DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

CHHATRAPATI SAMBHAJINAGAR

NAAC Reaccredited A+ Grade

FACULTY OF SCIENCE & TECHNOLOGY

4 Years B.Sc. Data Science

(Apprenticeship Embedded Degree Programme (AEDP))

Course Structure

For University Department

BSc Data Science Honours– Apprenticeship Embedded Degree Programme (AEDP)

A. Preamble

Welcome to Department of Computer Science and Information Technology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The department is one of the most vibrant departments on the university campus and also recognized by Department of Science and Technology (**DST**) **FIST**, University Grants Commission (**UGC**) **SAP** (DRS – PHASE 1, PHASE 2) programs of Government of India.

We observe that the 21st century has witnessed an unprecedented data revolution, transforming industries, governance, and societal frameworks through the power of data-driven decision-making. As artificial intelligence, machine learning, and big data analytics redefine global technological paradigms, the demand for skilled data scientists with both academic expertise and practical industry experience has surged exponentially.

Recognizing this critical need and aligning with the visionary National Education Policy (NEP) 2020, the Department of Computer Science at Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar, proudly introduces the **BSc Data Science Honours – Apprenticeship Embedded Degree Programme (AEDP)**. This innovative programme, commencing in the academic year 2025–26, is meticulously designed to bridge the gap between theoretical knowledge and real-world application, fostering a new generation of data professionals equipped to lead in the digital economy.

The BSc Data Science Honours AEDP is a pioneering initiative that integrates rigorous academic coursework with immersive apprenticeship training, ensuring students gain hands-on experience in cutting-edge data science applications. Structured in accordance with the **University Grants Commission (UGC) AEDP Guidelines** and the **Government of Maharashtra's GR dated 22nd April 2025**, the programme emphasizes:

- **Multi-disciplinary and Flexible Learning**: Offering multiple entry and exit options with certifications at UG Certificate (44 credits), Diploma (88 credits), Degree (132 credits), and Honours (176 credits) levels.
- **Industry-Aligned Apprenticeship**: A robust **50+ credit apprenticeship** component in Semesters VI to VIII, enabling students to work with leading organizations in data analytics, AI, and related sectors.
- **Holistic Skill Development**: A balanced curriculum combining core data science disciplines, specialized electives, research projects, and value-added courses in ethics, communication, and Indian Knowledge Systems.

- **Regional and National Industry Collaboration**: Strategic partnerships with enterprises in the **Aurangabad and Marathwada region**, as well as national tech hubs, to ensure apprenticeships meet evolving sectoral demands.

Developed through extensive consultation with **industry leaders, academic experts, and policymakers**, the programme adheres to the **National Skills Qualifications Framework (NSQF)** and **National Higher Education Qualifications Framework (NHEQF)**, guaranteeing global relevance and employability.

By merging academic excellence with experiential learning, the BSc Data Science Honours AEDP aspires to cultivate **analytical thinkers, problem solvers, and innovators** capable of harnessing data to drive transformative change. Graduates will emerge not just as degree holders, but as **industry-ready professionals** poised to excel in careers spanning analytics, AI research, business intelligence, and beyond.

This programme stands as a testament to the university's commitment to **future-ready education**, empowering students to thrive in an era where data is the cornerstone of progress.

Program Objectives of BSc Data Science

1. **Develop Core Competencies**
    - Equip students with strong foundations in data science, statistics, machine learning, and programming to solve complex real-world problems.
2. **Bridge Industry-Academia Gap**
    - Provide hands-on apprenticeship experience through structured industry collaborations, ensuring graduates are job-ready with practical skills.
3. **Foster Research & Innovation**
    - Cultivate research capabilities in emerging areas like AI, big data analytics, and IoT through project-based learning and industry partnerships.
4. **Promote Ethical Data Practices**
    - Instill professional ethics and awareness of data privacy, security, and responsible AI usage in line with global standards.
5. **Encourage Entrepreneurial Mindset**
    - Develop business acumen and entrepreneurial skills to enable graduates to launch tech startups or drive innovation in existing organizations.
6. **Enhance Employability**
    - Align curriculum with current industry demands and global certifications to maximize career opportunities in diverse sectors.
7. **Support Lifelong Learning**

- Prepare graduates for continuous professional development through flexible learning pathways and credit bank systems.

8. **Develop Interdisciplinary Skills**
    - Integrate domain knowledge from fields like healthcare, finance, and social sciences to create versatile data professionals.
9. **Strengthen Problem-Solving Abilities**
    - Train students to apply analytical thinking and data-driven approaches to address challenges across various domains.
10. **Cultivate Leadership & Teamwork**
    - Develop communication and collaborative skills needed to lead data science projects and work effectively in multidisciplinary teams.

Program Distinctiveness :

- Industry-integrated curriculum with 50+ apprenticeship credits
- Balanced focus on theoretical foundations and practical implementation
- Multiple entry-exit options with stackable certifications
- Emphasis on both technical mastery and professional skills
- Alignment with National Education Policy 2020 objectives

These objectives are designed to produce graduates who are not only technically competent but also industry-ready, ethically grounded, and capable of driving innovation in the data science field. This program creates skilled, work-ready data science professionals.

B. Eligibility and Selection Criteria

Minimum eligibility is 10+2 in science stream with Mathematics as a subject or equivalent qualification as per university norms. Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying Examination.

C. Duration

Duration of the Only **BSc Data Science Apprenticeship Embedded Degree Programme (AEDP)** shall be 3 years/ 6 semesters. (132 Credits) & **BSc Data Science Honours – Apprenticeship Embedded Degree Programme (AEDP)** shall be 4 years/ 8 semesters. (176 Credits)

D. Programme Structure and Credit Distribution

Award Level	Minimum Credits	NSQF Level	Duration
UG Certificate	44	Level 5	After 1st Year
UG Diploma	88	Level 6	After 2nd Year
UG Degree	132	Level 7	After 3rd Year
UG Honours Degree	176	Level 8	After 4th Year

E. Exam or Evaluation scheme :

Evaluation Scheme will be as per UG courses evaluation scheme of our university.

F. Attendance

B.Sc. Data Science is full time course; therefore, it is necessary for the student to attend all theory as well as practical schedule precisely. The students must have 75% of attendance in each Discipline Specific Core Courses (DSC), Discipline Specific Elective Courses (DSEC),Open Electives(OE),Ability Enhancement Courses (AEC) or Value Education Course (VEC), Co-curricular Course (CC), On Job Training (OJT), Vocational Skill Courses (VSC), Skill Enhancement Course(SEC)and listed courses for appearing the Internal Evaluations(IE)and/or External Evaluation (EE) examination. However, student having 65% attendance with medical certificate may apply to the Head of Department for commendation of attendance. The student failing to produce such permission or failing in achieving the required attendance, he/she will not be allowed to submit examination form so attend the examination

G. Grade Awards

In order to pass the examination will be followed. Ten point rating scale shall be used for evaluation of performance of the student to provide Letter Grade for each course and overall grade for this course. Grade points are based on the total number of marks obtained by him / her in all the heads of the examination of the course. These grade points and their equivalent range of the marks are shown separately in following:

Table – I: Ten Point grades and grade description

Sr. No.	Equivalent Percentage	Grade points for SGPAand CGPA	Grade	Grade Description
1.	90 – 100	9.00 – 10	O	Outstanding
2.	80 – 89.99	8.00 – 8.99	A++	Excellent
3.	70 – 79.99	7.00 – 7.99	A+	Exceptional
4.	60 – 69.99	6.00 – 6.99	A	Very Good
5.	55 – 59.99	5.50 – 5.99	B+	Good
6.	50 – 54.99	5.00 – 5.49	B	Fair
7.	45 – 49.99	4.50 – 4.99	C+	Average
8.	**40.01 – 44.99**	**4.01 – 4.49**	C	Below Average
9.	40	4.00	D	Pass
10.	Below 40	0.00	F	Fail

In the event of student registered for the examination (i.e. Internal Tests/End Semester Examination/Practical/Seminar/Project Viva-voce), non-appearance shall be treated as the student deemed to be absent in the respective course.

Minimum D grade shall be the limit to clear /pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations.

Using table – I, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and Cumulative Grade Card with CGPA will be given on completion of the course.

Computation of SGPA (Semester Grade Point Average) &CGPA (Cumulative Grade Point Average)

The computation of SGPA and CGPA will be as below:

Semester Grade Point Average (SGPA) is the weighted average of points obtained by a student in a semester and will be computed as follows:

$$\textbf{SGPA} = \frac{\text{Sum(Course Credit * Number of Points in concern course gained by the student)}}{\text{Sum (Course Credit)}}$$

The SGPA for all four semesters will be mentioned at the end of every semester.

The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semesters of the course and will be computed as follows:

$$\textbf{CGPA} = \frac{\text{Sum(All Four semester SGPA)}}{\text{Total number of semesters}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

H. Tripartite Agreement for Apprenticeship (Mandatory)

A formal agreement for Apprenticeship will be signed between:

- University Department
- Industry/Company/Startup
- Student (Apprentice)

I. Fees Structure (Per Semester):

Sr.No	Subject	BSC Data Science (AEDP) (Non-Granted)
01	Student Fees W.F	10
02	Sport	10
03	Ashwamedh & SSI	12
04	E- Service	50
05	**Avi, Ind etc	29
06	Other Charges	0
07	Reg.fees	50
08	Lib.Fees/Other stu.Acti	500
09	Admin.Fees	200
10	Gym.Fees	25
11	Medi.Exam	5
12	Lab.Fees/ Comp.Lab/Apprenticeship fees	10850
13	Other Fees/study Tour	0
14	Uniform	0
15	Placement	0
16	Development fees	0
17	Industrial/ Placement	0
18	Other	0
19	Amount of Tuition Fees(Indian Student)	20,000
Total		Rs 31,741/-

Annual Fees :Rs 63482/-

COURSE STRUCTURE

SEMESTER(I)			CREDITS			HOURS/WEEK		SCHEMEOFEXAMINATIONS			
Course Type	**Course Code**	**Course Name**	**COURSE CREDIT**	**THEORY CREDITS**	**PR CREDITS**	**TH HRS**	**PR HRS**	**MAX**	**IA**	**UA**	**MIN MARKS**
Discipline SpecificCore (DSC)	DS/DSC/T/100	Foundation of Data Science-Part I	4	2	-	2	-	50	20	30	20
	DS/DSC/T/101	Introduction to Python Programming	4	2	-	2	-	50	20	30	20
	DS/DSC/T/102	Operating Systems	4	2	-	2	-	50	20	30	20
	DS/DSC/P/126	Practical based on Foundation of Data Science -Part I	-	-	2	-	4	50	20	30	20
	DS/DSC/P/127	Practical based on Introduction to Python Programming	-	-	2	-	4	50	20	30	20
	DS/DSC/P/128	Practical Based on Operating Systems	-	-	2	-	4	50	20	30	20
Open Elective(Choose any one from Pool of courses)	DS/OE-1/T/100	**Choose any one from pool of courses**	2	2	-	2	-	50	20	30	20
SEC	DS/SEC/T/100	Concepts of Cyber Security	2	1	-	1	-	50	20	30	20
	DS/SEC/P/126	Practical Based on Concepts of Cyber Security			1	-	2	50	20	30	20
AEC/IKS	DS/AEC/T/100	English	2	2	-	2	-	50	20	30	20
	DS/IKS/T/101	Indian Knowledge Systems(choose any from IKS basket)	2	2	-	2	-	50	20	30	20
CC/OJT	DS/CC/P/126	Health and wellness(Common for all the faculty)	2		2	-	4	50	20	30	20
		Total	**22**	**13**	**9**	**13**	**18**	**600**	**240**	**360**	**240**

