AC -24/11/2023

Item No. - 6.3 (N)

As Per NEP 2020

University of Mumbai

Title of the program

A- U.G. Certificate in Data Science
B- U.G. Diploma in Data Science
C- B.Sc. (Data Science)
D- B.Sc. (Honours) in Data Science
E- B.Sc. (Honours with Research) in Science

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2024-25 Progressively)

University of Mumbai

Syllabus for Approval

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O. SU-505A**	A	Title of the program U.G. Certificate in Data Science
	O. SU-505B	B	U.G. Diploma in Data Science
	O. SU-505C	C	B.Sc. (Data Science)
	O. SU-505D	D	B.Sc. (Honours) in Data Science
	O. SU-505E	E	B.Sc. (Honours with Research) in Data Science
2	**Eligibility** **O.SU-506A**	A	A candidate for being eligible to the degree course o Bachelor of Science in Science should have passed XII standard examination of the Maharashtra Board of Higher Secondary Education or its equivalent in Arts/Science/Commerce/MCVC with Mathematics and/or Statistics as one of the subjects **(OR)** A candidate who has completed Diploma in IT/CS/Electrical/Electronics/Mechanical/Civil/ Electronics and Telecommunication/Instrumentation and/or allied branches from MSBTE or equivalent board **(OR)** A candidate for being eligible to the degree course o Bachelor of Science in Science should have passed XII standard examination of the Maharashtra Board of Higher Secondary

			Education or its equivalent in Arts/Science/Commerce/MCVC without Mathematics and/or Statistics has to undergo a bridge course of 30 hours in Mathematics and/or Statistics **(OR)** Passed Equivalent Academic Level 4.0 with Mathematics and/or Statistics as one of the subjects
	O.SU-506B	B	Under Graduate Certificate in Data Science Academic Level 4.5
	O. SU-506C	C	Under Graduate Diploma in Data Science Academic Level 5.0
	O. SU-506D	D	Bachelors of Science in Data Science with minimum CGPA of 7.5 Academic Level 5.5
	O. SU-506E	E	Bachelors of Science in Data Science with minimum CGPA of 7.5 Academic Level 5.5
3	**Duration of program** **R. SU-511**	A	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years
4	**Intake Capacity** **R. SU-512**		
5	**Scheme of Examination** **R.SU-513**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	**Standards of Passing** **R.SU-514**	40% in each component	

7	**Credit Structure** **Sem. I R: SU-515A** **Sem. II R:SU-515B**	Attached herewith	
	Credit Structure **Sem. III R: SU-515C** **Sem. IV R: SU-515D**		
	Credit Structure **Sem. V R: SU-515E** **Sem. VI R: SU-515F**		
8	**Semesters**	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
		D	Sem VII & VIII
		E	Sem VII & VIII
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5
		D	6.0
		E	6.0
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2023-24	

Sign of Chairperson
Dr. Mrs. R. Srivaramangai
Ad-hoc BoS (Data Science)

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of Offg. Dean,
Prof. Shivram S. Garje
Faculty of Science & Technology

Preamble

1. Introduction: A Data Science degree program is a dynamic educational pathway that equips students with a multidisciplinary skill set essential for navigating the intricacies of the data-driven world. Foundational courses in mathematics and statistics lay the groundwork, while programming skills in languages like Python and Rare honed for data manipulation and analysis. The curriculum delves into machine learning techniques, covering both supervised and unsupervised learning, and explores big data technologies such as Hadoop and Spark. Students gain practical experience in applying these skills to real-world problems through capstone projects, ensuring they are well-prepared to address the challenges of data science in diverse industries.

Furthermore, Data Science degree programs emphasize the ethical considerations surrounding data use and privacy. Students engage in discussions about responsible conduct in data science, addressing the societal implications of their work. The program typically culminates in the development of strong communication skills, with a focus on data visualization and effective presentation of findings to non-technical stakeholders. Through a combination of theoretical knowledge, practical experience, and ethical considerations, graduates of Data Science degree programs are well-positioned to make meaningful contributions in a data-driven world.

2. Aims and Objectives:

A) Aims:

- To cultivate a strong foundation in mathematical and computational skills essential for data analysis.
- To enable students to understand and apply machine learning algorithms for predictive modeling and pattern recognition.
- familiarize students with technologies and frameworks for handling and processing large datasets efficiently.
- To instill a sense of ethical responsibility and awareness of privacy considerations in data science work.
- To prepare students to apply data science techniques to specific industry domains.
- To develop effective communication skills for conveying data-driven insights to diverse audiences.
- To ensure students can apply theoretical knowledge to solve real-world problems.
- To prepare students for a field that is constantly evolving.

B) Objectives:

- To provide courses in mathematics, statistics, and programming languages, enabling students to manipulate, process, and analyze large datasets.
- To cover supervised and unsupervised learning techniques, ensuring students can select and deploy appropriate models for various data-driven tasks.
- To provide hands-on experience with tools like Hadoop and Spark, allowing

students to work with big data in real-world scenarios.

- To incorporate discussions on ethical considerations in data collection, analysis, and dissemination, and to emphasize the responsible use of data.
- To offer courses or projects that focus on the application of data science in areas such as healthcare, finance, marketing, or other relevant sectors.
- To provide training in data visualization techniques and enhance report writing and presentation skills to facilitate clear communication of findings.
- To incorporate hands-on projects, possibly in the form of a capstone project or industry internship, allowing students to gain practical experience and build a portfolio of work.
- To encourage a mindset of continuous learning, adaptability, and staying abreast of emerging technologies and methodologies in data science.

3. Learning Outcomes: The B. Sc. (Data Science) Programme shall prepare and enable the graduates to:

- ✓ Proficiency in Data Analysis
- ✓ Mastery of Machine Learning Techniques
- ✓ Competence in Big Data Technologies
- ✓ Application of Data Science in Specific Domains
- ✓ Ethical Considerations and Privacy Awareness
- ✓ Effective Communication of Insights
- ✓ Critical Thinking and Problem-Solving
- ✓ Continuous Learning and Adaptability
- ✓ Team Collaboration and Interdisciplinary Skills
- ✓ Quantitative and Qualitative Research Skills
- ✓ Leadership and Decision-Making Skills

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completing the B. Sc. Data Science…

PSO 1. Graduates will possess a comprehensive skill set in data analysis, including the ability to collect, clean, and analyze data using statistical methods and programming languages.

PSO 2. Graduates will demonstrate expertise in machine learning techniques, enabling them to develop and deploy predictive models for various applications.

PSO 3. Graduates will be proficient in utilizing big data technologies, such as Hadoop and Spark, for processing and analyzing large datasets efficiently.

PSO 4. The program will prepare students to apply data science techniques effectively in diverse domains, addressing industry-specific challenges.

PSO 5. Graduates will exhibit ethical awareness and responsible practices in data science, considering privacy concerns and societal implications in their work.

PSO 6. Graduates will develop strong communication skills, both written and oral, and the ability to visually communicate complex data-driven insights through effective data visualization techniques.

PSO 7. The program will foster critical thinking skills, empowering graduates to approach complex problems systematically and devise innovative solutions using data-driven methodologies.

PSO 8. Graduates will embrace a culture of continuous learning, staying informed about emerging technologies and methodologies in data science, and adapting to industry advancements.

PSO 9. The program will instill the ability to collaborate effectively in multidisciplinary teams, leveraging data science expertise to contribute to broader organizational objectives.

PSO 10. Graduates will have engaged in hands-on, real-world projects, demonstrating their ability to apply theoretical knowledge to practical scenarios and solving authentic data science problems.

PSO 11. Graduates will possess skills in designing and conducting both quantitative and qualitative research, contributing to the advancement of knowledge in the field.

PSO 12. The program will nurture leadership skills, enabling graduates to make informed, data-driven decisions and contribute to strategic planning within organizations.

1) Credit Structure of the Program (Sem I, II, III, IV, V and VI)
Under Graduate Certificate in Data Science

(Credit Struture Sem I & II)

	R: _____A									
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
	I	**6**		**-**	**2+2**	**VSC:2, SEC:2**	**AEC:2, VEC:2, IKS:2**	**CC:2**	**22**	
		• Python Programming-02 • Descriptive Statistics-02 • Practical 1-02				• VSC : Excel for Business -02 • SEC – 02 • Office Tools for Data Scientists **OR** • Digital Marketing				**UG** **Certificate 44**
	R: _____B									
	II	**6**		**2**	**2+2**	**VSC:2, SEC:2**	**AEC:2, VEC:2**	**CC:2**	**22**	
		• Advanced Python Programming-02 • Database Management Systems-02 • Practical 2-02				• VSC : Discrete Mathematics – 02 • SEC: 02 • Web Technology **OR** • Graph Theory				
	Cum Cr.	**12**	**-**	**2**	**8**	**8**	**10**	**4**	**44**	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Majorand Minor										

Under Graduate Diploma in Data Science

Credit Structure (Sem. III & IV)

	R: _____C									
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC,RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
	III	**8**		**4**	**2**	**VSC:2**	**AEC:2,**	**FP :2 CC:2**	**22**	**UG Diploma 88**
		• Design and Analysis of Algorithms-02 • Design and Analysis of Algorithms Practical-02 • Data Warehousing and Mining-02 • Data Warehousing and Mining Practical-02				VSC : Linear Algebra -02				
	R: _____D									
	IV	**6**		**4**	**2**	**SEC:2**	**AEC: 2**	**CEP: 2 CC:2**	**22**	
		• Big Data - 02 • Big Data Practical-02 • Artificial Intelligence-02 • Artificial Intelligence Practical-02				• Testing of Hypothesis **OR** • Mojo				
	Cum Cr.	28		10	12	12	14	12	88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continuewith Major and Minor										

