
- generate 3D models from images.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1	**Introduction:** Image Processing, Computer Vision and Computer Graphics, what is Computer Vision – Low-level, Mid-level, High-level, Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality	03	15
2	**Handling Files, Cameras, and GUI's:** Basic I/O scripts, reading and writing image files, converting between an image and raw bytes, reading and writing video file, capturing camera frames, displaying camera frames in window. **An Object-oriented design:** Abstracting a video stream, abstracting a window and a frame	04	10
3	**Image Formation Models:** Monocular imaging system, Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc., Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading, Photometric Stereo, Depth from Defocus, Construction of 3D model from images	04	15
4	**Image Processing and Feature Extraction:** Image preprocessing, Image representations (continuous and discrete) , Edge detection	04	10
Section II			

Module No.	Content	Hours	Weightage in %
1	**Shape Representation and Segmentation:** Contour based representation, Region based representation, Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multiresolution analysis	05	15
2	**Object recognition:** Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition	04	15
3	**Image Understanding:** Pattern recognition methods, HMM, GMM and EM	04	15
4	**Case Studies:** Face Recognition, Medical Imaging, object detection	02	05

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Implement image preprocessing and Edge detection	02
2.	Implement camera calibration methods	02
3.	Implement Projection	02
4.	Determine depth map from Stereo pair	02
5.	Construct 3D model from Stereo pair	02
6.	Implement Segmentation methods	02
7.	Construct 3D model from defocus image	02
8.	Construct 3D model from Images	02
9.	Implement optical flow method	02
10.	Implement object detection and tracking from video	04
11.	Face detection and Recognition	04
12.	Face detection and Recognition	04

Text Book(s):

Title	Author/s	Publication
Computer Vision - A modern approach	D. Forsyth and J. Ponce	Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hil
Introductory Techniques for 3D Computer Vision	E. Trucco and A. Verri	Prentice Hall
OpenCV Computer Vision with python	Joseph Howse	Packt Publishing

Reference Book(s):

Title	Author/s	Publication
Digital Image Processing	R. C. Gonzalez, R. E. Woods	Addison Wesley Longman
Computer Vision: Algorithms and Applications	Richard Szeliski	Springer

Web Material Link(s):

- https://homepages.inf.ed.ac.uk/rbf/BOOKS/BANDB/toc.htm
- https://www.pyimagesearch.com/start-here/
- https://realpython.com/tutorials/computer-vision/

Course Evaluation:
Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same will be converted out of 30 marks.
- Faculty Evaluation consists of 10 marks as per guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks exam.

Practical:

- Continuous Evaluation consists of the performance of practical which will be evaluated out of 10 per each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

- implement fundamental image processing for computer vision.
- understand image formation process.
- generate 3D models from images.
- develop applications with computer vision.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8550
Course Name: Blockchain Technology
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- comprehend the structure of a Blockchain networks
- evaluate security issues relating to Blockchain and cryptocurrency
- design and analyze the applications based on Blockchain technology

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Blockchain:** History, Digital Money to Distributed Ledgers, Design Primitives, Protocols, Security, Consensus, Permissions, Privacy	3	10
2.	**Blockchain Architecture, Design and Consensus:** Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms, Requirements for the consensus protocols, PoW and PoS, Scalability aspects of Blockchain consensus protocols	6	20
3.	**Permissioned and Public Blockchains:** Design goals, Consensus protocols for Permissioned Blockchains, Hyperledger Fabric, Decomposing the consensus process, Hyperledger fabric components, Smart Contracts, Chain code design, Hybrid models (PoS and PoW)	6	20
Section II			
4.	**Blockchain cryptography:** Different techniques for Blockchain cryptography, privacy and security of Blockchain, multi-sig concept	8	25
5.	**Recent trends and research issues in Blockchain:** Scalability, secure cryptographic protocols on Blockchain, multiparty communication, FinTech and Blockchain applicabilities	7	25

List of Practical(s):

Sr No	Name of Practical	Hours
1.	Generating Blocks	10
2.	Write your first blockchain application	10
3.	Build your own network	10

Text Book:

Title	Author/s	Publication
Blockchain Basics – A Non-Technical Introduction in 25 Steps.	Daniel Drescher	Apress

Reference Book:

Title	Author/s	Publication
Mastering Blockchain	Imran Bashir	Packt
The Business Blockchain – Promise, practice, and application of the next internet technology.	William Mougayar	Wiley

Web Material Link(s):

- https://www.udemy.com/course/blockchain-and-bitcoin-fundamentals/
- https://cognitiveclass.ai/courses/blockchain-course
- https://www.coursera.org/courses?query=blockchain

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the
  same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 20 marks.
- Practical performance/quiz/test consists of 10 marks during End SemesterExam.
- Viva/Oral performance of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to,