COURSE STRUCTURE

SEMESTER (II)			CREDITS			HOURS/WEEK		SCHEMEOFEXAMINATIONS			
Course Type	**Course Code**	**Course Name**	**COURSE CREDIT**	**THEORY CREDITS**	**PR CREDITS**	**TH HRS**	**PR HRS**	**MAX**	**IA**	**UA**	**MIN MARKS**
Discipline Specific Core (DSC)	DS/DSC/T/150	Foundation of Data Science - Part II	4	2	-	2		50	20	30	20
	DS/DSC/T/151	Statistics and Probability for data science	4	2	-	2		50	20	30	20
	DS/DSC/T/152	Database Concepts	4	2	-	2		50	20	30	20
	DS/DSC/P/176	Practical based on Foundation of Data Science -Part II	-	-	2		4	50	20	30	20
	DCS/DSC/P/177	Practical based on Statistics and Probability for data science	-	-	2		4	50	20	30	20
	DS/DSC/P/178	Practical based on Database Concepts	-	-	2		4	50	20	30	20
Open Elective(Choose any one from pool of courses)	DS/OE-2/T/150	**Open elective open for other discipline**	2	2	-	2		50	20	30	20
SEC	DS/VSC/T/150	Basics of Hardware	2	1	-	1		50	20	30	20
	DS/VSC/P/176	Practical Based on Basics of Hardware			1		2	50	20	30	20
AEC/IKS	DS/AEC/T/150	Modern Indian Language (MIL-1) (Choose any one from pool of language courses)	2	2	-	2		50	20	30	20
	DS/VEC/T/151	Constitution of India	2	2	-	2		50	20	30	20

CC/OJT	DS/CC/P/176	Yoga Education/Sports and Fitness (Common for all the faculty)	2		2		4	50	20	30	20
Total			**22**	**13**	**9**	**13**	**18**	**600**	**240**	**360**	**240**

COURSE STRUCTURE

SEMESTER (III)			**CREDITS**			**HOURS/WEEK**		**SCHEMEOFEXAMINATIONS**			
Course Type	**Course Code**	**Course Name**	**COURSE CREDIT**	**THEORY CREDITS**	**PR CREDITS**	**TH HRS**	**PR HRS**	**MAX**	**IA**	**UA**	**MIN MARKS**
Discipline Specific Core	DS/DSC/T/200	Data Analytics using Power BI	4	2	-	2	-	50	20	30	20
	DS/DSC/T/201	RDBMS	4	2	-	2	-	50	20	30	20
	DS/DSC/P/226	Practical based on Data Analytics using Power BI	-	-	2	-	4	50	20	30	20
	DS/DSC/P/227	Practical based on RDBMS	-	-	2	-	4	50	20	30	20
Minor	DS/Mn-1/T/200	Minor-I	2	1	-	1	-	50	20	30	20
	DS/Mn-1/P/226	Practical based on Minor-I	-	-	1	-	2	50	20	30	20
	DS/Mn-2/T/201	Minor -2	2	1	-	1	-	50	20	30	20
	DS/Mn-2/P/227	Practical based on Minor-2	-	-	1	-	2	50	20	30	20
OE(Choose any One from pool of courses)	DS/OE-3/T/200	Open elective open for other discipline	2	2	-	2	-	50	20	30	20
VSC	DS/VSC/T/200	Advance Hardware	2	1	-	1	-	50	20	30	20
	DS/VSC/P/226	Practical Based on Advance Hardware	-	-	1	-	2	50	20	30	20
AEC	DS/AEC/T/200	English	2	2	-	2	-	50	20	30	20

VEC	DS/VEC/T/201	Environmental Studies	2	2	-	2	-	50	20	30	20
OJT/ FP/CEP/CC/RP	DS/CC/P/226	Health and wellness-II / Cultural Activity / NSS,NCC (Common for all the faculty)	2	-	2	-	4	50	20	30	20
Total			**22**	**13**	**9**	13	18	**700**	**280**	**420**	**280**

COURSE STRUCTURE

SEMESTER (IV)			**CREDITS**			**HOURS/WEEK**		**SCHEME OF EXAMINATIONS**			
Course Type	**Course Code**	**Course Name**	**COURSE CREDIT**	**THEORY CREDITS**	**PR CREDITS**	**TH HRS**	**PR HRS**	**MAX**	**IA**	**UA**	**MIN MARKS**
Discipline Specific Core	DS/DSC/T/250	Data Visualization	4	2	-	2	-	50	20	30	20
	DS/DSC/T/251	Software Engineering	4	2	-	2	-	50	20	30	20
	DS/DSC/P/276	Practical based on Data Visualization	-	-	2	-	4	50	20	30	20
	DS/DSC/P/277	Practical based on Software Engineering	-	-	2	-	4	50	20	30	20
Minor	DS/Mn-1/T/250	Minor I	2	1	-	1	-	50	20	30	20
	DS/Mn-1/P/276	Practical based on Minor 1	-	-	1	-	2	50	20	30	20
	DS/Mn-2/T/251	Minor 2	2	1	-	1	-	50	20	30	20
	DS/Mn-2/P/277	Practical based on Minor 2	-	-	1	-	2	50	20	30	20
OE(Choose any one from pool of courses)	DS/OE-3/T/250	Open elective open for other discipline	2	2	-	2	-	50	20	30	20
SEC	DS/VSC/T/250	Web Designing	2	1	-	1	-	50	20	30	20
	DS/VSC/P/276	Practical Based on Web	-	-	1	-	2	50	20	30	20

		Designing									
AEC	DS/AEC/T/250	Modern Indian Language (MIL-2)	2	2	-	2	-	50	20	30	20
OJT/ FP/CEP/CC/RP	DS/FP/P/276	Field Project	4	-	4	-	8	50	20	30	20
		Total	**22**	**11**	**11**	**11**	**22**	**650**	**260**	**390**	**260**

COURSE STRUCTURE

SEMESTER (V)			**CREDITS**			**HOURS/WEEK**		**SCHEME OF EXAMINATIONS**			
Course Type	**Course Code**	**Course Name**	**COURSE CREDIT**	**THEORY CREDITS**	**PR CREDITS**	**TH HRS**	**PR HRS**	**MAX**	**IA**	**UA**	**MINMARKS**
Discipline Specific Core	DS/DSC/ T/300	Computer Networks	4	2	-	2	-	50	20	30	20
	DS/DSC/ T/301	Data Warehousing and Data Mining (DWDM)	4	2	-	2	-	50	20	30	20
	DS/DSC-/P/326	Practical based on Computer Networks	-	-	2	-	4	50	20	30	20
	DS/DSC/ P/327	Practical based on Data Warehousing and Data Mining (DWDM)	-	-	2	-	4	50	20	30	20
DSE	DS/DSE/T /300	Machine Learning	4	2	-	2	-	50	20	30	20
	DS/DSE/P /326	Practical based on Machine Learning	-	-	2	-	4	50	20	30	20
Minor Choose any two	DS/Mn-1/T/300	Minor 1	2	1	-	1	-	50	20	30	20
	DS/Mn-1/P/326	Practical based Minor 1	-	-	1	-	2	50	20	30	20

	DS/Mn-2/T/301	Minor 2	2	1	-	1	-	50	20	30	20
	DS/Mn-2/P/327	Practical based Minor 2	-	-	1	-	2	50	20	30	20
VSC	DS/VSC/T/300	PC Maintenance and Trouble Shooting	2	1	-	1	-	50	20	30	20
	DS/VSC/P/326	Practical Based PC Maintenance and Trouble Shooting	-	-	1	-	2	50	20	30	20
FP/CEP	DS/FP/P/326 OR DS/CEP/P326	Field Project /Community Engagement	4	-	4	-	8	50	20	30	20
Total			**22**	**9**	**13**	**9**	**26**	**650**	**260**	**390**	**260**

COURSE STRUCTURE

Sr. No.	Course Name	Sixth Semester			Scheme of Examination			
		Course Code	Course Type	Credits	Max Marks	IA	UA	Min Marks
1	Apprenticeship	DS/AEDP/01	Apprenticeship	22	500	200	300	200
Total				22	500	200	300	200

Fourth Year (Semester VII & VIII) - Honors with Research

r. No.	Course Name	Seventh Semester			Scheme of Examination			
		Course Code	Course Type	Credits	Max Marks	IA	UA	Min Marks
1	Apprenticeship	DS/AEDP/02	Apprenticeship	22	500	200	300	200
Total				22	500	200	300	200
Sr.	**Course Name**	**Eighth Semester**			**Scheme of Examination**			

No.		Course Code	Course Type	Credits	Max Marks	IA	UA	Min Marks
1	Apprenticeship	DS/AEDP/03	Apprenticeship	22	500	200	300	200
Total				22	500	200	300	200

Minor 1

Sem-III (DS/Mn-1/T/200) & (DS/Mn-1/P/226)	Sem-IV (DS/Mn-1/T/250) & (DS/Mn-1/P/276)	Sem-V (DS/Mn-1/T/300) & (DS/Mn-1/P/326)	Sem-VI (DS/Mn-1/T/350) & (DS/Mn-1/P/376)
Python	Advance Python	Advance Python using OOPS	Python for Data Science and Machine Learning

Minor 2

Sem-III (DS/Mn-2/T/201) & (DS/Mn-2/P/227)	Sem-IV (DS/Mn-2/T/251) & (DS/Mn-2/P/277)	Sem-V (DS/Mn-2/T/301) & (DS/Mn-2/P/327)	Sem-VI (DS/Mn-2/T/351) & (DS/Mn-2/P/377)
Core Java	Advance Java	Advance Java using OOPS	Full Stack Java Development

Open Elective Designed for the students of other faculty

Sem-I	Sem-II	Sem-III	Sem-IV
Introduction to Computing for Behavioural Sciences	Data Analysis for Psychology	Human-Computer Interaction & Behavioural Technology	Digital Psychology and Emerging Technologies

Semester I

Course No: (DS/DSC/T/100): Foundation of Data Science -Part I

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week		Total No. of Lectures /Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/T/100	DSC	Theory	02	02		30		----	----	----

Course Title of the Course: (Foundation of Data Science -Part I):
Course Outcome (CO):
After completion of course students will be able to:
CO1: Understand basic concepts and applications of data science in real-world domains.
CO2: Identify and differentiate types of data, formats, and their characteristics.
CO3: Perform data collection, cleaning, and transformation for analysis.
B Apply basic statistical techniques for data summarization.

Foundation of Data Science -Part I	Total Hrs: 30
Unit-I	10 hrs
Introduction to Data Science: Definition and scope of data science, Data science life cycle, Roles in data science: Data analyst, data scientist, Types of data: Structured, unstructured, semi-structured, Data formats: CSV, JSON, XML, Applications of data science in various domains	
Unit-II	10 hrs
Data Collection and Preparation: Data collection methods: Files, APIs, web scraping, Data cleaning: Handling missing values, duplicates, noise, Data transformation: Scaling, normalization, encoding, Data types and conversions, Introduction to data wrangling using tools like Pandas	
Unit-III	10 hrs
Data Analysis and Visualization: Descriptive statistics: Mean, median, mode, variance, standard deviation, Introduction to data exploration and EDA, Data visualization techniques: Bar charts, histograms, boxplots, scatter plots, Tools for visualization: Matplotlib, Seaborn, Basics of interpreting and communicating insights from data	

Books Recommended:
Provost, F., & Fawcett, T. (2013). *Data science for business: What you need to know about data mining and data-analytic thinking*. O'Reilly Media.
VanderPlas, J. (2016). *Python data science handbook: Essential tools for working with data*. O'Reilly Media.
Grus, J. (2019). *Data science from scratch: First principles with Python* (2nd ed.). O'Reilly

Media.
McKinney, W. (2022). *Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter* (3rd ed.). O'Reilly Media.
Kelleher, J. D., & Tierney, B. (2018). *Data science: An introduction*. MIT Press.
James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An introduction to statistical learning: With applications in R* (2nd ed.). Springer.