B.Sc. (Data Science)

Credit Structure (Sem. V & VI)

	R: _____E									
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
	V	**10**	**4**	**4**		**VSC: 2**		**FP/CEP:2**	**22**	
		• Data Engineering-02 • Data Engineering Practical-02 • Cloud Computing-02 • Cloud Computing Practical-02 • Social Media Analytics-02	• Marketing and Retail Analytics-02 • Marketing and Retail Analytics Practical-02 **OR** • Robotic Process Automation-02 Robotic Process Automation Practical-02			• Data Visualization -02		FP: Project Dissertation-02	22	**UG Degree 132**
	R: _____F									
	VI	**10**	**4**	**4**				**OJT :4**	**22**	
		• Machine Learning-02 • Machine Learning Practical-02 • Deep Learning -02 • Deep Learning Practical-02 • Data Security and Compliance-02	• Applied Business Analytics-02 • Applied Business Analytics Practical-02 **OR** • Sports Analytics-02 • Sports Analytics Practical-02					• OJT: Project Implementation-04		
	Cum Cr.	**48**	**8**	**18**	**12**	**14**	**14**	**18**	**132**	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

SEMESTER I

Syllabus

B.Sc. (Data Science)

(Sem.- I)

Major Courses

Name of the Course: Python Programming

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** Python programming has become a cornerstone in the tech world due to its simplicity, versatility, and readability. This introduction explores the relevance, utility, applications, and growing demand for Python in the industry. • **Relevance and Usefulness:** Python's adaptability makes it relevant across diverse sectors, from web development to data science and automation, solidifying its place in the ever-changing technological landscape. Python's simplicity and an extensive library make it user-friendly and practical for developers, enabling efficient problem-solving and streamlined development tasks. • **Applications:** Python finds applications in web development through frameworks like Django, in data science with libraries like NumPy and Pandas, and in emerging technologies such as IoT and blockchain. • **Interest and Connection with Other Courses:** Python's popularity among beginners and its interdisciplinary applications make it a sought-after language, seamlessly integrating into various courses and fields. • **Demand in the Industry:** The industry demands Python skills for web development, data analysis, machine learning, and automation, creating a growing need for professionals proficient in Python programming. • **Job Prospects:** Professionals skilled in Python programming enjoy promising job prospects in roles ranging from web developers to data scientists, reflecting the language's versatility and ongoing industry demand.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credits:**	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** CO 1. To Learn Programming fundamentals using Python. CO 2. To understand the concept of data types and other basic elements in python. CO 3. To learn control statements and operators in python. CO 4. To learn write different functions and strings in python. CO 5. To understand the concept of dictionaries in python.	
8	**Course Outcomes (OC):** OC 1. Ability to use variables with different data types and input output functions. OC 2. Ability to use control statements and operators in programming.	

	OC 3. Proficiency in using function and strings. OC 4. Acquire knowledge of dictionaries,	
9	**Modules: -** **Module 1:**	
	1. Introduction to Python Language: Overview, Features of Python, Execution of a Python Program, Innards of Python, Frozen Binaries, Python Interpreter, Comparison of Python with C and Java, Installing Python, Writing & Executing, IDLE **2. Data Types, Variables and Other Basic Elements**: Comments, Docstrings, Data types-Numeric, Compound, Boolean, Dictionary, Sets, Mapping, Basic Elements of Python, Variables. **3. Input and Output Operations**: Input Function, Output Statements, Command Line Arguments **Control Statements:** Control Statements- Loop Statement, The else Suite, break Statement, continue Statement, pass Statement, assert Statement, return Statement. **4. Functions**: Defining & Calling a Function, Returning Results, Returning Multiple Values, Built in Functions, Parameters and Arguments, Recursive Functions, Anonymous or Lambda Functions.	**15 Hrs**
	Module 2:	
	1. Operators: Arithmetic operator, Assignment operators, Unary minus operator, Relational operators, Logical operators, Bitwise operators, Membership operators, Identity operators, Precedence of Operators, Associativity of Operators. **2. Arrays**: Creating Arrays, Indexing and Slicing, Basic Array Operations, Arrays Processing, Mathematical Operations on Array, Aliasing Arrays, Slicing and Indexing in NumPy Arrays, Basic Slicing. Advanced Indexing. Dimensions of Arrays, Attributes of an Array **3. Strings**: Creating Strings, Functions of Strings, Working with Strings, Length of a String, Indexing & Slicing, Repeating& Concatenation of Strings, Checking Membership, Comparing Strings, Removing Spaces, Finding Substrings, Counting Substrings, Strings are Immutable, Splitting and Joining Strings, Changing Case, Checking Starting and Ending of a String, Sorting & Searching in the Strings, Formatting the Strings, Working with Characters **4. Dictionaries**: Creating a Dictionary, Operators in Dictionary, Dictionary Methods, Using for Loop with Dictionaries, Operations on Dictionaries, Ordered Dictionaries	**15 Hrs**
10	**Text Books** 1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1st edition (2018) 2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1st edition (2016) **3.** Let Us Python, Yashwant Kanetkar, BPB publication , 1st edition (2019)	
11	**Reference Books** **1.** Programming in Python3, Mark Summerfield, Pearson Education, 2nd edition (2018) **2.** Learning Python, LutzM, O'Reilly- Shroff, 5th edition, 2013.	

	3. Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009. **4.** Star Python, Star Certification, Star Certification,1st, 2018.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Descriptive Statistics

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** Descriptive Statistics is the fundamental tool for distilling complex data into meaningful insights. From uncovering central tendencies to visualizing distributions, this statistical discipline provides a crucial foundation for understanding data patterns. • **Relevance and Usefulness:** In today's data-centric landscape, Descriptive Statistics is indispensable across various sectors, including business, science, and healthcare. It transforms raw data into actionable intelligence, enabling professionals to make informed decisions. Descriptive Statistics offers quick and clear insights into data characteristics. Through measures like mean, median, and graphical representations, it enhances interpretability and aids in better decision-making. • **Applications:** Widely applicable, Descriptive Statistics is employed in finance, healthcare, sociology, and beyond, making it an essential skill for professionals in data analysis. • **Interest and Connection with Other Courses:** The appeal lies in its ability to unravel complex datasets. Those with analytical and creative inclinations find the visual nature of descriptive representations intriguing. Descriptive Statistics forms a foundational link to advanced statistical courses, providing a seamless transition to inferential statistics and machine learning. • **Demand in the Industry:** As industries increasingly rely on data, there is a growing demand for professionals skilled in Descriptive Statistics, especially in roles like data analyst, business analyst, and statistical consultant. • **Job Prospects:** Professionals proficient in Descriptive Statistics are highly sought after, contributing significantly to organizational success through data-driven decision-making.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** **CO 1:** To understand different types of Data, and to analyze and present the data. **CO 2** : To compute various Measures of Central Tendencies. **CO 3** : To compute various Measures of Dispersion. **CO 4** : To understand the concept of Skewness and Kurtosis. **CO 5**: To compute Correlation Coefficient for bivariate data and further apply the regression analysis .	

8	**Course Outcomes (OC):** **CO 1.** Able to organize, manage and present the data. **CO 2.** To understand the use Measures of Central Tendencies and Dispersion. **CO 3.** Able to understand and compute the consistent and inconsistent data **CO 4.** Able to identify the association between variables **CO 5.** Able to understand forecasting techniques and to find cause and effect relationship between variable through regression analysis.	
9	**Modules:-** **Module 1:**	
	1. Introduction of Statistics: Meaning of Statistics, Importance of Statistics, Types of Characteristics, Different types of Scales: Nominal, Ordinal, Interval and ratio. Univariate frequency distribution of discrete and continuous variables and Cumulative frequency distribution. Data Presentation: Frequency Distribution, Histogram and Ogives Curves. **2. Measures of Central Tendencies**: Concept of Central Tendency, characteristics of good measures of Central Tendency, Positional Averages: Median, Mode , Partition values: Quartiles, Deciles and Percentiles -examples of ungrouped and grouped data **3. Measures of Dispersion:** Concept of Dispersion, Requirements of good measures of Dispersion, Absolute and Relative measures of Dispersion: Range, Quartile Deviation, Mean Absolute Deviation, Standard Deviation, Combined Standard Deviation-examples of ungrouped and grouped data **4.** Raw and Central Moments, relation between Raw and Central moments, concept of Skewness and Kurtosis.	**15 Hrs**
	Module 2:	
	1. Concept of Correlation, types and interpretation, Scatter Diagram, Product Moment Correlation Coefficient, and its properties **2.** Spearman' s Rank Correlation (with and without ties) **3.** Concept of Linear Regression, Principle of Least Square, Fitting a straight line by method of least square. **4.** Difference between Correlation and Regression, relation between Correlation and Regression **5.** Concept of multiple correlation **6.** Concept of multiple regression and logistics regression	**15 Hrs**
10	**Text Books** **1.** Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentce Hall of India, NewDelhi. **2.** Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, NewDelhi. **3.** Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi. **4.** Schaum‟s Outline Of Theory And Problems Of Beginning Statistics, Larry J. Stephens, Schaum‟s Outline Series Mcgraw-Hill	