- understand blockchain and its applications.
- create their own Blockchain application.
- build their own network.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8560
Course Name: Artificial Intelligence
Prerequisite Course (s): Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand basics of AI.
- develop roles in future and also introduce the intelligence of machine.
- design AI.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** What is an AI Technique? The AI Problems and applications, Major areas of Artificial Intelligence, History of AI	03	10
2.	**Problems, State Space Search & Heuristic Search Techniques** Defining the Problems as a State Space Search, Production Systems: control & search strategies, Depth first and Breadth first search, Bidirectional Search, Hill Climbing, Best first search, A* algorithm	06	20
3.	**Knowledge Representation Techniques** Procedural Versus Declarative Knowledge, Forward Reasoning, Backward Reasoning, Representations and Mappings, Approaches to Knowledge Representation, Using Propositional logic and Predicate Logic, Resolution, Semantic network, Frame based knowledge, Representing knowledge using rules	06	20
Section II			
1.	**Uncertain Reasoning and alternatives** Probability and Bayes' Theorem, Certainty Factors and	05	20

	Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory, Fuzzy sets, Fuzzy Logic, Fuzzy systems, Hidden Markov model		
2.	**Game Theory** Introduction to Game playing, The Minimax search procedure, Alpha-Beta procedure, Refinements, Iterative Deepening DFS	05	10
3.	**Connectionist Models** Introduction to Hopfield Network, Learning in Neural Network, Application of Neural Networks, Recurrent Networks, Introduction to multilayer Neural networks	05	20

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Overview of Artificial Intelligence systems.	02
2.	Write a program to implement BFS (for 8 puzzle problem or Water Jug problem or any AI search problem)	02
3.	Write a program to implement DFS (for 8 puzzle problem or Water Jug problem or any AI search problem)	02
4.	Write a program to Implement A* Algorithm.	04
5.	Explore different python packages which are applicable in AI.	04
6.	Write a program to construct a Bayesian network from given data.	04
7.	Write a program to infer from the Bayesian network.	04
8.	Hidden Markov model implementation using python.	04
9.	Character recognition application using python.	02
10.	Neural Network application using python.	02

Text Book(s):

Title	Author/s	Publication
Artificial Intelligence	By Elaine Rich And Kevin Knight	(2nd Edition) Tata McGraw-Hill

Reference Book(s):

Title	Author/s	Publication
Artificial Intelligence: A Modern Approach	Stuart Russel, Peter Norvig	PHI

Web Material Link:

- https://nptel.ac.in/courses/106/102/106102220/

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 20 marks.
- Practical performance/quiz/test consists of 10 marks during End SemesterExam.
- Viva/Oral performance of 15 marks during End Semester Exam.

Course Outcome(s):

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

- learn the fundamentals of distributed environment.
- develop efficient distributed system with their own logic & capabilities.
- understand the security aspects in distributed environment.

P P Savani University
School of Sciences

Master of Science (Data Science & Machine Learning)

Course Code: SSDS8571
Course Name: Deep Learning
Prerequisite Course (s): Machine Learning (SSDS8012)

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	02	00	03	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand Deep Learning concepts.
- apply Deep Learning knowledge to solve real life problems.

Course Content:

Module No.	Content	Hours	Weightage in %
	Section I		
1.	**Introduction to Deep Learning** Artificial Intelligence, Machine Learning, Brief History of Deep Learning, Why Deep Leaning?	2	5
2.	**Mathematical building blocks of Neural Networks** Introduction to Neural Network, Data Representation, Tensor Operations, Gradient based optimization	5	15
3.	**Neural Network** Anatomy of Neural Network, Introduction to Keras, Setting up Work station, Binary classification, Multiclass classification	8	30
	Section II		
4.	**Deep Learning for Computer Vision** Introduction to Convolutional Neural Networks, Training CNN, Pre trained CNN	5	20
5.	**Deep Learning for text and sequences** Working with text data, Understanding Recurrent Neural Network, Advanced use of RNN, Sequence processing with CNN	5	20
6.	**Advanced Deep Learning** Sequential Model, Deep Learning Models using Keras callback & TensorBoard , Getting out most of your model	5	10

List of Practical(s):

Sr. No	Name of Practical	Hours
1.	Introduction to Google Colab	02
2.	Data Representation	02
3.	Introduction to Keras and NN	04
4.	Practical Based on Binary Classification	04
5.	Practical Based on Multiclass Classification	04
6.	Practical based on Computer Vision	06
7.	Practical Based on CNN	04
8.	Practical Based on RNN	04

Reference Book(s):

Title	Author/s	Publication
Deep Learning with Python	François Chollet	MANNING SHELTER ISLAND

Web Material Link:

- https://nptel.ac.in/courses/106/106/106106184/

Course Evaluation:

Theory

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical

- Continuous Evaluation will be cumulative of practical performances, activities, presentations, viva and submissions consisting of 40 marks.
- Practical performance/quiz/drawing/test/submission of 30 marks during End Semester Exam.
- Viva/Oral performance of 30 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the Deep Learning.
- understand and apply knowledge of Deep Learning in Computer Vision and Textual data.
- implement Deep learning to solve real life problems.