Course No: (DS/DSC/T/101): Introduction to Python Programming

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/T/101	DSC	Theory	02	02	30		-	-	-

Course Title of the Course (Introduction to Python Programming):
Course Outcome (CO):
After completion of course students will be able to:
CO1: To familiarize students with Python syntax, data types, and control structures.
CO2: To develop problem-solving skills through algorithm design and coding.
CO3: To introduce the concept of modular and object-oriented programming in Python.
CO4: To equip students with the ability to handle files, work with libraries, and process data.
CO5: To prepare students to solve real-world problems through case-study-based assignments

Introduction to Python Programming	**Total Hrs: 30**
UNIT-I	**10 hrs**
Python Basics and Control Structures: Introduction to Python, Features, and Applications, Python Installation and IDEs (IDLE, Jupiter Notebook, VS Code), Basic Syntax, Variables, Data Types, and Type Casting, Operators: Arithmetic, Relational, Logical, Assignment, Bitwise, Control Structures: if, if-else, nested if, switch-case equivalent, Looping: for, while, nested loops, loop control statements (break, continue, pass),BasicInput/OutputinPython.	
Unit-II	**10 hrs**
Functions, Data Structures: Functions: Defining, Calling, Arguments, Return Values, Scope (Local s Global), Lambda Functions, Recursion, Data Structures: Strings, Lists, Tuples,Sets, Dictionaries with Operations and Methods, Comprehensions: List ,Dictionary, Set Comprehensions	
Unit-III	**10 hrs**
File Handling, Exceptions and Working with Libraries: File Handling: Reading, Writing, Appending, Working with CSV files, Exception Handling	

:try, except, finally, raise, Working with Modules and Packages: Introduction to Popular Libraries like NumPy for numerical computation, Pandas for data analysis, Matplotlib for data visualization, Introduction to Python for Automation and Scripting	

Books Recommended:

- Python Crash Course–EricMatthes,No Starch Press
- Learning Python– MarkLutz, O'Reilly Media, 6th Edition(also available at https://cfm.ehu.es/ricardo/docs/python/Learning_Python.pdf)
- Automate the Boring Stuff with Python–AlS weigart (also available at https://automatetheboringstuff.com/)
- Python Programming:Using Problem Solving Approach–Reema Thareja, Oxford University Press

Course No: (DS/DSC/T/102): **Operating System**

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/T/102	DSC	Theory	02	02	30		----	----	----

Course Title of the Course: **(Operating System)**
Course Outcome (CO):
After completion of course students will be able to:
CO1: *Understand the basic functions, structure, and types of operating systems.*
CO2: Describe and analyze process management mechanisms
CO3: Use memory management and page replacement techniques

Operating System	**Total Hrs: 30**
Unit-I	**10 hrs**
Introduction to Operating Systems: Definition and Purpose, Types of Operating Systems (Batch, Time-Sharing, Distributed, Real-Time, etc.), Operating System Services, Functions of Operating System, Memory allocation techniques (Worst-fit, Best-fit, First-fit)	
Unit-II	**10 hrs**
Process Synchronization: General structure of a typical process, race condition, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors **CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF, SRTF, Priority, RR, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling), Thread Scheduling	
Unit-III	**10 hrs**

Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Concept of Deadlock Avoidance , Banker's Algorithm Deadlock Detection and Recovery by resource preemption technique and wait-for graph technique.	

Books Recommended:

- **"Operating System Concepts",** by Abraham Silberschatz, Peter B. Galvin, Greg Gagne.
- "**Modern Operating Systems**", by Andrew S. Tanenbaum.

Course No: (DS/DSC/P/126): Practical based on Foundation of Data Science-Part I

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/P/126	DSC	Practical	02	04	60		----	----	----

Course Title of the Course: (Practical based on Foundation of Data Science-Part I):
Course Outcome (CO):
After completion of course students will be able to:
CO1: Set up a data science environment and import datasets.
CO2: Clean and preprocess raw datasets using Python libraries.
CO3: Perform descriptive analysis and compute basic statistics.
CO4: Create effective visualizations using Matplotlib and Seaborn.

Practical based on Foundation of Data Science-Part I	**Total Hrs: 60**
Unit-I	**20 hrs**
• Python/R basics for data science • Importing/exporting datasets (CSV, Excel) • Handling missing data • Data normalization techniques	
Unit-II	**20 hrs**
• Calculating descriptive statistics • Creating basic visualizations • Performing EDA on a dataset • Detecting and handling outliers • Working with probability distributions • Conducting hypothesis tests	
Unit-III	**20 hrs**

• Correlation analysis • Simple linear regression • Data aggregation techniques • Feature engineering basics • Mini-project: Applying concepts to a real-world problem	

Books Recommended:

- VanderPlas, J. (2016). *Python Data Science Handbook*. O'Reilly.
- Wickham, H. & Grolemund, G. (2017). *R for Data Science*. O'Reilly.
- James, G., et al. (2021). *An Introduction to Statistical Learning*. Springer.
- Provost, F. & Fawcett, T. (2013). *Data Science for Business*. O'Reilly.
- Grus, J. (2019). *Data Science from Scratch*. O'Reilly.

Course No: (DS/DSC/P/127): Practical based on Introduction to Python Programming

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC /P/127	DSC	Practical	2	04	60	--	-	-	-

Course Title of the Course: (Practical based on Introduction to Python Programming):

Course Outcome (CO):

After completion of course students will be able to:

CO1: Write Python programs using control structures, functions, and data structures

CO2: Apply object-oriented concepts to Python programming.

CO3: Utilize Python libraries for data manipulation and file handling.

Practical based on Introduction to Python Programming	**Total Hrs: 60**
1. Develop a simple calculator that performs basic arithmetic operations through user input.	
2. Create a student grading system that accepts scores and computes grades using conditional logic.	
3. Build a contact book application using dictionaries for contact storage and basic add/search functionality.	
4. Analyze a text file to compute the frequency of each word, demonstrating fileI/O and string manipulation.	
5. Implement a basic inventory management system using lists and tuples to track products and quantities.	
6. Design a bank account system applying classes and objects, facilitating deposits, with drawls ,and balance inquiry.	
7. Develop a quiz application that uses functions and data structures to store questions and validate user responses.	

8. Write a temperature conversion tool supporting Celsius, Fahrenheit,and Kelvin ,incorporating user input and exception handling.	
9. Create a reminder app that reads and writes reminders to a file,with error handling for file access.	
10. Simulate a library catalogue with options to add, delete, search, and display books, utilizing object-oriented programming concepts and file storage	

Books Recommended:

- Python Crash Course–EricMatthes,No Starch Press
- Learning Python– MarkLutz, O'Reilly Media, 6th Edition(also available at https://cfm.ehu.es/ricardo/docs/python/Learning_Python.pdf)
- Automate the Boring Stuff with Python–AlS weigart (also available at https://automatetheboringstuff.com/)
- Python Programming:Using Problem Solving Approach–Reema Thareja, Oxford University Press

Course No (DS/DSC/P/128): Practical based on Operating system

Course No.	Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/P/128	DSC	Practical	02	04	60		----	----	----

Course Title of the Course: (**Practical based on Operating system**):

Course Outcomes (COs):

After completion of course students will be able to:

CO1: Implement basic file handling and system-level operations to interact with the operating system.

CO2: Simulate memory management techniques such as First-fit, Best-fit, and Worst-fit for efficient memory allocation.

CO3: Apply process synchronization and simulate CPU scheduling algorithms including FCFS, SJF, Priority, and Round-Robin.

CO4: Design and implement deadlock handling techniques including detection, avoidance (Banker's Algorithm), prevention, and recovery methods.

Practical based on Operating system	**Total Hrs: 60**
Unit-I	**20 hrs**

1. Write a program to create a file named myfile.txt and write the line "Hello, this is a file." into it. The program should check if the file is successfully opened before writing, and display a success message after writing. 2. Write a program to display system information. 3. Write a program to simulate the Worst-fit contiguous memory allocation technique. 4. Write a program to simulate the Best-fit contiguous memory allocation technique. 5. Write a program to simulate the First-fit contiguous memory allocation technique.	
Unit-II	**20 hrs**
1. Write a program to simulate producer-consumer problem using Semaphores. 2. Write a program to stimulate the CPU scheduling algorithm Shortest job first (Non- Preemption) 3. Write a c program to simulate the CPU scheduling algorithm First Come First Serve (FCFS) 4. Write a program to simulate the CPU scheduling priority algorithm. 5. Write a program to simulate the CPU scheduling algorithm round-robin.	
Unit-III	**20 hrs**
1. Write a program to detect a deadlock 2. Write a program to simulate bankers algorithm for Dead Lock Avoidance (Banker‘s Algorithm) 3. Write a program to implement deadlock prevention technique 4. Write a program to simulate deadlock recovery by resource preemption technique 5. Write a program to simulate deadlock recovery by using a wait-for graph technique.	

Course No: (DS/SEC/T/100): Concepts of Cyber Security

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/SEC/T/100	SEC	Theory	01	01	15	-	----	----	----

Course Title of the Course: (**Concepts of Cyber Security**):
Course Outcome (CO):
After completion of course students will be able to:
CO1: Explain the core concepts and terminologies of cyber security**.**
CO 2: Identify potential security threats and assess vulnerabilities**.**
CO3: Apply appropriate defense mechanisms and security tools.

Concepts of Cyber Security	Total Hrs: 15
Unit-I	**05 hrs**
Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance– Challenges and Constraints, Computer Criminals, CIA Triad,	
Unit-II	**05 hrs**
Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defence, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyberterrorism, CyberEspionage ,etc.,Comprehensive Cyber Security Policy, cybercrime	
Unit-III	**05 hrs**
Types of Attacks and Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow	

Books Recommended:

- Cyber Security :Understanding Cyber Crimes,Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure,Wiley INDIA.
- Cyber Security Essentials,JamesGraham,Richard Howard and Ryan Otson,CRC Press.
- IntroductiontoCyberSecurity,Chwan-Hwa(john)Wu,J.DavidIrwin.CRCPressTsFGroup.
- William Stallings, Network Security Essentials: Applications and Standards, Pearson(available at https://www.emgywomenscollege.ac.in/templateEditor/kcfinder/upload/files/Network-security-essentials.pdf)InformationTechnologyAct,2000(with latest amendments).

Course No: (DS/SEC/P/126) Practical Based on Concepts of Cyber Security

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/SEC/P/126	SEC	Practical	01	02	30	-	----	----	----

Course Title of the Course: (Practical Based on Concepts of Cyber Security):
Course Outcome (CO):
After completion of course students will be able to:

CO1: Interpret and comply with basic cyber laws and ethical practices.
CO 2: Practically working on potential security threats and assess vulnerabilities**.**
CO3: Demonstrate problem-solving skills through real time application on tools..

Practical Based on Concepts of Cyber Security	**Total Hrs: 30**
1. Phishing Simulations Analysis–Identify phishing email characteristics and analyze an example campaign. 2 Password Security Audit–Evaluate password strength and implement multi-factor authentication. 3.Wireshark Traffic Analysis Capture and analyze network packets to detect suspicious activity. 4.Firewall Rule Configuration–Implement basic firewall rules to block specific threats. 5.Ransomware Case Study–Study a real-world ransom wareattack and recommend preventive strategies. 6.Web Application Vulnerability Test–Conduct basic testing for XSS and SQL Injection. 7.Incident Report Preparation–Draft an incident response report for a simulated breach. 8.CryptographyLab–Implement AES encryption and decryption for sample data. 9. Cyber Law Violation Case–Analyze a real-life cyber law violation and its legal outcome. 10.Security Policy Drafting–Create a simple security policy for a small organization.	

Books Recommended:

- Cyber Security :Understanding Cyber Crimes,Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure,Wiley INDIA.
- Cyber Security Essentials,JamesGraham,Richard Howard and Ryan Otson,CRC Press.
- IntroductiontoCyberSecurity,Chwan-Hwa(john)Wu,J.DavidIrwin.CRCPressTsFGroup.
- William Stallings, Network Security Essentials: Applications and Standards, Pearson(available at https://www.emgywomenscollege.ac.in/templateEditor/kcfinder/upload/files/Network-security-essentials.pdf)InformationTechnologyAct,2000(with latest amendments).

Course No: (DS/AEC/T/100): English

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/AEC/T/100	AEC	Theory	02	02	30	-	----	----	----

Course Title of the Course: (**English**):
Course Outcome (CO):
After completion of course students will be able to:
CO1: Demonstrate a clear understanding of basic grammar, vocabulary, and sentence structures for professional communication.
CO 2: Apply appropriate verbal and non-verbal communication techniques in formal and workplace settings.
CO3: Develop well-structured professional documents such as emails, memos, reports, and resumes using correct format and tone.