	5. Gupta, S.C. and Kapoor, V.K. (1987): Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi	
11	**Reference Books** **1.** Goon AM, Gupta MK, Das Gupta B: Fundamentals of Statistics, Vol-I, the World Press Pt. Ltd, Kolkata **2.** Shah R.J: Descriptive Statistics: Seth Publication, Eight Edition **3.** Spiegel M.R: Theory and Problems of Statistics, Schaum's Publishing Series, Tata McGraw-Hill, First Edition **4.** Basic Statistics: Agarwal B.L: New Age International Ltd	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Major Practical 1

Sr.No.	Heading	Particulars
1	**Description the course:**	Basic python programming practical modules make able to acquire knowledge for implementing python code for various applications such as handling different data types, control and loops structure. Module make able to get knowledge about handling strings and arrays. It also make able to use functions for various applications.
2	**Vertical :**	Major
3	**Type :**	Practical
4	**Credits :**	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** CO 1. To implement various data types. CO 2. To implement different functions. CO 3. To implement arrays and strings. CO 4. To plot graphs and charts CO 5. To develop ability to analyze statistical data .	
8	**Course Outcomes (OC):** OC 1. Ability to use all data types in different ways. OC 2. Acquire knowledge to implement user defined, built in and lambda functions. OC 3. Make a use of arrays and strings in python programming. OC 4. Enables to understand data analysis through programming. OC 5. Study the relationship between variables using techniques of correlation and regression.	
9	**Modules:-** **Module 1:**	
	1. Practical No. 1 a. Write a Python program to use various datatypes. b. Write a python code to define the values of various data types and check their data types. c. Write a Python program to perform Input and Output Operations. d. Write a code in python to accept message from user and display it. **2. Practical No. 2** a. Write a Python program to check whether entered number is Armstrong or not using while loop. b. Write a python program to print first n natural numbers. c. Write a python program to demonstrate looping in python and use of break statement and continue statement	**30 Hrs**

	d. Write a python code to find factorial of given number. **3. Practical No.3** a. Write a Python program to check whether entered number is even or odd. b. Write a Python program to demonstrate function with keyword arguments and default arguments. c. Write a python program to merge Mails. d. Write a python program to find the largest among three numbers. **4. Practical No. 4** a. Write a Python program to convert Celsius to Fahrenheit. b. Write a python program to convert Kilometers to Miles. c. Write a Python program to make a simple calculator. d. Write a Python program to solve Quadratic Equation. **5. Practical No. 5** a. Write a Python program to Find HCF or GCD. b. Write a Python program to convert Decimal to Binary, Octal and Hexadecimal. c. Write a Python code to find the size(Resolution) of an image. d. Write a program to check leap year. **6. Practical No. 6** a. Write a python program to add two numbers. b. Write a Python program to calculate the area of a triangle. c. Write a Python program to demonstrate the use of Built-in Functions. d. Write a Python Program to implement Lambda Functions. **7. Practical No. 7** a. WriteaPythonProgramtoimplementarraysforstoringhomogeneousdataitems. b. Write a Python program to Apply indexing and slicing operations to access elements of array. c. Write a python code to add element from an array and remove element from an array. **8. Practical No. 8** a. Write a Python Program to demonstrate that python string is immutable and also demonstrate to use multiline string. b. Write a python program to compare two strings. c. Write a python program to concat two strings. d. Write a Python program to find ASCII value of character. **9. Practical No. 9** a. Write a python code to remove punctuation from a string. b. Write a python code to check whether a string is palindrome or Not. c. Write a Python program to count the number of each vowel. d. Write a Python program to sort words in Alphabetic Order. **10. Practical No. 10** a. Write a Python program to swap Two Variables. b. Write a Python program to shuffle Deck of Cards. c. Write a Python Program to Transpose a Matrix. Write a Python program to Add Two Matrices.	
	Module 2:	
	1. Practical No. 1-Introduction to Excel a. Understanding Data Tools. b. Understanding Formula Tools, insert functional library using insert function.	**30 Hrs**

c. Add-Ins Analysis tool packs
d. Formula writing, Functions, using Cell reference, Sort, Filter and Advance Filter

2. **Practical No. 2- Data Entry and Manipulation**
   a. Tools for data entry and accuracy: Quick Access toolbar customization, Form tool
   b. Data Transposition to fit Excel (as an Array)
   c. Data Conversion with the Logical If, VLOOKUP, Pivot table, Pivot chart.
   d. Data conversion to Text from Non-Excel Sources. Using text to Column
3. **Practical No. 3- Data Validation**
   a. Specifying a valid range of values for a cell.
   b. Specifying a list of valid values for a cell
   c. Specifying custom validation based on formula for a cell.
4. **Practical No. 4- Diagrams and Graphs**
   a. Write a Python/ Excel program to plot Histogram.
   b. Write a Python/ Excel program to plot Bar Graphs.
   c. Write a Python/ Excel program to plot Pie chart.
   d. Boxplot and multiple Boxplots
5. **Practical No 5- Measures of Central Tendency**
   a. Write a Python/ Excel program to find Mean.
   b. Write a Python/ Excel program to find Median.
   c. Write a Python/ Excel program to find Mode
6. **Practical No. 6- Measures of Dispersion**
   a. Write a Python/ Excel program to find Range, Interquartile Range
   b. Write a Python/ Excel program to find Variance.
   c. Write a Python/ Excel program to find Standard Deviation.
   d. Write a Python/ Excel program to find Skewness and Kurtosis.
7. **Practical No. 7-Correlation**
   a. Write a Python/ Excel program to find Positive Correlation.
   b. Write a Python/ Excel program to find Negative Correlation.
   c. Write a Python/ Excel program to find Zero Correlation.
8. **Practical No. 8-Regression-1**
   a. Write a Python/ Excel program to perform linear regression for prediction.
   b. Write a Python/ Excel program to perform polynomial regression for prediction
9. **Practical No. 9-Regression – 2**
   a. Write a Python/ Excel program to perform multiple linear regression for prediction.
   b. Write a Python/ Excel program to perform logistic regression for prediction
10. **Practical No. 10**

a. Design a survey form, get primary data and analyse it. (given case study)

10	**Text Books** **1.** Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1st edition (2018) **2.** Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1st edition (2016) **3.** Let Us Python, Yashwant Kanetkar, BPB publication , 1st edition (2019)	
11	**Reference Books** **1.** Programming in Python3, Mark Summerfield, Pearson Education, 2nd edition (2018) **2.** Learning Python, LutzM, O'Reilly- Shroff, 5th edition, 2013. **3.** Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009. Star Python, Star Certification, Star Certification,1st , 2018. **4.** Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi. **5.** Schaum"s Outline Of Theory And Problems Of Beginning Statistics, Larry J. Stephens, Schaum"s Outline Series Mcgraw-Hill	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	**Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Vocational Skill Course (VSC)

Name of the Course: Excel for Business

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** Excel for Business and Financial Modelling is a specialized course designed to empower professionals with the skills to effectively utilize Microsoft Excel for financial analysis, data management, and decision-making in the business context. • **Relevance and Usefulness:** In today's data-driven business environment, proficiency in Excel is crucial for professionals working in finance, accounting, business analysis, and other related fields. • **Applications:** The course focuses on practical applications of Excel for financial modelling, budgeting, forecasting, and decision support. Participants learn to create dynamic financial models that aid in strategic planning, risk analysis, and performance evaluation. • **Interest and Connection with Other Courses:** Excel for Business and Financial Modelling often complements courses in finance, accounting, and business analytics. It provides a hands-on approach to applying theoretical concepts, bridging the gap between financial theory and real-world decision-making. • **Demand in the Industry:** Proficiency in Excel is a highly sought-after skill in the business and finance sectors. Organizations value employees who can harness Excel's power for financial modelling, as it leads to more accurate analyses and informed decision-making. • **Job Prospects:** Job prospects for individuals with expertise in Excel for Business and Financial Modelling include roles such as financial analyst, business analyst, financial consultant, and management accountant.
2	**Vertical:**	Vocational Skill Course(VSC)
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** **CO 1:** Introduce participants to the fundamentals of spreadsheets and financial models. **CO 2:** Explore various types of financial models and their specific applications. **CO 3:** Teach participants how to select the right tools for effective financial modelling. **CO 4:** Guide participants in designing efficient and error-free financial models. **CO 5:** Familiarize participants with the components of a financial model workbook and effective project planning. **CO 6:** Teach effective model layout techniques and the use of flowcharting in financial modelling. **CO 7:** Provide a step-by-step guide to building financial models and managing	