English	**Total Hrs: 30**
Unit-I	**10 hrs**
Fundamentals of Professional Communication, Introduction to Professional English, Principles of Effective Communication, Basic Grammar, Types of Communication: Verbal, Non-verbal, Written, and Visual, Barriers to Communication and Strategies to Overcome Them, Listening Skills: Active Listening and Note-Taking, Speaking Skills: Clarity, Tone, and Pronunciation.	
Unit-II	**10 hrs**
Workplace and Interpersonal Communication, Professional Etiquette and Communication Ethics, Group Discussions and Public Speaking, Business Presentations: Structure, Delivery, and Visual Aids, Interview Skills: Preparation, Response Strategies, and Follow-up, Cross-Cultural Communication and Sensitivity, Telephone and Virtual Meeting Etiquette.	
Unit-III	**10 hrs**
Writing for Professional Purposes, Principles of Business Writing, Formal Emails: Format, Tone, and Content, Writing Memos, Circulars, and Notices, Resume and Cover Letter Writing, Report Writing and Minutes of Meeting, Proposals and Executive Summaries.	

Books Recommended:

- **"English for Professionals"** by S. K. Sharma & D. Mohan.
- **"Business Communication"** by Meenakshi Raman & Prakash Singh.

Semester II

Course No: (DS/DSC/T/150): Foundation of Data Science -Part II

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/T/150	DSC	Theory	02	02	30		----	----	----

Course Title of the Course: (Foundation of Data Science -Part II):
Course Outcome (CO):
After completion of course students will be able to:
CO1: Apply probability concepts to real-life data science problems**.**
CO2: Understand and use statistical methods for data interpretation.
CO3: Explain the basic principles of machine learning and its types.
CO4: Build and evaluate simple predictive models**.**

Foundation of Data Science -Part II	**Total Hrs: 30**
Unit-I	**10 hrs**
Introduction to Probability and Statistics: Basics of probability: Events, outcomes, and rules, Conditional probability and Bayes' theorem, Random variables and probability distributions, Measures of central tendency and dispersion, Introduction to statistical inference, Sampling techniques and sampling distributions.	
Unit-II	**10 hrs**
Introduction to Machine Learning Concepts: Difference between supervised and unsupervised learning, Overview of classification, regression, and clustering, Introduction to common algorithms: k-NN, decision trees, k-means, Model evaluation metrics: Accuracy, precision, recall, F1-score, Over fitting and under fitting, Basics of training and testing data.	
Unit-III :	**10 hrs**
Working with Real-World Data: Importing real-world datasets from open sources (e.g., UCI, Kaggle) Performing complete Exploratory Data Analysis (EDA), Data preprocessing for machine learning, Building and evaluating a simple classification or regression model, Introduction to pipelines and reproducible workflows, Communicating results through reports and visualization	

Books Recommended:

- Grus, J. (2019). *Data science from scratch: First principles with Python* (2nd ed.). O'Reilly Media.
- McKinney, W. (2022). *Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter* (3rd ed.). O'Reilly Media.
- Geron, A. (2019). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems* (2nd ed.). O'Reilly Media.
- VanderPlas, J. (2016). *Python data science handbook: Essential tools for working with data*. O'Reilly Media.
- Allen, D. M. (2020). *Data science for beginners: 4 books in 1 - Python, Data Analysis, Data Science, Machine Learning*. Independently published.

Course No: (DS/DSC/T/151) Statistics and Probability for Data Science

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC-5/T/151	DSC	Theory	02	02	30	-	----	----	----

Course Title of the Course: (**Statistics and Probability for Data Science**):

Course Outcome (CO):

After completion of course students will be able to:

Learning Outcomes:

CO1: Understand basics concepts of Statistics, used to describe data using numerical summaries.

CO2: Understand the applications of statistical tools and Create, download, manipulate, and analyse data sets.

CO3: Learning the basics of probability theory and its applications.

Statistics and Probability for Data Science	**Total Hrs: 30**
Unit-I	**10 hrs**
Introduction to Statistics and Data Science, Role of Statistics in Data Science, Types of Data Understanding different types of data (numerical, categorical, etc.) and their characteristics. Sample and Population. **Descriptive Statistics:** Summarizing and describing data using statistical measures like Measure of Central Tendency, Measure of Dispersion, Measure of Shape. **Inferential Statistics: Sampling methods–** Random and grouped, **Tests –** Z-test, T-test, Chi-square, ANOVA, **and Hypothesis testing.** Introduction to simple linear regression model.	
Unit-II	**10 hrs**
Probability Theory: Basic Concepts: Random experiments, sample space, events,	

and the algebra of events. Definitions of Probability: Classical, statistical. **Conditional Probability and Independence:** Understanding how events influence each other and the concept of independence. **Bayes' Theorem:** Its applications in updating probabilities based on new evidence. **Random Variables:** Discrete and continuous random variables, probability mass functions (PMF), probability density functions (PDF), and cumulative distribution functions (CDF). **Expectation and Variance:** Understanding expected values, variances, and their properties. Common Probability Distributions: Exploring discrete distributions (e.g., binomial, Poisson) and continuous distributions.	
Unit-III	**10 hrs**
Dataset and its Presentation: Different sources and types of data, Examples of real-life datasets. Frequency distributions, Line chart, Bar diagram, Pie chart, Multiple bar diagram, Leaf and Stem plot, Histogram, Boxplot and other relevant plots. Overview of: Statistics for Machine Learning, Exploratory Data Analysis (EDA) and Visualization, Statistical Software Tools.	

Books Recommended:

1. Rohatgi, V.K. and Saleh, A.K. Md. E. (2015). An Introduction to Probability and Statistics (3rd Edition),Wiley Series in Probability and Statistics, India.
2. Introduction to Probability book by Joseph k. Blitzstein and Jessica Hwang.
3. Introduction To Probability And Statistics For Engineers And Scientists, Fifth Edition, Sheldon M. Ross, University of Southern California, Los Angeles, USA

Course No: (DS/DSC/T/152): Database Concepts

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/T/152	DSC	Theory	02	02	30		----	----	----

Course Title of the Course: (Database Concepts):
Course Outcome (CO):

After completion of course students will be able to:
CO1: Understand the purpose and functionality of database systems.
CO 2: Model real-world scenarios using the Entity-Relationship (ER) approach.
CO3: Apply relational concepts and normalization techniques to design efficient databases.

Database Concepts	**Total Hrs: 30**
Unit-I	**10 hrs**
Database Basics, Definition and Need for Databases Traditional File Systems vs. Database Systems Applications of Databases, Database System Architecture, Data Models, Database Languages(DDL, DML, DCL), Data Abstraction and Data	

Independence, Database Users and their roles	
Unit-II	**10 hrs**
Introduction to Data Modelling, Importance and Purpose of Data Modelling, Entity-Relationship (ER) Model, Enhanced ER (EER) Model, ER to Relational Mapping, Primary key, Composite Primary key, Reference key, Foreign key, SQL	
Unit-II	**10 hrs**
Relational Model and Normalization, Relational Model Concepts, Relational Algebra (Conceptual), Query Processing, Normalization, Transaction, ACID property, states of a transaction , Distributed databases	

Books Recommended:

- "**Database System Concepts**" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan.
- "**Fundamentals of Database Systems**" by RamezElmasri and Shamkant B. Navathe.

Course No: (DS/DSC/P/176): Practical based on Foundation of Data Science -Part II

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures /Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC/P/176	DSC	Practical	02	04	60		----	----	----

Course Title of the Course (Practical based on Foundation of Data Science -Part II)
Course Outcome (CO):
After completion of course students will be able to:
CO1: Apply probability and statistical techniques to analyze data and interpret outcomes using Python.
CO2: Visualize statistical distributions and relationships using appropriate plotting tools.
CO3: Implement basic machine learning models such as regression, classification, and clustering.
CO4: Evaluate model performance using appropriate validation techniques and metrics.

Practical based on Foundation of Data Science -Part II	**Total Hrs: 60**
Unit-I	**20 hrs**
• Implementing Logistic Regression • Building Decision Tree models • Evaluating models using confusion matrix • Applying Random Forest on a dataset • Hyper parameter tuning with Grid Search CV	

Unit-II	**20 hrs**
• Dimensionality reduction using PCA • Implementing K-Means clustering • Basic Neural Network with TensorFlow / Keras • Creating a simple data pipeline	
Unit-III	**20 hrs**
• **Build and visualize a decision tree classifier** using scikit-learn. • **Perform k-means clustering** on a sample dataset and plot the results. • **Use confusion matrix and calculate classification metrics** (accuracy, precision, recall, F1-score). • **Conduct Exploratory Data Analysis (EDA)** on a real-world dataset (e.g., Titanic, Iris) • **Prepare a mini project/report**	

Books Recommended:

- Grus, J. (2019). *Data science from scratch: First principles with Python* (2nd ed.). O'Reilly Media.
- McKinney, W. (2022). *Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter* (3rd ed.). O'Reilly Media.
- Geron, A. (2019). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems* (2nd ed.). O'Reilly Media.
- VanderPlas, J. (2016). *Python data science handbook: Essential tools for working with data*. O'Reilly Media.
- Wilke, C. O. (2019). *Fundamentals of data visualization: A primer on making informative and compelling figures*. O'Reilly Media.

Course No: (DCS/DSC/P/177) Practical based on Statistics and Probability for data science

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures /Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DCS/DSC/P/177	DSC	Practical	02	04	60		----	----	----

Course Title of the Course: (Practical based on Statistics and Probability for data science):

Course Outcome (CO):

After completion of course students will be able to:

CO1: Demonstrate an ability to design and develop R and Python programs for analysis of thedata and generate the related report or results.

CO2: Demonstrate an ability to design programming on probability distribution and computed allpossible outcomes or required reports

CO3: Apply the basic Statistical and Probability measures for data science.

Practical based on Statistics and Probability for data science	**Total Hrs: 60**
Unit-I	**20 hrs**
1. Write Python/R code to conduct various Descriptive Statistics tests and Visualization by writing Python code, by considering dataset. 2. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the data set. 3. Consider50 observations from given dataset, generating random data using functions provided, likerbinom, etc. 4. Performing basic statistical computations using built-in functions of R. 5. Measures of Central Tendency: Given a sample of 50 Observations (from any dataset), use functions R or Python and calculate mean, mode, median, range, and quintile. 6. Measures of Dispersion: Calculate sd, var. 7. Measures of Shape: Create histograms of the data to visually assess the shape of the distribution and confirm the calculated skewness and kurtosis values. 8. Create different charts for visualization of given set of data. 9. Write Python code to conduct various statistical tests including a T test, an ANOVA, and regression analysis. 10. Interpret the results of your statistical analysis after conducting hypothesis testing.	
Unit-II	**20 hrs**
1. Write Python Code to create Sets and perform Set operations. 2. Write Python Code to predict the probability of Tossing Coin experiment. 3. Write Python Code to investigate the probability distributions of discrete and continuous random variables. 4. Generate and draw the cdf and pdf of a normal distribution with given values. 5. Understanding the graphical representation of Probability Mass Functions and Probability Density Functions.	
Unit-III	**20hrs**
1. Practical Introduction to various datasets that are used for various experiments. 2. Analyze the frequency distribution to identify patterns, such as such as the most frequent values, the range of values etc. 3. To Apply and explore various plotting functions on given Dataset.	

Books Recommended:

1. Rohatgi, V.K. and Saleh, A.K. Md. E. (2015). An Introduction to Probability and Statistics (3rd Edition),Wiley Series in Probability and Statistics, India.
2. Introduction to Probability book by Joseph k. Blitzstein and Jessica Hwang.
3. Introduction To Probability And Statistics For Engineers And Scientists, Fifth Edition, Sheldon M. Ross, University of Southern California, Los Angeles, USA

Course No: (DS/DSC/P/178): Practical based on Database Concepts

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/DSC /P/178	DSC	Practical	02	04	60		----	----	----

Course Title of the Course: (Practical based on Database Concepts)
Course Outcomes (COs):
After completion of course students will be able to:
CO1: Design and implement relational databases using SQL, including creating tables, defining primary/foreign keys, and inserting data.
CO2: Perform essential SQL operations such as data insertion, retrieval, modification, and deletion on structured data.
CO3: Normalize database schemas up to Third Normal Form (3NF) to eliminate redundancy and ensure data integrity.
CO4: Utilize advanced SQL features including SET operators (UNION, INTERSECT, MINUS) and pattern matching with string operators for effective data querying.
CO5: Demonstrate the ability to compare traditional file-based systems with relational databases, and apply query optimization techniques to improve performance.

Practical's based on Database Concepts	**Total Hrs: 60**
Unit-I	**20 hrs**
1. Create a database named college. Inside this database, create a table named students with the following fields: • student_id (INT, Primary Key) • name (VARCHAR(50)) • age (INT) • course (VARCHAR(30)) • admission_date (DATE) Write SQL commands to: • Create the database and table. • Insert 5 records into the students table. • Display all records. **2.** Simulate a traditional file system by creating a .txt or .csv file containing student data. Then, perform the same operation using a database table. **3.** Using the students table modify the table to add a new column email (VARCHAR (100)). **4.** Using the students table update the email of a student with student_id = 101 **5.** Using the students table delete the record of the student whose name = 'Amit'	
Unit-II	**20 hrs**
1. Create a Student table with the following fields: • RollNo (Primary Key) • Name • Department.	

2. Create a Course table and an Enrollment table. The Enrollment table should have: • RollNo (Foreign Key referencing Student) • CourseID • Grade 3. Design two tables Department(course_id, course_name, Emp_name and Employee(Emp_id, Emp_name, Emp_address) Insert at least 5 records in it. 4. Execute SET operators (UNION, INTERSECT, MINUS) on the above two tables by taking your own data. 5. Execute String operators (Percent, Underscore) on the above two tables by taking your own data.	
Unit-III	**20 hrs**
1. Create following Unnormalized Table (UNF): • Student(RollNo, Name, Courses) • Data Example: (1, 'Amit', 'Math, Physics') (2, 'Neha', 'Chemistry') 2. Convert the above table to First Normal Form (1NF). 3. Convert the 1NF table into 2NF. 4. Convert this 2NF table into 3NF 5. Demonstrate the concept of query optimization by taking your own data.	

Course No: (DS/VSC/T/150): Basics of Hardware

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures /Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/VSC-1/T/150	VSC	Theory	01	01	15	-	-	-	-

Course Title of the Course: (Basics of Hardware):

Course Outcome (CO):

After completion of course students will be able to:

CO1: Understanding the working principle of PC and its different hardware components.

CO2: Understanding the concept of installing and working of different basic I/O devices.

CO3: Resolving of troubleshoot, Hardware issues.

Basics of Hardware	**Total Hrs: 15**
Unit-I	**05 hrs**
Computer Fundamental, Types of computer, Basic component of a computer, power systems / Supply, SMPS, UPS, Transistors, Microprocessor, Switches, logic Gates.	
Unit-II	**05 hrs**
Introduction of Basic I/O system, CMOS, POST, Motherboard, RAM/ROM,	

Hard Disk Drive, Optical Drive, Keyboard, Mouse, Monitor, Printers, Scanner, Virus and Types of Viruses, Malwares, Adwares, Spywares, Phishing Attacks, etc. Prevention and Curing Virus and Spywares, Installation of Antivirus, Internet Security Tools, Updates.	
Unit-III	**05 hrs**
Operating System Installations and Procedures/Booting Procedures, Disk Management Procedure, Windows Configurations & Adding Device Drivers, Install and configure Internet, Necessary backups for the security of customer data before repairs, Working on Internet using various browsers like IE, Chrome, Firefox, Opera, etc. Explaining URL, HTTP, HTTPS, etc. Clearing Browser Cache, Use of Internet Concepts, Surfing, Mailing & Social Media, Use of identifying different Desktop Icons. My Computer, My Documents.	

Books Recommended:

- Complete PC upgrade and maintenance guide, mark spaceman's, bpb publication
- PC hardware the complete reference Craig Zacker and John Rouske, php publications.

Course No: (DS/VSC/P/176): Practical based on Basics of Hardware

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/VSC/P/176	VSC	Practical	01	02	30				

Course Title of the Course: (Practical based on Basics of Hardware):
Course Outcome (CO):
After completion of course students will be able to:
CO1: identify different parts and understanding their functions.
CO2: Apply the knowledge for software and hardware devices on PC.
CO3: Analyzing troubleshooting problems.

Practical based on Basics of Hardware	**Total Hrs: 30**
1. To check & measure various supply voltage of PC.	
2. Study of layout of motherboard & different components.	
3. Study of explain slots, bus structure, & ports with color code.	
4. Study of functioning of SMPS with o/p voltage & connector.	
5. Study of HDD interfaces.	

6. Connecting H/W components for assemble of computers.	
7. Setting up of CMOS.	
8. How to install different S/W.	
9. Study of different bios setup.	
10. Performance trouble shooting.	
11. Partition of hard disk.	
12. To study various cards used in a system (display, LAN)	
13. To remove, study & replace (D-ROM)	
14. To install printer	
15. To increase the size of RAM	
16. To install for internet network cables connector.	
17. Install mouse & keyboards.	
18. Installing OS	
19. Study of routers.	
20. Study of printer files sharing.	

Books Recommended:

- Complete pc upgrade and maintance guide, mark spacemaines, bpb publication
- PC hardware the complete reference Craig Zacker and John Rouske, php publications.

Course No: (DS/AEC/T/150): English

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures /Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DS/AEC/T/150	AEC	Theory	02	02	30		----	----	----

Course Title of the Course: (English)

Course Outcome (CO):

After completion of course students will be able to:

CO1: Analyze and produce complex written content such as reports, proposals, and academic summaries using appropriate style and tone.

CO 2: Demonstrate advanced verbal communication skills in professional settings including debates, presentations, and negotiations.

CO3: Apply critical thinking and rhetorical strategies to communicate persuasively and effectively.

English	Total Hrs: 30
Unit-I	**10 hrs**
Advanced Writing for the Workplace and Academia, Formal and Technical Report Writing, Project Proposals and Executive Summaries, Abstracts and Research Paper Writing (Basic structure), Email Etiquette and Professional Correspondence, Editing and Proofreading Techniques, Tone, Style, and Clarity in Advanced Writing.	
Unit-II	**10 hrs**
Oral Communication and Rhetorical Techniques, Advanced Presentation Skills (Persuasive & Informative), Debate and Argumentation Techniques, Negotiation and Conflict Resolution in Communication, Rhetorical Devices: Logos, Ethos, Pathos, Voice Modulation, Fluency, and Non-verbal Cues, Handling Q&A and Impromptu Speaking.	
Unit-III	**10 hrs**
Cross-Cultural and Collaborative Communication, Communication in Multicultural Environments, Global English and Cultural Sensitivity, Team Communication and Virtual Collaboration, Interpersonal Skills and Emotional Intelligence.	

Books Recommended:

- **"Business Communication: Building Critical Skills"** by Locker & Kaczmarek
- **"English for Effective Business Communication"** by Mable Chan

Semester III

Course No. (DS/DSC/T/200) Data Analytics using Power BI

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/DSC/T/200	DSC	Theory	2	2	30		----	----	----

Title of the Course (DS/DSC/T/200) Data Analytics using Power BI

Learning Objectives of the Course

LO1: Explain the concepts of Data Analytics, types of analytics, Business Intelligence, and their significance in business decision-making.

LO2: Describe data preprocessing, data modelling techniques, relationships between tables, and schema designs used in Power BI.

LO3: Understand DAX concepts, calculated columns, measures, and data aggregation techniques for analytical reporting.

Course Outcomes (COs) :

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

CO1: Explain the fundamental concepts of Data Analytics, Business Intelligence, and various types of analytics used in business decision-making.

CO2: Describe data preprocessing techniques, data modeling concepts, table relationships, and schema designs used in analytical systems.

CO3: Apply DAX concepts, calculated measures, and data aggregation techniques to derive meaningful insights from data.

Data Analytics using Power BI	Total Hrs: 30
Unit-I	10 hrs
Fundamentals of Data Analytics Concept of Data Analytics Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Role of Data Analytics in Business Decision Making Introduction to Business Intelligence Concept of Business Intelligence (BI), BI vs Data Analytics Components of BI Systems	
Unit-II	10 hrs

Overview and Features of Microsoft Power BI Components of Power BI: Power BI Desktop, Power BI Service,Power BI Mobile. Installation and Interface of Power BI Desktop Data Sources and Data Import: Connecting Power BI to various data sources Importing data from Excel, CSV, databases Data loading and preview	
Unit-III :	10 hrs
Data Cleaning and Transformation Data pre-processing concepts: Using Power Query Editor in Microsoft Power BI, Handling missing values, Removing duplicates, Data formatting and transformation Data Modeling: Concept of Data Model,Tables, Relationships, and Keys, Creating relationships between tables, Star Schema and Snowflake Schema DAX (Data Analysis Expressions) Introduction to DAX, Calculated Columns and Measures, Basic DAX functions:SUM, COUNT, AVERAGE, IF, FILTER Data Aggregation and Calculations Creating calculated fields, Data grouping and summarization	

Books Recommended:

1. Brian Larson (2020),Data Analysis with Microsoft Power BI by McGraw-Hill Education
2. Dan Clark, (2020). Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics. Apress.
3. Brett Powell (2018). Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence. Packt Publishing Ltd.

Additional Reference:

4. Ferrari, A., & Russo, M. (2019). The Definitive Guide to DAX: Business intelligence for Microsoft Power BI, SQL Server Analysis Services, and Excel. Microsoft Press.

Course No. (DS/DSC/P/226) Practical based on Data Analytics using Power BI

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/DSC/P/226**	DSC	Practical	2	4	60		----	----	----

Title of the Course (DS/DSC/P/226) Data Analytics using Power BI

Learning Objectives of the Course

LO1: Connect Microsoft Power BI to various data sources and import datasets from Excel, CSV files, and databases.

LO2: Perform data cleaning, transformation, and data modeling using Power Query Editor and relationship management features in Power BI.

LO3: Create calculated columns, measures, and summarized reports using DAX functions and data aggregation techniques in Power BI.

Course Outcomes (COs) :

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

CO1: Connect Power BI to multiple data sources and import datasets for analysis.

CO2: Perform data cleaning, transformation, and modeling using Power Query Editor and relationship management tools in Power BI.

CO3: Develop analytical reports and dashboards by creating calculated columns, measures, and visualizations using DAX functions and aggregation techniques.

Practical based on Data Analytics using Power BI	Total Hrs: 60
Unit-I	
1. **Installation and Interface Exploration** Install Microsoft Power BI Desktop and explore Home, Data, Model, and Report views. 2. **Importing Data from Excel** Import an Excel dataset into Power BI and examine the data preview and loading process. 3. **Importing Data from CSV Files** Load a CSV dataset into Power BI and configure data import settings. 4. **Data Cleaning – Removing Duplicates** Identify and remove duplicate records using Power Query Editor. 5. **Data Transformation**	

	Change data types, rename columns, and split a column into multiple columns	
Unit-II		
6.	**Handling Missing Values** Detect and handle null or missing values using appropriate transformation techniques.	
7.	**Data Filtering and Sorting** Apply filters and sorting operations on datasets to prepare data for analysis.	
8.	**Grouping and Aggregation** Group data by categories and perform aggregation operations such as sum, count, and average.	
9.	**Merging and Appending Tables** Merge multiple tables and append datasets using Power Query Editor.	
10.	**Data Modeling and Relationships** Create relationships between tables and design a simple star schema model.	
Unit-III :		
11.	**Creating Basic Visualizations** Develop bar charts, line charts, pie charts, and table visualizations from a given dataset.	
12.	**Interactive Reporting** Apply filters, slicers, and drill-down features to create interactive reports.	
13.	**DAX Calculated Columns** Create calculated columns using DAX expressions for derived business metrics**.**	
14.	**DAX Measures and Aggregations** Create measures using DAX functions such as SUM(), COUNT(), AVERAGE(), IF(), and FILTER().	
15.	**Dashboard Publishing and Sharing** Publish reports to Power BI Service, create dashboards, share reports, export to PDF/PowerPoint, and connect to a live data source for real-time analytics.	