	information requests. **CO 8:** Instruct participants on utilizing Excel for financial modelling tasks. **CO 9:** Explore advanced Excel functions relevant to financial modelling. **CO 10:** Introduce tools for displaying financial models and common modelling applications.	
8	**Course Outcomes (OC):** **OC 1:** Participants will gain a foundational understanding of spreadsheet structure and the components of financial models. **OC 2:** Participants will be able to identify and choose the appropriate financial model for different business scenarios. **OC 3:** Participants will acquire the skills to choose and use appropriate software tools for financial modelling tasks. **OC 4:** Participants will be able to create well-structured financial models, addressing common design challenges. **OC 5:** Participants will understand the anatomy of a financial model workbook and plan projects efficiently. **OC 6:** Participants will design models with clear layouts and utilize flowcharts for improved model visualization. **OC 7:** Participants will be proficient in constructing financial models and handling data requests effectively. **OC 8:** Participants will master Excel functions, shortcuts, cell referencing, and named ranges for efficient financial modelling. **OC 9:** Participants will be able to apply aggregation, lookup, regression, and financial project evaluation functions in modelling scenarios. **OC 10:** Participants will gain expertise in formatting, using form controls, creating PivotTables, and employing various tools for effective financial modelling.	
9	**Modules: -** **Module 1:**	
	1. **Financial Modelling**: Spreadsheet and a Financial Model, Types and Purposes of Financial Models, Tool Selection, Model Design, Design Issues, The Workbook Anatomy of a Model, Project Planning Your Model, Model Layout Flowcharting, Steps to Building a Model, Information Requests. 2. **Using Excel in Financial Modelling**: Formulas and Functions in Excel, Handy Excel Shortcuts, Cell Referencing, Named Ranges, Basic Excel Functions, Logical Functions, Nesting Logical Functions. 3. **Functions for Financial Modelling:** Aggregation & LOOKUP Functions, Nesting Index and Match, OFFSET Function, Regression Analysis, Choose Function, Working with Dates, Financial Project Evaluation Functions, Loan Calculations. 4. **Tools for Model Display and Financial Modelling**: Basic Formatting, Conditional Formatting, Sparklines, Customising the Display Settings, Form Controls, Hiding Sections, Grouping, Array Formulas, Structured Reference Tables, PivotTables, Macros.	**15 Hrs**
	Module 2:	
	1. **Common Uses of Tools in Financial Modelling**: Understanding Nominal and Effective (Real) Rates, Calculating a Cumulative Sum	**15 Hrs**

	(Running Totals), How to Calculate a Payback Period, Weighted Average Cost of Capital (WACC), Building a Tiering Table, Modelling Depreciation Methods, Break-Even Analysis. 2. **Stress Testing, Scenarios, and Sensitivity Analysis in Financial Modelling**: What are the Differences Between Scenario, Sensitivity, and What-If Analyses? Overview of Scenario Analysis Tools and Methods, Advanced Conditional Formatting, Comparing Scenario Methods, Adding Probability to a Data Table. 3. **Presenting Model Output:** Preparing an Oral Presentation for Model Results, Preparing a Graphic or Written Presentation for Model Results, Chart Types, Working with Charts, Handy Charting Hints, Dynamic Named Ranges, Charting with Two Different Axes and Chart Types, Bubble Charts, Creating a Dynamic Chart, Waterfall Charts.	
10	**Online References:** **1.** https://www.w3schools.com/EXCEL/index.php **2.** Microsoft Excel Help Centre **3.** https://trumpexcel.com/learn-excel/	
11	**Reference Books** **1.** Using Excel for Business and Financial Modelling: A Practical Guide, by Danielle Stein Fairhurst, Wiley, 3rd Edition, 2019 **2.** Microsoft Excel Professional 2021 Guide: Complete Excel Reference, by CA Manmeet Singh Mehta, Paperback, 1st Edition, 2022 **3.** Microsoft Excel: Advanced Microsoft Excel Data Analysis for Business, by John Slavio, Hardcover, 1st Edition, 2019 **4.** Excel: Excel for Business, by Francesco Iannello, Createspace, 2016	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Skill Enhancement Courses (SEC)

Name of the Course: Office Tools for Data Scientists

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** The "Office Tools for Data Scientists" course is designed to equip professionals in the field of data science with a comprehensive skill set using a range of office tools essential for efficient data analysis, visualization, and communication. This course provides training in popular office applications, enhancing the ability of data scientists to extract meaningful insights from diverse datasets. • **Relevance and Usefulness:** In the dynamic landscape of data science, proficiency in office tools is indispensable. This course addresses the critical need for data scientists to effectively manage, analyse, and communicate their findings using widely adopted office applications. • **Applications:** The course covers a spectrum of applications, including data cleaning and analysis in spreadsheets, collaborative work in shared documents, interactive coding and documentation in notebooks, and compelling visualization and reporting using specialized tools. • **Interest and Connection with Other Courses:** This course is designed to pique the interest of data scientists by offering practical applications of office tools in real-world data scenarios. It complements other data science courses by providing a practical layer of skills that can be immediately applied to enhance the effectiveness of data analysis, interpretation, and presentation. • **Demand in the Industry:** There is a growing demand for data scientists who possess not only technical expertise but also the ability to communicate findings effectively. Professionals who can leverage office tools for data analysis, visualization, and reporting are highly sought after in industries ranging from finance and healthcare to e-commerce and beyond. • **Job Prospects:** Graduates of the "Office Tools for Data Scientists" course will be well-positioned for a variety of roles, including Data Analyst, Business Intelligence Analyst, and Data Scientist. The ability to proficiently use office tools enhances employability and opens doors to diverse opportunities in data-driven decision-making roles. • **Emerging Trends:** As the field of data science continues to evolve, the integration of advanced features in office tools, such as AI-driven analytics and collaborative coding environments, is an emerging trend. This course ensures participants are prepared to navigate and leverage these advancements.
2	**Vertical:**	Skill Enhancement Course(SEC)
3	**Type :**	Theory

4	**Credits :**	2 credits (1 credit = 15 Hours for Theory in a semester)	
5	**Hours Allotted :**	30 Hours	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives (CO):** **CO 1:** Familiarize participants with user-friendly data tools. **CO 2:** Instruct participants on importing data using Excel, OpenOffice, and statistical environments. **CO 3:** Instruct participants on conducting Descriptive Statistics in Excel, OpenOffice, and statistical environments. **CO 4:** Instruct participants on conducting Correlation, Regression, Confidence Intervals, Random Sampling across multiple statistical tools. **CO 5:** Introduce participants to Power analysis, F-Test, Regression/Correlation analysis using R/RStudio/Rattle, Excel, KNIME. **CO 6:** Familiarize participants with additional data packages and the Analysis ToolPak.		
8	**Course Outcomes (OC):** **OC 1:** Participants will confidently navigate and utilize data tools with ease. **OC 2:** Participants will acquire proficiency in importing data across various platforms. **OC 3:** Participants will be proficient in generating descriptive statistics using diverse tools. **OC 4:** Participants will confidently apply correlation tests, Regression, Confidence Intervals, Random Sampling in Excel, OpenOffice, RStudio/Rattle, and KNIME. **OC 5:** Participants will master power analysis techniques, F-Test, Regression/Correlation analysis in various statistical tools. **OC 6:** Participants will effectively use additional data packages and the Analysis ToolPak for diverse analysis needs		
9	**Modules: -** **Module 1:**		
	1. **Introduction to Data Tools:** The Software Is Easy to Use, The Software Is Available from Anywhere, The Software Is Updated Regularly, Why Data Analysis (Data Science) at All? Where to Get Data. 2. **Importing Data:** Excel, Excel Analysis ToolPak, OpenOffice, Import into R and Rattle, Import into RStudio, Rattle Import, Import into KNIME, Stoplight Approach. 3. **Statistical Tests:** Descriptive Statistics, Excel, OpenOffice, RStudio/Rattle, KNIME, Cumulative Probability Charts, Excel, OpenOffice, R/RStudio/Rattle, KNIME, T-Test (Parametric), Excel, OpenOffice, R/RStudio/Rattle, KNIME.		**15 Hrs**
	Module 2:		
	1. **More Statistical Tests:** Correlation, Excel, OpenOffice, RStudio/Rattle, KNIME, Regression, Excel, OpenOffice, RStudio/Rattle, KNIME, Confidence Interval, Excel, OpenOffice, RStudio/Rattle, KNIME, Random Sampling, Excel, OpenOffice, RStudio/Rattle, KNIME. 2. **Statistical Methods for Specific Tools:** Power, R/RStudio/Rattle, F-Test, Excel, R/RStudio/Rattle, KNIME, Multiple Regression/Correlation,		**15 Hrs**

	Excel, OpenOffice, R/RStudio/Rattle, KNIME, Benford's Law, Rattle, Lift, KNIME, Wordcloud, R/RStudio, KNIME, Filtering, Excel, OpenOffice, RStudio/Rattle, KNIME. **3. Additional Data:** Packages, Analysis ToolPak, Exercise – Tornado and the States, Solution, Pairing Exercise.	
10	**Online References:** **1.** https://www.w3schools.com/EXCEL/index.php **2.** https://www.w3schools.com/r/default.asp **3.** https://www.knime.com/	
11	**Reference Books** **1.** Data Science Tools, by Christopher Greco, MERCURY LEARNING, 1st Edition, 2019 **2.** R for Data Science, by Hadley Wickham, Garrett Grolemund, O'Reilly, 1st Edition, 2016 **3.** DATA SCIENCE with KNIME, by Dr Nickholas Anting, NASPSOFT, 1st Edition, 2022 **4.** Beginning OpenOffice Calc, by Jacek Artymiak, Apress, 2011	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Digital Marketing

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** The Digital Marketing course is a compass guiding professional through the dynamic world of online promotion. In today's business landscape, digital marketing is not just advantageous but essential for success, making this course highly relevant. • **Relevance and Usefulness:** With a focus on online platforms, the Digital Marketing course addresses the shift towards digital spaces, where brand visibility and consumer interactions thrive. Equipping individuals with skills in social media strategies, search engine optimization, and more, the course is practical and invaluable for enhancing brand visibility and engagement in the digital realm. • **Applications:** Digital Marketing has diverse applications across sectors, from e-commerce to healthcare, involving activities such as crafting social media campaigns and optimizing websites for search engines. • **Interest and Connection with Other Courses:** Appealing to those with a creative flair and an interest in digital trends, the course is engaging for individuals who enjoy the dynamic intersection of creativity and data analysis. The Digital Marketing course complements studies in business management, communications, and market research, providing specialized skills tailored to the digital landscape. • **Demand in the Industry:** As businesses prioritize online visibility, there is a growing demand for professionals skilled in digital marketing, making the course a valuable asset for career growth. • **Job Prospects:** Completing the Digital Marketing course opens doors to roles in digital marketing management, social media strategy, content creation, and search engine optimization, reflecting a diverse skill set acquired through the program.
2	**Vertical :**	Skill Enhancement Course(SEC)
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** **CO 1.** Develop a Comprehensive Understanding of Digital Marketing Fundamentals **CO 2.** Proficiency in Social Media Strategy and Management **CO 3.** Master Search Engine Optimization (SEO) Techniques **CO 4.** Competence in Content Creation and Marketing **CO 5.** Analyse and Utilize Data for Informed Decision-Making	

8	**Course Outcomes (OC):** **OC 1.** Students will be able to understand the concept of digital marketing and its integration with traditional marketing. **OC 2.** Students will be able to understand Customer value journey in digital context and behaviour of online consumers **OC 3.** Students will be able to understand social media marketing and apply the learnings to create digital media campaigns **OC 4.** Students will be able to examine various tactics for enhancing a website's position and ranking with search engines. **OC 5.** Students will be able to leverage the digital strategies to gain competitive advantage for business and carrier	
9	**Modules:-** **Module 1:**	
	1. Introduction to digital marketing- Meaning of Digital Marketing, Differences from Traditional Marketing, Return of Investments on Digital Marketing vs. Traditional Marketing, E Commerce, Tools used for successful marketing, SWOT Analysis of Business for Digital Marketing, Meaning of Blogs, Websites, Portal and Their Differences, Visibility, Visitor Engagement, Conversion Process, Retention, Performance Evaluation. **2.** Search Engine Optimization (SEO): On page Optimization Techniques, Off Page Optimization Techniques, Preparing Reports, Creating Search Campaigns, Creating Display Campaigns. Social Media Optimization (SMO): Introduction to Social Media Marketing, Advanced Facebook Marketing	**15 Hrs**
	Module 2:	
	1. Word press Blog Creation, Twitter Marketing, LinkedIn Marketing, Instagram Marketing, social media Analytical Tools. Search Engine Marketing: Meaning and Use of Search Engine Marketing, Tools used — Pay Per Click, Google Adwords, Display Advertising Techniques, Report Generation **2.** Website Traffic Analysis, Affiliate Marketing and Ad Designing: Google Analytics, Online Reputation Management, EMail Marketing, Affiliate Marketing, Understanding Ad Words Algorithm, Advertisement Designing	**15 Hrs**
10	**Text Books** 1. Digital Marketing by Seema Gupta Mcgraw Hill 2. Internet Marketing : A practical approach in the Indian context: Oxford Publishing	
11	**Reference Books** 1. Digital Marketing: Strategy, Implementation & Practice – Dave Chaffey & Fiona Ellis 2. Art of SEO (3rd edition) – Eric Enge	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**

13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

SEMESTER II

Syllabus

B.Sc. (Data Science)

(Sem.- II)

Major Courses

Name of the Course: Advanced Python Programming

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** The Advanced Python Programming course represents a pivotal step for developers aiming to deepen their Python expertise. This introduction explores the course's relevance, usefulness, applications, and the rising demand for advanced Python skills, emphasizing its impact on career prospects. • **Relevance and Usefulness:** In today's tech landscape, advanced Python proficiency sets developers apart. This course addresses the growing need for individuals capable of mastering complex Python concepts, making it highly relevant for those looking to advance their programming skills. • **Applications:** The acquired advanced Python skills are immediately applicable across various domains, including software development, data analysis, and automation. Participants are equipped to contribute to the development of scalable, efficient, and maintainable solutions. • **Interest and Connection with Other Courses:** Attracting those seeking a deeper understanding of Python, the course complements other programming courses, providing a comprehensive learning path for individuals aiming for well-rounded expertise in software development. • **Demand in the Industry:** As industries increasingly rely on Python for complex applications, the demand for professionals with advanced Python skills is rising. Employers seek individuals who can harness Python's full potential, contributing to the growing demand for experts trained in advanced Python concepts. • **Job Prospects:** Completion of the Advanced Python Programming course significantly enhances job prospects. Professionals with advanced Python skills are well-positioned for roles like software architects and technical leads, offering lucrative career opportunities in fields where advanced proficiency is crucial.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credits :**	2 credits (30 Hours in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):**	

	CO 1. To learn the concept of Lists and tuples in python programming, CO 2. To understand use of Regular Expression in python. CO 3. To learn use of date and time in python. CO 4. To understand the concept of Numpy in python. CO 5. To learn manipulation and visualization of data in python.	
8	**Course Outcomes (OC):** OC 1. Ability to use lists and tuples in python programming. OC 2. Ability to implement different regular expressions. OC 3. Ability to use date time in python programming. OC 4. Acquire knowledge of Numpy. OC 5. Proficiency in handling, manipulating and visualizing data.	
9	**Modules:** **Module 1:**	
	1. Lists and Tuples: Lists, List Functions and Methods, List Operations, Tuples, **2. Regular Expressions**: What is a Regular Expression? Sequence Characters in Regular Expressions, Quantifiers in Regular Expressions, Special Characters in Regular Expressions, Using Regular Expression on Files, Retrieving Information from an HTML File **3. Date and Time in Python:** Date and Time, Date and Time Now, Combining Date and Time, Formatting Dates and Times, Finding Durations using "timedelta", Comparing Two Dates, Sorting Dates, Stopping Execution Temporarily, Knowing the Time taken by a Program, Working with Calendar Module. **4. IPython:** Beyond Normal Python, Help and Documentation in IPython, Keyboard Shortcuts in the IPython Shell, IPython Magic Commands, Input and Output History, IPython and Shell Commands, Errors and Debugging, Profiling and Timing Code	**15 Hrs**
	Module 2:	
	1. Introduction to NumPy: Understanding Data Types in Python, The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything In Between, Computation on Arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data: NumPy's Structured Arrays. **2. Data Manipulation with Pandas**: Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets: Concat and Append. **3. Combining Datasets:** Merge and Join, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series. High-Performance Pandas: eval()and query()	**15 Hrs**

	4. Visualization with Matplotlib: Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends, Customizing Color bars, Multiple Subplots, Text and Annotation, Customizing Tick s, Customizing Matplotlib: Configurations and Stylesheets, Three- Dimensional Plotting in Matplotlib, Geographic Data with Basemap, Visualization with Seaborn	
10	**Text Books** 1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1st edition (2018) 2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1st edition (2016) 3. Let Us Python, Yashwant Kanetkar, BPB publication , 1st edition (2019)	
11	**Reference Books** 1. Programming in Python3, Mark Summerfield, Pearson Education, 2nd edition (2018) 2. Learning Python, LutzM, O'Reilly- Shroff, 5th edition, 2013. 3. Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009. 4. Star Python, Star Certification, Star Certification,1st , 2018.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Database Management System

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** A Database Management System (DBMS) is a software that manages databases. It provides an interface for interacting with the database, ensures data integrity, and supports efficient and secure data retrieval and storage. • **Relevance and Usefulness:** DBMS is widely used in business applications to store and manage large volumes of data related to customers, transactions, products, and more. DBMS allows for efficient data retrieval and manipulation, improving overall system performance. • **Applications:** The versatility of DBMS makes it a fundamental component in numerous applications, contributing to the efficient management and utilization of data across various industries. • **Interest and Connection with Other Courses:** Prerequisite: Basic Computer knowledge of computer architecture, storage, operating system. It also good to know about basic programming knowledge. Understanding DBMS principles and practices can enhance the effectiveness of professionals in various fields by providing them with the skills to manage and utilize data efficiently. • **Demand in the Industry:** Database Management System course aims to gain the knowledge of DBMS concept, principle, and design. Database is a collection of interrelated data, and this data can be managed, access, manipulate and organise data in system with the help of software. It benefits to user by providing data access, reduced redundancy, data integrity, data sharing, data organizing, data consistency, data accuracy, and security • **Job Prospects:** The job prospects in DBMS are diverse, and professionals with expertise in this field are sought after in nearly every industry where data plays a crucial role in decision-making and operations. As technology continues to evolve, the demand for skilled DBMS professionals is likely to remain strong.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credits :**	2 credits (30 Hours in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** CO 1. To understand concept of database by organizing, structuring and storing data. CO 2. To understand data models and entity relationship.	