Books Recommended:

1. Brian Larson (2020),Data Analysis with Microsoft Power BI by McGraw-Hill Education

2. Dan Clark, (2020). Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics. Apress.
3. Brett Powell (2018). Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence. Packt Publishing Ltd.

Additional Reference:

4. Ferrari, A., & Russo, M. (2019). The Definitive Guide to DAX: Business intelligence for Microsoft Power BI, SQL Server Analysis Services, and Excel. Microsoft Press.

Course No. (DS/DSC/T/201) RDBMS

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/DSC/T/201	DSC	Theory	2	2	30		----	----	----

Title of the Course (DS/DSC/T/201) RDBMS

Learning Objectives of the Course

LO1: To introduce fundamental concepts of Database Management Systems (DBMS) including database architecture, components, and database users.

LO2: To develop skills in SQL and PL/SQL programming including queries, aggregate functions, triggers, procedures, cursors, and exception handling.

LO3: To understand advanced database concepts such as indexing techniques, concurrency control, deadlock handling, and database recovery mechanisms.

Course Outcomes (COs) :

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

CO1: Understand the basic concepts of databases, Database Management Systems (DBMS), and the role of database users and administrators.

CO2: Apply SQL queries and functions to create, manipulate, and retrieve data from relational databases.

CO3: Develop database programs using PL/SQL constructs such as triggers, stored procedures, functions, cursors, and exception handling.

CO4: Analyze different storage structures and indexing techniques such as B-tree, B+ tree, and hashing for efficient data retrieval.

RDBMS	Total Hrs: 30
Unit-I	10 hrs
Introduction to Data and Databases , Database Management System (DBMS): Definition and Advantages , Components of a DBMS , Database Users and Database Administrator (DBA) **SQL:** Implementation of aggregate functions, string functions, set operations	
Unit-II	10 hrs
PL/ SQL : Triggers , Stored procedures , Functions , Cursors , and Exception Handling **Storage and Indexing :** File Organization , indexing techniques , (B+ Tree , B tree) , Hashing , and query optimization	
Unit-III :	10 hrs
Concurrency Control: Need of concurrency; Types of locking: Shared lock and Exclusive Lock; Two Phase Locking Protocol; Timestamp based Protocol; Deadlock; Database Recovery: Log Based Recovery; Immediate Database Modification; Deferred database modification; Shadow Paging	

Books Recommended:

1. **Database System Concepts –** Abraham Silberschatz
2. **Fundamentals of Database Systems –** Elmasri & Navathe
3. **SQL: The Complete Reference –** James Groff

Course No. (DS/DSC/P/227) Practical based on RDBMS

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/DSC/P/227**	DSC	Practical	2	4	60		----	----	----

Title of the Course (DS/DSC/P/227) RDBMS

Learning Objectives of the Course:
LO1: Understand the creation, modification, and management of relational database objects

using SQL commands and constraints.

LO2: Develop database programs using PL/SQL constructs such as procedures, functions, triggers, cursors, and exception handling.

LO3: Explore database performance, security, and transaction management techniques for efficient and reliable database operations.

Course Outcomes (COs) :

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

CO1: Create and manipulate databases, tables, and records using SQL DDL, DML, query processing, and aggregate functions.

CO2: Implement PL/SQL-based database applications using blocks, procedures, functions, triggers, cursors, and exception handling mechanisms.

CO3: Apply indexing, transaction management, concurrency control, views, joins, and recovery techniques to optimize and secure database systems.

Practical based on RDBMS	Total Hrs: 60
Unit-I	
Practical 1: Creating and Managing Database • Create a new database. • Create tables with appropriate data types. • Define Primary Key and NOT NULL constraints. • Display structure of tables. **Practical 2: Working with SQL DDL Commands** • Use CREATE, ALTER, and DROP commands. • Add new columns to a table. • Modify existing columns. • Delete table structures. **Practical 3: Data Manipulation Operations** • Insert records using INSERT. • Update records using UPDATE. • Delete records using DELETE. • Retrieve data using SELECT. **Practical 4: Working with SQL Queries for Aggregate Functions** • Use WHERE, ORDER BY, GROUP BY, and HAVING clauses. • Apply aggregate functions (SUM, AVG, COUNT, MAX, MIN). **Practical 5: Working with SQL Queries for SET operations**	

• Apply SET operations (Union, Minus, Intersect)	
Unit-II	
Practical 6: Working with SQL Queries for String Functions • Apply String operations (Percent (%) , Underscore (_)) **Practical 7: Implementing PL/SQL Blocks** • Write simple PL/SQL programs. • Use variables and control structures. • Display results using DBMS_OUTPUT. **Practical 8: Stored Procedures and Functions** • Create Stored Procedures. • Create User Defined Functions. • Execute procedures and functions with parameters. **Practical 9: Triggers in PL/SQL** • Create BEFORE INSERT trigger. • Create AFTER UPDATE trigger. • Demonstrate automatic execution of triggers. **Practical 10: Working with Cursors and Exception Handling** • Implement Explicit and Implicit Cursors. • Handle exceptions using EXCEPTION blocks. • Display error messages.	
Unit-III :	
Practical 11: Indexing and Query Optimization • Create Indexes on tables. • Study performance improvement using indexing. • Demonstrate B-tree indexing concept. **Practical 12: Transaction Management and Concurrency** • Demonstrate COMMIT, ROLLBACK, and SAVEPOINT. • Simulate concurrent transactions. • Observe locking mechanisms and possible deadlocks. • Demonstrate basic database recovery concepts. **Practical 13: Working with Views and Data Security** • Create Simple and Complex Views. • Perform operations on Views. • Implement Read-Only Views.	

• Study data abstraction and security using Views. **Practical 14: Database Joins and Subqueries** • Implement Inner Join, Left Join, Right Join, and Full Outer Join. • Write Nested and Correlated Subqueries. • Retrieve data from multiple related tables. • Compare Join operations with Subqueries. **Practical 15: Mini Database Application** • Design and implement a database application (Library Management, Student Management, Inventory Management, etc.). • Create tables, relationships, procedures, and triggers. • Perform transaction management and reporting. • Demonstrate complete database lifecycle operations using SQL and PL/SQL.	

Books Recommended:

1. **Database System Concepts –** Abraham Silberschatz
2. **Fundamentals of Database Systems –** Elmasri & Navathe
3. **SQL: The Complete Reference –** James Groff

Course No. (DS/Mn-1/T/200) Python

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/Mn-1/T/200	Mn	Theory	1	1	15		----	----	----

Title of the Course (DS/Mn-1/T/200) Python

Learning Objectives of the Course

LO1: Understand the fundamentals of Python programming, including syntax, data types, operators, control structures, strings, and built-in data structures.

LO2: Develop modular Python programs using functions, recursion, modules, packages, and object-oriented programming concepts.

LO3: Apply file handling, exception handling, and basic Python libraries to create efficient

solutions for computational and data-processing tasks.

Course Outcomes (COs) :

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

CO1: Write Python programs utilizing variables, operators, strings, control statements, and data structures to solve basic computational problems.

CO2: Design and implement Python applications using functions, modules, packages, classes, objects, inheritance, and polymorphism.

CO3: Develop robust Python programs incorporating file handling, exception handling, and basic data analysis using NumPy and Pandas libraries.

	Total Hrs: 15
Unit-I	5 hrs
Introduction to Python Programming Introduction to Python and its features Installation and Python IDEs Variables, Data Types, and Operators Input and Output Functions Conditional Statements (if, if-else, nested if) Looping Statements (for, while) Control Statements (break, continue, pass)	
Unit-II	5 hrs
Strings and String Operations Lists, Tuples, Sets, and Dictionaries List Comprehensions Functions: User-defined Functions Function Arguments and Return Values Recursive Functions Modules and Packages	
Unit-III :	5 hrs
File Handling (Read, Write, Append) Exception Handling Classes and Objects Constructors and Methods Inheritance and Polymorphism Introduction to Python Libraries (NumPy, Pandas – Basic Concepts)	

Books Recommended:

1. **Reema Thareja**, *Python Programming: Using Problem Solving Approach*, Oxford University Press.
2. **Paul Deitel and Harvey Deitel**, *Python for Programmers*, Pearson Education.
3. **Y. Daniel Liang**, *Introduction to Programming Using Python*, Pearson Education

Course No. (DS/Mn-1/P/200) Practical based on Python

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/Mn-1/P/226**	Mn	Practical	1	2	30		----	----	----

Title of the Course (DS/Mn-1/P/226) Practical based on Python

Learning Objectives of the Course

LO1: Understand the fundamental concepts of Python programming, including variables, operators, control structures, strings, and data structures.

LO2: Develop modular and object-oriented Python programs using functions, modules, classes, inheritance, and exception handling.

LO3: Apply file handling and Python libraries to solve computational and data-processing problems.

Course Outcomes (COs) :

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

CO1: Write and execute Python programs using control statements, strings, and built-in data structures to solve basic programming problems.

CO2: Design and implement Python applications using functions, modules, classes, objects, inheritance, and polymorphism.

CO3: Develop reliable Python programs incorporating file handling, exception handling, and basic data analysis using NumPy and Pandas.

Practical based on Python	Total Hrs: 30
Unit-I	
Practical 1: Introduction to Python • Write a Python program to display **"Hello, World!"** and demonstrate the use of print statements. **Practical 2: Variables and Operators**	

• Write a Python program to perform arithmetic, relational, and logical operations on user-input values. **Practical 3: Input and Output Operations** • Write a Python program to accept student details and display them in a formatted manner. **Practical 4: Decision Making Statements** • Write a Python program to find the largest of three numbers using if-else statements. **Practical 5: Looping Statements** • Write a Python program to generate multiplication tables using for and while loops.	
Unit-II	
Practical 6: String Operations • Write a Python program to perform string operations such as concatenation, slicing, length calculation, and case conversion. **Practical 7: Lists, Tuples, Sets, and Dictionaries** • Write a Python program to demonstrate creation and manipulation of lists, tuples, sets, and dictionaries. **Practical 8: List Comprehensions** • Write a Python program to generate squares of numbers and filter even numbers using list comprehensions. **Practical 9: User-Defined Functions** • Write a Python program to create user-defined functions for arithmetic operations and demonstrate function arguments and return values. **Practical 10: Recursive Functions** • Write a Python program to calculate the factorial and Fibonacci series using recursion.	
Unit-III :	
Practical 11: Modules and Packages • Create a user-defined module containing mathematical functions and import it into another Python program. **Practical 12: File Handling** • Write a Python program to create, write, read, and append data to a text file. **Practical 13: Exception Handling** • Write a Python program to demonstrate exception handling using try, except, else, and finally blocks. **Practical 14: Classes and Objects** • Write a Python program to create a Student class with constructors and methods to display student information. **Practical 15: Inheritance, Polymorphism, and Python Libraries**	

• Write a Python program to demonstrate inheritance and polymorphism. • Perform basic array operations using NumPy and create a simple DataFrame using Pandas.	

Books Recommended:

1. **Reema Thareja**, *Python Programming: Using Problem Solving Approach*, Oxford University Press.
2. **Paul Deitel and Harvey Deitel**, *Python for Programmers*, Pearson Education.
3. **Y. Daniel Liang**, *Introduction to Programming Using Python*, Pearson Education

Course No. (DS/Mn-2/T/201) Core Java

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/Mn-1/T/201	Mn	Theory	1	1	15		----	----	----

Title of the Course (DS/Mn-2/T/201) Core Java

Learning Objectives of the Course
LO1: To understand the fundamentals of Java programming language.
LO2: To learn object-oriented programming concepts in Java.
LO3: To develop simple Java programs using control structures and arrays.
LO4: To understand basic input/output and string handling in Java.