	CO 3. To understand retrieve data and concept of redundancy CO 4. To specify the data requirement in database applications CO 5. To create, manipulate queries in database.	
8	**Course Outcomes (OC):** OC 1. Students should be able to use the concept of database and it's important in software development. OC 2. Students should be able to design database and draw logical structure using Entity relationship. OC 3. Students should be able to construct normalized database and functional dependencies. OC 4. Students should be able to design the database schema with the appropriate data types. OC 5. Students should be able to create, manipulate the database management system to evaluate the business information problem.	
9	**Modules:** **Module 1:**	
	1. Introduction & DBMS Architecture: What is Database? Need of database, Role and Advantages of the DBMS, Types of Databases, Data Processing, Database System**s** **2. Data Models:** Data Modelling and Data Models, The Importance of Data Models, Data Model Basic Building Blocks, Business Rules, Degrees of Data Abstraction **3. Entity Relationship Model and Unified Modelling Language:** Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Degree, Recursive Relationships, Associative (Composite) Entities, Developing an ER Diagram. **4. Advanced Data Modelling:** The Extended Entity Relationship Model, Entity Clustering, Entity Integrity: Primary Keys, Design Cases: Learning Flexible Database Design.	**15 Hrs**
	Module 2:	
	1. **Normalization of Database Tables:** Database Tables and Normalization, The Normalization Process, Surrogate Key Considerations, Higher-Level Normal Forms, Normalization and Database Design, Denormalization, Data-modelling Checklist. 2. **Database Design:** The Information System, The Systems Development Life Cycle, The Database Life Cycle, Conceptual Design, DBMS Software Selection, Logical Design, Physical Design, Database Design Strategies, Centralized versus Decentralized Design 3. **Transaction Management and Concurrency Control:** What Is a Transaction? Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods, ANSI Levels of	**15 Hrs**

	Transaction Isolation, Database Recovery Management Database Performance Tuning and Query Optimization: Database Performance-Tuning Concepts, Query Processing, Indexes and Query Optimization, Optimizer Choices, SQL Performance Tuning, Query Formulation, DBMS Performance Tuning. 4. **Database Administration and Security:** Data as a Corporate Asset, The Need for a Database and Its Role in an Organization, Special Considerations, Security, Database Administration Tools, Data Administration Strategy, The DBA's Role in the Cloud, The DBA at Work: Using Oracle for Database Administration	
10, 11	**Reference and Text Books** 1. Fundamentals of Database Systems, Elmasri Ramez and Navathe Shamkant B, Pearson Education 6th Edition, 2010. 2. Database System Concepts Silberschatz, Korth, Sudarshan, McGraw Hill, 5 Edition, 2006. 3. Database Management Systems, Ramakrishna, Gehrke, McGraw- Hill, 2007 4. Murach's MySQL Joel Murach, Murach, 2012.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Major Practical 2

Sr.No.	Heading	Particulars
1	**Description the course:**	Advanced python programming practical modules make able to acquire knowledge for implementing python code for various applications such as handling data, analysing and visualizing data. Database Management System's practical approach is useful to gain the knowledge for software backend development. It benefits to user by providing data definition, data access, reduced data redundancy, data integrity, data sharing, data organizing, data consistency, data accuracy, and security.
2	**Vertical :**	Major
3	**Type :**	Practical
4	**Credits :**	2 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** CO 1. To implement tuple in python programming. CO 2. To implement various regular expression in python programming. CO 3. To use date and time with calendar module in python programming. CO 4. To implement Numpy in python programming. CO 5. To use pandas in python programming. CO 6. Identify entities and its relationship with relational model structure. CO 7. To understand relational database using SQL and constraints implementation using create table queries. CO 8. To Understand DML operations and backing of database CO 9. To understand how to retrieve data from database and learn how to retrieve single value after performing calculations on group of values. CO 10. To understand built-in functions to perform operations on data CO 11. To understand how to fetch data from two or more tables, which is joined to appear as single set of data CO 12. To understand nested and larger query as advanced fetching of data to understand concept of virtual table. CO 13. To understand how to control user access in a database.	
8	**Course Outcomes (OC):** OC 1. Ability to use list tuples in different ways using python programming. OC 2. Ability to implement different regular expression for search and replace operations. OC 3. To use date and time with different format in python programming. OC 4. Ability to use Numpy in python programming. OC 5. Acquire knowledge about pandas libraries and implement it. OC 6. Students able to perform various operations such as insert, update delete and retrieve data from database using SQL queries. OC 7. Students able to perform alteration in tables and can restore and take backup of the database.	

	OC 8. Students able to perform operations using simple SQL Queries to fetch data and learns various aggregate functions to get single value. OC 9. Students able to perform SQL Queries using JOIN keyword for joining two or more tables. OC 10. Students able to perform nested queries using in, exists operators. OC 11. Students able to create new table by joining one or more tables and learn how to hide attribute from end user. OC 12. Students able to restrict the user from accessing data in database. OC 13. Students should be able to create, manipulate the database management system to evaluate the business information problem.	
9	**Modules:** **Module 1:**	
	Practical No. 1 a. Write a python code to demonstrate concatenating tuples to nested tuples. b. Write a python code to sort the nested tuple using sorted() function. c. Write a python code to demonstrate unpacking of nested tuples. d. Write a python code to clone list using slice operator. **Practical No.2** a. Write a Python code to Find the size of Tuples. b. Write a Python code Find sum of tuple elements. c. Write a Python code to remove duplicate element from tuple. d. Write a Python code to Flatten tuple of list to tuple. **Practical No. 3** a. Write a python code to check immutability property of python tuples. b. Write a python code to implement various methods to search and replace operations. c. Write a python code to retrieve data from HTML file. d. Write a python code to print current date in different format. **Practical No. 4** a. Write a Python code to demonstrate time class. b. Write a Python code to use timedelta function to print date. c. Write a Python code to use strftime and strptime functions in python. d. Write a Python code to count remaining days using date object. **Practical No. 5** a. Write a python code to convert time stamp to date stamp. b. Write a python code to develop calendar module. c. Write a python code to compare two dates. d. Write a python code to create Numpy Array. **Practical No. 6** a. Write a Python code to find minimum elements in array using Numpy. b. Write a Python code to find mean of every Numpy array in the given list. c. Write a Python code to reverse Numpy array.	**30 Hrs**

	d. Write a Python code to add rows and columns in Numpy array. **Practical No. 7** a. Write a python code to demonstrate basic operations on single array. b. Write a python code to create array with 10 elements and slice element from 1st to 5th element. c. Write a python code to sort an array alphabetically. d. Write a python code to create a filter array that will return maximum values from an array. **Practical No.8** a. Write a python code to demonstrate importing pandas libraries and create data frame object. b. Write a Python code to create pandas series from a dictionary of values and ndarray. c. Write a Python code to perform arithmetic operations on two pandas series. d. Write a Python code to add some data in existing series. **Practical No. 9** a. Write a Python code to select the rows where percentage greater than 9b. Write a Python code to join the two given dataframes along rows and assign all data. b. Write a Python code to select rows from dataframe based on values in columns.(use relational and logical operators.) c. Write python code to filter duplicate rows. **Practical No. 10** a. Write a python code to demonstrate filter pandas series with Boolean arrays. b. Write a code to import and export data between pandas and csv files. c. Read employee.csv file to create dataframe and perform following operations: i) Display Name, Gender and department of employee. ii) Display first 5 and last 5 records from employee.csv d. Write a code to import and export data between pandas and MySQL Database. e. Write a code to replace all negative values to 0.	
	Module 2: Demonstration with explanation of concept of practical should be added in the beginning for each practical session. Student should practice on different databases during practical. **Practical No. 1**: **Write SQL query for given problem statement.** a. Viewing all databases b. Creating a Database c. Viewing all Tables in a Database **Practical No. 2**: **Perform the following Operations.** a. Creating Tables (With and Without Constraints) b. Inserting/Updating/Deleting Records in a Table	**30 Hrs**

	c. Saving (Commit) and Undoing (rollback) **Practical No. 3: Perform the following Operations.** a. Altering a Table b. Dropping/Truncating/Renaming Tables c. Backing up / Restoring a Database. **Practical No. 4: Perform following:** a. Simple Queries with Where Operators b. Where with Keywords and Logical Operators c. Simple Queries with Aggregate functions d. Queries with Aggregate functions (group by and having clause) **Practical No. 5: Perform Queries involving:** a. Date Functions b. String Functions c. Math Functions **Practical No. 6: Retrieving Data from Multiple Table:** a. Joining Tables (InnerJoins, Outer-Joins) b. Aliases for Table Names **Practical No. 7: Write Subqueries:** a. With IN clause b. With EXISTS clause c. Handling NULL **Practical No. 8**: **Perform Views commands:** a. Creating Views b. Dropping Views c. Selecting from view **Practical No. 9** : **Perform DCL statements:** a. Granting permissions b. Revoking permissions **Practical No. 10 : Use of DDL DML and DCL statement for employee payroll system (Or any other system recommended by teacher)** a. Identify employee payroll entities b. Define and Create Database, tables with constraint c. Insert 10 to 20 relevant records to support further queries d. Design simple queries using operators and functions e. Create Views and perform drop and select view command f. Perform grant and revoke commands.	
10, 11	**Reference and Text Books** 1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1st edition (2018) 2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1st edition (2016) 3. Let Us Python, Yashwant Kanetkar, BPB publication , 1st edition (2019) 4. Programming in Python3, Mark Summerfield, Pearson Education, 2nd edition (2018) 5. Learning Python, LutzM, O'Reilly- Shroff, 5th edition, 2013. 6. Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009. Star Python, Star Certification, Star Certification,1st , 2018.	

	7. Fundamentals of Database Systems, Elmasri Ramez and Navathe Shamkant B, Pearson Education 6th Edition, 2010. 8. Database System Concepts Silberschatz, Korth, Sudarshan, McGraw Hill, 5 Edition, 2006. 9. Database Management Systems, Ramakrishna, Gehrke, McGraw- Hill, 2007 10. Murach's MySQL Joel Murach, Murach, 2012.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	**Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Vocational Skill Course (VSC)

Name of the Course: Discrete Mathematics

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** Discrete Mathematics, the study of distinct and separate values, is the backbone of computer science and various other disciplines. In the digital era, it plays a crucial role in algorithm development, cryptography, and information theory. • **Relevance and Usefulness:** In a world dominated by technology, Discrete Mathematics is highly relevant, providing the theoretical basis for efficient algorithms, data structures, and logical reasoning in computer science. Discrete Mathematics is useful for solving real-world problems through concepts like set theory, graph theory, and combinatorics. • **Applications:** With applications in computer science, cryptography, operations research, and artificial intelligence, Discrete Mathematics is integral to developing algorithms, designing networks, and creating secure encryption protocols. • **Interest and Connection with Other Courses:** The field's appeal lies in its logic and precision, making it attractive to those with a penchant for problem-solving, logical reasoning, and abstract thinking, especially in the context of computer science. Discrete Mathematics forms a crucial foundation for advanced computer science courses, such as algorithms, data structures, computer networks, and artificial intelligence, creating a seamless progression for students. • **Demand in the Industry:** In the tech-driven industry, there is a growing demand for professionals with a strong foundation in Discrete Mathematics. Employers seek individuals capable of applying discrete structures to solve complex problems in software development, cybersecurity, and data analysis. • **Job Prospects:** Professionals proficient in Discrete Mathematics are well-positioned for rewarding careers as software developers, computer scientists, data analysts, and cybersecurity specialists, given their ability to solve complex problems in the tech landscape.
2	**Vertical :**	Vocational Skill Course (VSC)
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted:**	30 Hours

6	**Marks Allotted:** 50 Marks	
7	**Course Objectives(CO):** **OC 1.** To lay mathematical foundation of computing through studies of different mathematical structures. **OC 2.** To learn about Advanced counting **OC 3.** To work with relations and investigate their properties **OC 4.** To learn about Permutation and Recurrence Relation **OC 5.** To use finite-state machines to model computer operations	
8	**Course Outcomes (OC):** **OC 1.** Read, interpret and write basic mathematical notations. **OC 2.** Determine types of mathematical relations and functions **OC 3.** Use various counting techniques to solve an appropriate counting problem **OC 4.** Solve puzzles based on counting principles. **OC 5.** Provide basic knowledge about models of automata theory and the corresponding formal languages.	
9	**Modules:-** **Module 1:**	
	1. **Functions**: Definition of function; Domain, co-domain, range of a function; Examples of standard functions such as identity and constant functions, absolute value function, logarithmic and exponential functions, flooring and ceiling functions; Injective, surjective and bijective functions; Composite and inverse functions. 2. **Relations**: Definition and examples of relation; Properties of relations, Representation of relations using diagraphs and matrices; Equivalence relation; Partial Order relation, Hasse Diagrams, maximal, minimal, greatest, least element, Lattices. 3. **Recurrence Relations**: Definition and Formulation of recurrence relations; Solution of a recurrence relation; Solving recurrence relations- Back tracking method, Linear homogeneous recurrence relations with constant coefficients; Homogeneous solution of linear homogeneous recurrence relation with constant coefficients; Particular solution of non-linear homogeneous recurrence relation with constant coefficients; 4. General solution of non-linear homogeneous recurrence relation with constant coefficients; Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi, Intersection of lines in a plane, Sorting Algorithms.	**15 Hrs**
	Module 2:	
	1. **Counting Principles**: Basic Counting Principles (Sum and Product Rule); Pigeonhole Principle (without proof) - Simple examples; Inclusion Exclusion Principle (Sieve formula) (without proof); Counting using Tree diagrams. 2. **Permutations and Combinations**: Permutation without and with repetition; Combination without and with repetition; Binomial numbers and identities: Pascal Identity, Vandermonde‟s Identity, Pascal triangle, Binomial theorem (without proof) and applications;	**15 Hrs**

	Multinomial numbers, Multinomial theorem (without proof) and applications. **3. Languages, Grammars and Machines**: Languages and Grammars – Introduction, Phase structure grammar, Types of grammar, derivation trees; Finite-State Machines with Output; Finite-State Machines with No Output **4.** Regular Expression and Regular Language.	
10	**Text Books** **1.** Applied Combinatorics by Alan Tucker **2.** Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989. **3.** Discrete Mathematics: An Open Introduction by Oscar Levin **4.** Combinatorics to Topics, techniques, Algorithms by Peter J. Cameron. **5.** Foundations in Discrete Mathematics: K.D. Joshi, New Age Publication, New Delhi.	
11	**Reference Books** **1.** "Discrete Mathematical Structures" by Shanker G Rao **2.** "Discrete Mathematics and its Applications" by Kenneth H Rosen **3.** "Discrete Mathematical Structures" by J P Chauhan **4.** "Discrete Mathematical Structures" by Subramaniyan **5.** "Discrete Mathematics: SemyourLipschutz, Marc Lipson, Schaum‟s out lines, McGraw- Hill Inc.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Skill Enhancement Courses (SEC)

Name of the Course: Web Technology

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** Web design involves the creation and arrangement of visual elements on a website to ensure an aesthetically pleasing and user-friendly experience. It encompasses various disciplines, including graphic design, user interface (UI) design, and user experience design. • **Relevance and Usefulness:** In an era dominated by digital presence, web design is crucial for attracting and retaining online users. It focuses on creating visually appealing layouts, intuitive navigation, and a positive overall user experience. Effective web design enhances a website's functionality and communicates the brand's message. • **Applications:** Web design is applied across various platforms, including websites, web applications, and mobile applications. It plays a key role in shaping the online identity of businesses, organizations, and individuals. Well-designed websites are essential for engaging and converting visitors into customers or users. • **Interest and Connection with Other Courses:** Linked with graphic design, visual communication, and user experience design. • **Demand in the Industry:** There is a continuous demand for skilled web designers as businesses recognize the significance of a visually appealing and user-friendly online presence. Companies across various industries seek designers who can create websites and interfaces that align with their brand identity and effectively communicate their message to the target audience. • **Job Prospects:** Opportunities include roles like web designer, UI/UX designer, and graphic designer. • **Emerging Trends:** Dark mode adoption, micro-interactions, and a focus on accessibility are shaping the future of web design.
2	**Vertical:**	Skill Enhancement Course(SEC)
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 hrs in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** **CO 1:** Define the Internet and its role in connecting global networks. **CO 2:** Introduce HTML 5 and its role in structuring web content.	

	CO 3: Explore linking external resources such as stylesheets and scripts to HTML documents. **CO 4:** Cover various HTML elements, including input controls, forms, divs, sectioning elements, navigation bars, labels, output elements, void elements, media elements, progress elements, selection menu controls, embed, iframes, SVG, canvas, and tabindex. **CO 5:** Demonstrate how to implement styles using stylesheets and apply them to text and links. **CO 6:** Introduce jQuery as a powerful JavaScript library. **CO 7:** Understand and implement basic jQuery effects. **CO 8:** Understand the basics of JSON (JavaScript Object Notation). **CO 9:** Learn the JSON grammar and structure. **CO 10:** Learn to create and use JSON objects.	
8	**Course Outcomes (OC):** **OC 1:** Create structured HTML documents using HTML 5. **OC 2:** Apply CSS for text and link styling. **OC 3:** Implement responsive design with CSS. **OC 4:** Demonstrate proficiency in creating visually appealing web pages. **OC 5:** Grasp fundamental Internet concepts and applications. **OC 6:** Implement JavaScript events and event handlers for interactive web pages. **OC 7:** Apply jQuery effects to enhance user experience. **OC 8:** Understand the basics of JSON and its data structures. **OC 9:** Create, parse, and persist JSON data. **OC 10:** Integrate JSON and HTML effectively in web development.	
9	**Modules: -** **Module 1:**	
	1. **Internet and the World Wide Web:** What is Internet? Applications of Internet, internet related concepts. 2. **HTML 5**: Getting started with HTML, Doctypes, Headings, Paragraphs, Text Formatting, Anchors and Hyperlinks, Lists, Tables, Comments, Classes and IDs, Linking Resources, Images, Image Maps. 3. **HTML OTHER ELEMENTS:** Input Control Elements, Forms, Div Element, Sectioning Elements, Navigation Bars, Label Element, Output Element, Void Elements, Media Elements, Progress Element, Selection Menu Controls, Embed, IFrames, SVG, Canvas, Tabindex. 4. **CSS**: Implementing Styles using CSS – Stylesheets, Formatting Text and Links using CSS, CSS Selectors, Changing Background, Adding Border, Margin and Padding, Setting Dimensions, Using Inline Container to mark up a part of a text.	**15 Hrs**

	Module 2:	
	1. Java Script Events and Event Handlers: HTML Events, DOM Events, DOM Event Listener, onAbort, onBlur, onChange, onClick, onDblClick, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onReset, onResize, onSelect, onSubmit, onUnload, Form Validation Example. **2. jQuery**: Introduction, Syntax, Selectors, Events, Effects, Hide/Show, Fade, Slide, Animate, stop(), Callback, Chaining, HTML, Get, Set, Add, Remove, CSS Classes, css( ), Dimensions. **3. JSON**: Introduction, JSON Grammar, JSON Values, JSON Tokens, Syntax, JSON vs XML, Data Types, Objects, Arrays, Creating JSON, JSON Object, Parsing JSON, Persisting JSON, Data Interchange, JSONHTM, JSONP.	**15 Hrs**
10	**Online References:** **1.** https://www.w3schools.com/ **2.** https://www.tutorialspoint.com/index.htm **3.** https://www.javatpoint.com/	
11	**Reference Books** **1.** Web Design with HTML, CSS, JavaScript and JQuery, by Jon Duckett, Paperback, 1st Edition, 2014 **2.** HTML 5 Black Book, by DT Editorial Services, Paperback, 2nd Edition, 2016 **3.** Beginning JSON, by Ben Smith, Apress, 1st Edition, 2015 **4.** Web Design: The Complete Reference, by Thomas Powell, TMH, 2009	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Graph Theory