Course Outcomes (COs) :
After completion of the course, students will be able to –
CO1: Understand Java programming fundamentals
CO2: Understand the program structure, data types, operators, and control statements.
CO3: Apply object-oriented programming concepts such as classes, objects, constructors, methods, and inheritance to develop simple Java programs

Core Java	Total Hrs: 15
Unit-I	5 hrs

Introduction to Java and Basic Programming Concepts: Introduction to Java, history and features of Java, Java platform and editions, JVM architecture, JDK and JRE, structure of Java program, compiling and executing Java programs, data types, variables and constants, type casting, operators (arithmetic, relational, logical, assignment, unary), decision making statements (if, if-else, nested if, switch), looping statements (for, while, do-while), break and continue statements.	
Unit-II	5 hrs
Arrays and Object-Oriented Programming Concepts: Arrays in Java, one-dimensional arrays, two-dimensional arrays, command line arguments, introduction to classes and objects, creating classes and objects, constructors, method definition and method calling, method overloading, basic concepts of inheritance, use of this keyword, introduction to packages and access modifiers	
Unit-III :	5 hrs
String Handling and Basic Input/Output : Introduction to String class, creating and manipulating strings, string methods, StringBuffer and StringBuilder basics, basic input using Scanner class, formatted output, introduction to exception handling (try, catch, finally), basic file handling concepts, simple Java applications.	

Books Recommended:

1. "Programming with Java: A Primer" by E. Balagurusamy.
2. "Core Java Volume I -- Fundamentals" by Cay S. Horstmann and Gary Cornell, published by Pearson Education India.
3. "Java: The Complete Reference" by Herbert Schildt, published by McGraw Hill Education India.

Course No. (DS/Mn-2/P/226) Practical based on Core Java

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/Mn-2/P/227**	Mn	Practical	1	2	30		----	----	----

Title of the Course (DS/Mn-2/P/227) Practical based on Core Java

Learning Objectives of the Course

LO1: Understand the fundamentals of Java programming, including program structure, data types, operators, control statements, arrays, and user input handling.

LO2: Develop Java programs using object-oriented programming concepts such as classes, objects, constructors, inheritance, and method overloading.

LO3: Apply Java programming techniques for string manipulation, exception handling, and problem-solving through structured program development.

Course Outcomes (COs) :

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

CO1: Write, compile, and execute Java programs using control structures, arrays, methods, and input/output operations.

CO2: Design and implement object-oriented Java applications utilizing classes, objects, constructors, inheritance, method overloading, and the this keyword.

CO3: Develop robust Java programs incorporating string handling, exception handling, and user interaction to solve computational problems effectively.

Practical based on Core Java	Total Hrs: 30
Unit-I	
1. Write a Java program to display "Hello World" and demonstrate the basic structure of a Java program. 2. Write a Java program to perform arithmetic operations (addition, subtraction, multiplication, division) using command line arguments. 3. Write a Java program to demonstrate decision making statements using if–else to find the largest of three numbers. 4. Write a Java program to demonstrate the use of switch statement to perform simple calculator operations. 5. Write a Java program to demonstrate looping statements by printing numbers from 1 to 10 using for, while, and do-while loops.	
Unit-II	
6. Write a Java program to create and display one-dimensional array elements and calculate their sum and average. 7. Write a Java program to perform matrix addition using two-dimensional arrays. 8. Write a Java program to demonstrate the use of classes and objects by creating a class for student details. 9. Write a Java program to demonstrate the use of constructors for initializing object values.	

10. Write a Java program to demonstrate method overloading for performing different arithmetic operations.	
Unit-III :	
11. Write a Java program to demonstrate inheritance by creating a base class and derived class. 12. Write a Java program to demonstrate the use of this keyword in Java. 13. Write a Java program to demonstrate string handling methods such as length(), substring(), and toUpperCase(). 14. Write a Java program to take input from the user using the Scanner class and display the result. 15. Write a Java program to demonstrate basic exception handling using try, catch, and finally.	

Books Recommended:

1. "Programming with Java: A Primer" by E. Balagurusamy.
2. "Core Java Volume I -- Fundamentals" by Cay S. Horstmann and Gary Cornell, published by Pearson Education India.
3. "Java: The Complete Reference" by Herbert Schildt, published by McGraw Hill Education India.

Course No. (DS/VSC/T/200) Advance Computer Hardware

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/VSC/T/200	VSC	Theory	1	1	15		----	----	----

Title of the Course (DS/VSC/T/200) Advance Computer Hardware

Learning Objectives of the Course

LO1: Understand the architecture, components, and emerging trends in advanced computer hardware systems.

LO2: Explain the principles, organization, and applications of microprocessors and microcontrollers in computing and embedded systems.

LO3: Analyze the concepts of parallel processing and evaluate its role in enhancing computing performance and efficiency.

Course Outcomes (COs) :

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

CO1: Design and Analyze advance hardware system.

CO2: Implement different operations for 8086 microprocessors.

CO3: Understand Parallel Processing Architecture.

Advance Computer Hardware	Total Hrs: 15
Unit-I	5 hrs
Introduction to Advance Hardware, Overview of Advance Hardware: Trends, Design, Methodologies and Tools, Introduction to Microprocessors, Instruction Sets and Instruction Sequencing	
Unit-II	5hrs
Processor System, Memory System, Input/Output System, Input/Output Interface, Bus Architecture.	
Unit-III :	5 hrs
Overview of 8086 Microprocessor, Microcontrollers, Parallel Processing, Multi-cores, Multiprocessors, SIMD and MIMD Architecture.	

Books Recommended:

1. Digital Design, 5th Edition by M. Morris Mano and Michael Ciletti
2. 8086 microprocessor book by Bharat Acharya
3. Computer Organization and embedded system 6th edition by Carl Hamacher , McGrawhill Higher Education.
4. Computer Organization and Design, the hardware software interface 5th edition by Devid A. Paeerterson and John L. Hennessy, Elsevier

Course No. (DS/VSC/P/226) Practical based on Advance Computer Hardware

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/DSC/P/226**	DSC	Practical	1	2	30		----	----	----

Title of the Course (DS/VSC/P/226) Practical based on Advance Computer Hardware

Learning Objectives of the Course
LO1: To understand the 8086 microprocessor and used of microcontrollers
LO2: Implement basic operations of 8086 microprocessors.
LO3: Use of Parallel Processing.

Course Outcomes (COs) :
After completion of the course, students will be able to -
CO1: Write and execute assembly language programs to perform arithmetic, data transfer, and decision-making operations.

CO2: Analyze and implement algorithms for numerical computations and data processing using microprocessors.

CO3: Design and develop basic embedded system applications using microcontrollers and peripheral interfacing techniques.

Practical based on Advance Computer Hardware	Total Hrs: 30
Unit-I	
Practical 1: Addition of 8-bit Numbers • Write an assembly language program to perform addition of two 8-bit numbers. **Practical 2: Addition of 16-bit Numbers** • Write an assembly language program to perform addition of two 16-bit numbers. **Practical 3: Subtraction of 8-bit Numbers** • Write an assembly language program to perform subtraction of two 8-bit numbers. **Practical 4: Subtraction of 16-bit Numbers** • Write an assembly language program to perform subtraction of two 16-bit numbers. **Practical 5: Multiplication of 8-bit Numbers** • Write an assembly language program to multiply two 8-bit numbers.	
Unit-II	
Practical 6: Division of 8-bit Numbers • Write an assembly language program to divide one 8-bit number by another 8-bit number. **Practical 7: Finding the Largest Number** • Write a program to find the largest number among a given set of numbers. **Practical 8: Finding the Smallest Number** • Write a program to find the smallest number among a given set of numbers. **Practical 9: Sum of Series of N Numbers** • Write a program to calculate the sum of the first N natural numbers. **Practical 10: Factorial of a Number** • Write a program to find the factorial of a given number.	
Unit-III :	

Practical 11: Number Series Generation • Write a program to generate Fibonacci series up to N terms. **Practical 12: Data Transfer Operations** • Write a program to demonstrate data transfer between memory locations and registers. **Practical 13: LED Interfacing Using Microcontroller** • Interface LEDs with a microcontroller and demonstrate blinking patterns. **Practical 14: Switch/Keypad Interfacing Using Microcontroller** • Interface switches or a keypad with a microcontroller and display the input status. **Practical 15: Microcontroller-Based Mini Project** • Design and implement a mini project using a microcontroller, such as: o Traffic Light Controller o Digital Counter o Temperature Monitoring System	

Books Recommended:

1. Digital Design, 5th Edition by M. Morris Mano and Michael Ciletti
2. 8086 microprocessor book by Bharat Acharya
3. Computer Organization and embedded system 6th edition by Carl Hamacher , McGrawhill Higher Education.
4. Computer Organization and Design, the hardware software interface 5th edition by Devid A. Paeerterson and John L. Hennessy, Elsevier

Semester IV

Course No. (DS/DSC/T/250) Data Visualization

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/DSC/T/200	DSC-1	Theory	2	2	30		----	----	----

Title of the Course (DS/DSC/T/250) Data Visualization

Learning Objectives of the Course:

LO1: Explain the concepts, methods, tools, and chart types used in data visualization.

LO2: Understand cognitive and perceptual principles, visual ethics, and design practices for

creating effective visualizations.

LO3: Develop and evaluate exploratory and explanatory visualizations to communicate data-driven insights and support decision-making.

Course Outcomes (COs) :

After completion of the course, students will be able to -
CO1: Understand foundational visualization concepts
CO2: Demonstrate visualizations principles to enhance data visualization
CO3: Analyse and apply essential design principles to data exploration and visualization
CO4: Design appropriate charts, tables, maps and dashboards
CO5: Effectively create and tell a story based on visualized data

Data Visualization	Total Hrs: 30
Unit-I	10 hrs
Introduction to data visualization, Need for data visualization and its definition-Tools for Visualizing Data, Methods of visualizing data, Overview of modern visualization tools, working with various data formats, Basic chart types	
Unit-II	10 hrs
The Human Brain and Data Visualization, Cognitive vs Perceptual Design Distinction, Introduction of Effective and Ineffective Visuals, Types of Visualizations and its examples, Practicing Good Ethics in Data Visualization, Ineffective Visuals and improvements, Visual Perception and Cognitive Principles, Strategic Use of Pre-Attentive Attributes, De-Cluttering.	
Unit-III :	10 hrs
Exploratory and Explanatory Analysis, Identifying Outliers, Constructing a Control Chart, Design For Purpose, Data, Relationships, and Design, Static Versus Interactive Visualizations, Multiple, Connected View, Language, Labelling, and Scales, Visual Lies and Cognitive Bias, Case Study.	

Books Recommended:

1. Colin Ware and Kaufman M, Visual thinking for design‖, Morgan Kaufmann Publishers, 2008
2. Ben Fry, "Visualizing data", O'Reily,2007
3. Chakrabarti, S, —Mining the web: Discovering knowledge from hypertext data —, Morgan Kaufman Publishers, 2003

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.coursera.org/learn/data-visualizationtableau?specialization=data-visualization
2. Essential Design Principles for Tableau: https://www.coursera.org/learn/dataviz-design?specialization=data-visualization
3. Visual Analytics with Tableau :

https://www.coursera.org/learn/datavizvisual-analytics?specialization=data-visualization

4. Creating Dashboards and Storytelling with Tableau: https://www.coursera.org/learn/dataviz-dashboards?specialization=datavisualization
5. Data Visualization with Tableau Project: https://www.coursera.org/learn/dataviz-project
6. Data Visualization with Tableau Specialization:

https://www.coursera.org/specializations/data-visualization

Course No. (DS/DSC/P/276) Practical based on Data Visualization

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/DSC/P/276**	DSC	Practical	2	4	60		----	----	----

Title of the Course (DS/DSC/P/276) Practical based on Data Visualization

Learning Objectives of the Course

LO1: Understand the fundamental concepts, tools, and techniques of data visualization for representing different types of data.

LO2: Analyze and apply visual design principles, cognitive concepts, and ethical practices to create effective visualizations.