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** Graph Theory, a discipline within discrete mathematics, is a crucial study of interconnected systems. In today's world, where relationships define structures, the Graph Theory course offers a key understanding of these connections, making it highly relevant. • **Relevance and Usefulness:** The Graph Theory course is relevant across diverse fields as it provides a theoretical foundation for comprehending complex relationships and structures. This course is useful for modeling and analyzing relationships within systems, offering insights applicable to various domains. From optimizing networks to solving real-world problems, it equips individuals to navigate interconnected structures. • **Applications:** Graph Theory finds application in computer science, social sciences, logistics, and biology, playing a crucial role in algorithm design, network optimization, and problem-solving within interconnected systems. • **Interest and Connection with Other Courses:** The Graph Theory course is intellectually stimulating for individuals curious about understanding patterns, relationships, and network dynamics. It appeals to those interested in unravelling the complexity of interconnected systems. Establishing a meaningful link with computer science and mathematics courses, Graph Theory serves as a foundation for understanding algorithms, data structures, and network design. • **Demand in the Industry:** As industries increasingly rely on data analysis and network optimization, professionals with expertise in Graph Theory are in high demand. Employers seek individuals capable of applying graph-based models to solve complex problems. • **Job Prospects:** Completing the Graph Theory course opens doors to roles in software development, network analysis, data science, and research, reflecting the valuable skill set acquired in understanding and modeling relationships.
2	**Vertical:**	Skill Enhancement Course(SEC)
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours work in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):**	

	CO 1: Develop a Fundamental Understanding of Graph Structures. **CO 2:** Master Graph Algorithms and Optimization Techniques. **CO 3:** Apply Graph Theory to Real-World Problems. **CO 4:** Explore Advanced Topics in Graph Theory. **CO 5:** Develop Proficiency in Graph Visualization and Representation.	
8	**Course Outcomes (OC):** **OC 1:** Learners should demonstrate a deep understanding of graph structures, including knowledge of vertices, edges, and the different types of graphs. **OC 2:** Learners will gain proficiency in applying graph algorithms and optimization techniques. **OC 3:** Learners should be capable of modeling complex systems, identifying relationships, and using graph-based models to address practical challenges. **OC 4:** Learners will delve into advanced topics within graph theory, including topics such as network flows, graph colouring, and spectral graph theory. **OC 5:** Learners should be able to use graph visualization tools, comprehend different graph representations, and communicate graph-based insights clearly to diverse audiences.	
9	**Modules: -** **Module 1:**	
	1. **GRAPHS AND DIGRAPHS:** Introduction, Graph Isomorphism, Subgraphs, 1Degrees, Indegrees, and Outdegrees, Adjacency Matrices and Incidence Matrices, Degree Vectors of Simple Graphs 2. **Connectivity**: Paths. Circuits, and Cycles, Connected Graphs and Digraphs, Trees and Spanning Trees, Strong Orientations of Graphs 3. **Eulerian and Hamiltonian Graphs:** Eulerian Graphs and Digraphs, Hamiltonian Graphs and Digraphs, Tournaments. 4. **Optimization Involving Trees**: Minimum Weight Spanning Trees, Maximum Weight Branching's, Minimum Weight arborescence's, Matroids and the Greedy Algorithm 5. **Shortest Path Problems:** Two Shortest Path Algorithms, The Steiner Network Problem, Facility Location Problems	**15 Hrs**
	Module 2:	
	1. **Flow and Connectivity and Combinatorics:** Flows in Networks and Menger's Theorem, More on Connectivity, Some Applications to Combinatorics 2. **Matchings and Factors**: More on Matchings, The Optimal Assignment Problem, The Traveling Salesperson Problem (TSP), Factors, Factorizations, and the Petersen Graph, 3. **Graph Embeddings**: Planar Graphs and Duality, Hamiltonian Plane Graphs, Maximum Flow in Planar Networks, Graphs on Surfaces (An Informal Treatment) Colourings of Graphs: Vertex Colouring of Graphs, Edge Colouring of Graphs, Colouring of Planar Graphs	**15 Hrs**

<table>
<tr><td>10, 11</td><td colspan="2">Reference Books
1. Schaum's Outline of Graph Theory: Including Hundreds of Solved Problems, by V. K. Balakrishnan, McGraw-Hill Education, 1997
2. A Textbook of Graph Theory, R. Balakrishnan, K. Ranganathan, Springer, 2nd Edition, 2012
3. Introduction to Graph Theory, by Richard J. Trudeau, Dover, 1st Edition, 2013
4. Introduction to Graph Theory, by Douglas Brent West, Prentice Hall, 1st Edition, 2010
5. Graph Theory, by Frank Harary, Addison-Wesley, 1st Edition, 2010
6. Basic Graph Theory, by Md. Saidur Rahman, Springer, 1st Edition, 2017</td></tr>
<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>Continuous Evaluation through:
Class test of 1 of 15 marks
Class test of 2 of 15 marks
Average of the two: 15 marks

Quizzes/ Presentations/ Assignments: 5 marks
Total: 20 marks</td><td>Format of Question Paper: External Examination (30 Marks)– 1 hr duration</td></tr>
<tr><td>14</td><td colspan="2">Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)
Q1: Attempt any two (out of four) from Module 1 (15 marks)
Q2: Attempt any two (out of four) from Module 2 (15 marks)</td></tr>
</table>

QUESTION PAPER PATTERN

(External and Internal)

<table>
<tr><td rowspan="5">I</td><td colspan="2">A Theory of 2 credits is evaluated for a total of 50 Marks</td></tr>
<tr><td>Internal Continuous Assessment:</td><td>40%[20 Marks]</td></tr>
<tr><td colspan="2">Continuous Evaluation through:
Class test of 1 of 15 marks
Class test of 2 of 15 marks
Average of the two: 15 marks

Quizzes/ Presentations/ Assignments: 5 marks
Total: 20 marks</td></tr>
<tr><td colspan="2">External Semester End Examination: 60% [30 Marks]</td></tr>
<tr><td colspan="2">Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)
Q1: Attempt any two (out of four) from Module 1 (15 marks)
Q2: Attempt any two (out of four) from Module 2 (15 marks)</td></tr>
<tr><td rowspan="5">II</td><td colspan="2">A Practical of 2 credits is evaluated for a total of 50 Marks</td></tr>
<tr><td>Internal Continuous Assessment:</td><td>40%[20 Marks]</td></tr>
<tr><td colspan="2">Continuous Evaluation through:
Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.</td></tr>
<tr><td colspan="2">Semester End Examination: 60%[30 Marks]</td></tr>
<tr><td colspan="2">Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination (30 Marks)
Practical Slip:
Q1. From Module 1 13 marks
Q2. From Module 2 12marks
Q3. Journal and Viva 05 marks</td></tr>
</table>

Examination and Standard of Passing:

Regulations regarding the scheme of exams, number of credits and standard of passing will be asprescribed by the University of Mumbai.

A student is said to have passed if he/she secures 40% of marks allotted in each head of passing. External evaluation of 30 marks and Internal evaluation of 20 marks are treated as separate heads of passing.

The Ten Point Grading System prescribed by the University of Mumbai will be as follows:

Letter Grades and Grade Points

Semester GPA/ Program CGPA Semester/ Program	**% of Marks**	**Alpha-Sign / Letter GradeResult**	**Grade Points**
9.00-10.00	90.0-100	O (Outstanding)	10
8.00-<9.00	80.0-<90.0	A+ (Excellent)	9
7.00-<8.00	70.0-<80.0	A (Very Good)	8
6.00-<7.00	60.0-<70.0	B+ (Good)	7
5.50-<6.00	55.0-<60.0	B (Above Average)	6
5.00-<5.50	50.0-<55.0	C (Average)	5
4.00-<5.00	40.0-<50.0	P (Pass)	4
Below 4.00	Below 40	F (Fail)	0
Ab (Absent)	-	Absent	0

This syllabus is applicable to IDOL students as well, w.e.f. 2025-26.

Appendix B

Justification for B.Sc. (Data Science)

1.	Necessity for starting the course:	**There is a growing importance of data in today's digital age. t equips individuals with the skills and knowledge needed to extract valuable insights from data, drive innovation, and address complex challenges across diverse industries**
2.	Whether the UGC has recommended the course:	**Yes**
3.	Whether all the courses have commenced from the academic year 2024-2025	**To be implemented from 2024-2025 onwards**
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	**Self-financed** **Yes. Some experts are called as visiting faculties**
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	**4 years. Not possible to compress the program**
6.	The intake capacity of each course and no. of admissions given in the current academic year:	**60 seats for one division. Admissions will be held from 2024-2025 onwards**
7.	Opportunities of Employability / Employment available after undertaking these courses:	**B.Sc in Data Science opens up a variety of opportunities and high employability in today's data-driven economy. As organizations continue to recognize the value of data in gaining a competitive edge, individuals with a B.Sc in Data Science are well-positioned for diverse and rewarding career opportunities.**

Sign of Chairperson
Dr. Mrs. R. Srivaramangai
Ad-hoc BoS (Data Science)

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of Offg. Dean,
Prof. Shivram S. Garje
Faculty of Science & Technology