LO3: Develop exploratory and explanatory visualizations to identify patterns, trends, outliers, and relationships in datasets.

Course Outcomes (COs) :

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

CO1: Create a variety of charts and visual representations using modern data visualization tools and datasets.

CO2: Design effective visualizations by applying perceptual, cognitive, and ethical principles of visual communication.

CO3: Analyze data through interactive and exploratory visualizations to derive insights and support decision-making.

Practical based on Data Visualization	Total Hrs: 60
Unit-I	
Practical 1: Introduction to Data Visualization Tools • Install and explore a data visualization tool (Tableau Public / Power BI / Python Matplotlib). **Practical 2: Working with Different Data Formats** • Import and visualize data from CSV, Excel, and JSON files. **Practical 3: Creating Basic Bar Charts** • Create bar charts to compare categorical data. **Practical 4: Creating Line Charts** • Visualize trends over time using line charts. **Practical 5: Creating Pie Charts and Donut Charts** • Represent proportional data using pie and donut charts.	
Unit-II	
Practical 6: Creating Histograms • Analyze frequency distribution of numerical data using histograms. **Practical 7: Scatter Plot Visualization** • Create scatter plots to study relationships between variables. **Practical 8: Box Plot for Outlier Detection** • Identify outliers and data spread using box plots. **Practical 9: Comparative Visualization Design** • Create effective and ineffective visualizations and compare their impact. **Practical 10: Applying Visual Design Principles** • Improve existing visualizations using color, labeling, and decluttering techniques.	
Unit-III :	
Practical 11: Dashboard Creation • Design a simple dashboard integrating multiple visualizations. **Practical 12: Exploratory Data Analysis (EDA)** • Perform exploratory analysis to discover patterns and trends in a dataset. **Practical 13: Constructing a Control Chart** • Create a control chart and interpret process variations. **Practical 14: Interactive Visualization** • Develop interactive visualizations using filters, slicers, or tooltips. **Practical 15: Case Study on Data Visualization** • Analyze a real-world dataset and prepare an explanatory report with appropriate visualizations and insights.	

Books Recommended:

1. Colin Ware and Kaufman M, Visual thinking for design‖, Morgan Kaufmann Publishers, 2008
2. Ben Fry, "Visualizing data", O'Reily,2007
3. Chakrabarti, S, —Mining the web: Discovering knowledge from hypertext data —, Morgan Kaufman Publishers, 2003

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

4. https://www.coursera.org/learn/data-visualizationtableau?specialization=data-visualization
5. Essential Design Principles for Tableau: https://www.coursera.org/learn/dataviz-design?specialization=data-visualization
6. Visual Analytics with Tableau : https://www.coursera.org/learn/datavizvisual-analytics?specialization=data-visualization
7. Creating Dashboards and Storytelling with Tableau: https://www.coursera.org/learn/dataviz-dashboards?specialization=datavisualization
8. Data Visualization with Tableau Project: https://www.coursera.org/learn/dataviz-project
9. Data Visualization with Tableau Specialization: https://www.coursera.org/specializations/data-visualization

Course No. (DS/DSC/T/251) Software Engineering

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/DSC/T/251	DSC	Theory	2	2	30		----	----	----

Title of the Course (DS/DSC/T/251) Software Engineering

Learning Objectives of the Course

LO1: Understand fundamental concepts of Software Engineering, including SDLC models, software processes, and development methodologies.

LO2: Analyze and document software requirements by preparing basic SRS documents.
LO3: Apply software design and testing principles to develop reliable, maintainable, and efficient software systems.
LO4: Demonstrate the use of version control and project management techniques for collaborative software development, especially in Data Science projects

Course Outcomes (COs) :

After completion of the course, students will be able to -
CO1: Understand basic principles of software engineering.
CO2: Explain SDLC models and choose appropriate model.
CO3: Prepare simple SRS.
CO4: Apply basic testing techniques.
CO5: Understand version control and project management basics

Software Engineering	Total Hrs: 30
Unit-I	10 hrs
Introduction to Software Engineering & SDLC: Definition of Software Engineering, Need of Software Engineering, Software vs Hardware, Characteristics of Good Software, Software Crisis Software Development Life Cycle (SDLC): Phases of SDLC, SDLC Models-Waterfall Model, Iterative Model, Spiral Model, RAD Model , Agile Model Software Requirements and Analysis: System Engineering, Product Engineering: Characteristics of a Good SRS, Requirement analysis, Principal, Software prototyping, Specification and its review. Analysis modeling: data modeling, mechanics for structured analysis, system analysis tools and techniques, Data Flow Diagram, ER- Diagrams. Data Dictionary.	
Unit-II	10 hrs
The Design Process, Design Concepts, Design Model. Architectural Design: Software Architecture, Architectural Genres, Architectural Styles Architectural Design, Assessing Alternative Architectural Designs. Component Level Design: Designing Class-Based Components, Conducting Component-Level Design, Cohesion and Coupling. User Interface Design: The Golden Rules, Interface Analysis and Design, Interface Analysis Interface Design Steps	
Unit-III :	10 hrs
Testing, Maintenance & Project Management: Software Testing, Importance of Testing, Types of Testing: Black Box Testing, White Box Testing , Unit Testing, Integration Testing, System Testing, Acceptance Testing, Software Maintenance: Types of Maintenance, Version Control & Collaboration, Software Project Management: Project Planning, Cost Estimation, Risk Management, Gantt Chart, Team Roles in Software Project	

Books Recommended:

1. "Fundamentals of Software Engineering" - Rajib Mall, PHI Learning.

2. "Software Engineering" - K.K. Aggarwal, Yogesh Singh, New Age International Publishers
3. "Introduction to Software Engineering" - R. S. Pressman, McGraw Hill.
4. "An Integrated Approach to Software Engineering", Pankaj Jalote, Narosa Publishing.

Course No. (DS/DSC/P/277) Practical based on Software Engineering

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/DSC/P/277**	DSC	Practical	2	4	60		----	----	----

Title of the Course (DS/DSC/P/277) Practical based on Software Engineering

Learning Objectives of the Course

LO1: Understand software engineering principles, software development life cycle (SDLC) models, and requirement engineering processes used in software development.

LO2: Analyze and design software systems using modeling techniques, architectural design principles, component-level design, and user interface design methodologies.

LO3: Apply software testing, maintenance, version control, and project management techniques to develop and manage quality software systems.

Course Outcomes (COs) :

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

CO1: Analyze software requirements and prepare software design artifacts such as SRS, DFDs, ER diagrams, and data dictionaries.

CO2: Design software architectures, components, and user interfaces by applying software engineering principles and design methodologies.

CO3: Perform software testing, maintenance, and project management activities to ensure software quality and successful project execution.

Practical based on Software Engineering	Total Hrs: 60
Unit-I	
Practical 1: Study of Software Development Life Cycle Models	

• Compare Waterfall, Iterative, Spiral, RAD, and Agile models using a case study. **Practical 2: Software Requirement Specification (SRS)** • Prepare an SRS document for a Library Management System or Student Management System. **Practical 3: Requirement Analysis** • Identify functional and non-functional requirements for a software application. **Practical 4: Software Prototyping** • Create a low-fidelity prototype for a selected software application. **Practical 5: Data Flow Diagram (DFD)** • Draw Context Level and Level-1 DFD for a real-world system.	
Unit-II	
Practical 6: Entity Relationship Diagram (ER Diagram) • Design an ER diagram for a Library, Hospital, or Banking System. **Practical 7: Data Dictionary Preparation** • Create a data dictionary corresponding to the DFD and ER model. **Practical 8: Architectural Design** • Design software architecture using Layered Architecture or Client-Server Architecture. **Practical 9: Component-Level Design** • Identify software components and analyze cohesion and coupling in a sample application. **Practical 10: User Interface Design** • Design user interfaces for a web or desktop application following UI design principles.	
Unit-III :	
Practical 11: Interface Evaluation • Analyze an existing application's interface and suggest improvements based on the Golden Rules of UI Design. **Practical 12: Software Testing Techniques** • Prepare test cases using Black Box Testing techniques (Boundary Value Analysis and Equivalence Partitioning). **Practical 13: White Box Testing** • Perform White Box Testing and draw a Control Flow Graph for a given program. **Practical 14: Project Planning and Estimation** • Prepare a project plan including effort estimation, cost estimation, Gantt chart, and risk analysis. **Practical 15: Version Control and Mini Project Documentation**	

• Use Git for version control and prepare complete software engineering documentation including SRS, DFD, ER Diagram, Architecture Design, Test Cases, and Project Plan for a mini project.	

Books Recommended:

1. "Fundamentals of Software Engineering" - Rajib Mall, PHI Learning.
2. "Software Engineering" - K.K. Aggarwal, Yogesh Singh, New Age International Publishers
3. "Introduction to Software Engineering" - R. S. Pressman, McGraw Hill.
4. "An Integrated Approach to Software Engineering", Pankaj Jalote, Narosa Publishing.

Course No. (DS/Mn-1/T/250) Advance Python

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/Mn-1/T/200	Mn	Theory	1	1	15		----	----	----

Title of the Course (DS/Mn-1/T/200) Advance Python

Learning Objectives of the Course:

LO1: Understand advanced Python programming constructs, data structures, and functional programming techniques.

LO2: Analyze and implement advanced object-oriented programming concepts, exception handling, and database applications.

LO3: Develop Python-based GUI, multithreaded, and web applications using modern Python libraries and frameworks.

Course Outcomes (COs) :

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

CO1: Apply advanced Python programming techniques including generators, decorators, regular expressions, and functional programming concepts.

CO2: Design and implement object-oriented applications with database connectivity and robust exception handling mechanisms.

CO3: Develop GUI, multithreaded, and web-based applications using Python frameworks and libraries

Advance Python	Total Hrs: 30
Unit-I	10 hrs
Advanced Python Programming Concepts • Review of Python Fundamentals • Advanced Data Structures • Iterators and Generators • Lambda Functions • Map(), Filter(), Reduce() • List, Set, Dictionary Comprehensions • Decorators • Regular Expressions • Date and Time Modules	
Unit-II	10 hrs
Advanced Object-Oriented Programming and Database Connectivity • Advanced OOP Concepts • Encapsulation, Abstraction • Multiple Inheritance • Method Overriding • Operator Overloading • Abstract Classes and Interfaces • Exception Handling Techniques • Database Connectivity using SQLite/MySQL • CRUD Operations in Python	
Unit-III :	10 hrs
GUI Programming, Multithreading and Web Applications • GUI Programming using Tkinter • Event-Driven Programming • File and Directory Management • Multithreading and Multiprocessing • Socket Programming Basics • Introduction to Web Development using Flask • REST API Basics • Introduction to NumPy and Pandas Applications	

Books Recommended:

1. **Mark Lutz**, *Learning Python*, O'Reilly Media.
2. **Dusty Phillips**, *Python 3 Object-Oriented Programming*, Packt Publishing.
3. **Reema Thareja**, *Python Programming Using Problem Solving Approach*, Oxford University Press.

Course No. (DS/Mn-1/P/276) Practical based on Advance Python

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/Mn-1/P/276**	Mn	Practical	1	2	30		----	----	----

Title of the Course (DS/Mn-1/P/276) Practical based on Advance Python

Learning Objectives of the Course

LO1: Develop proficiency in advanced Python programming techniques and functional programming constructs.

LO2: Implement object-oriented, database-driven, and GUI-based applications using Python.

LO3: Design and develop multithreaded, network-based, and web applications using Python frameworks and libraries.

Course Outcomes (COs) :

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

CO1: Develop Python programs utilizing comprehensions, generators, decorators, regular expressions, and functional programming techniques.

CO2: Create object-oriented and database-enabled applications with effective exception handling and GUI interfaces.

CO3: Build multithreaded, networked, and web-based applications using Python tools, libraries, and frameworks

Practical based on Advance Python	Total Hrs: 30
Unit-I	
Practical 1 Write a Python program to demonstrate list, set, and dictionary comprehensions. **Practical 2** Write a Python program using lambda functions with map(), filter(), and reduce(). **Practical 3**	

Write a Python program to create and use iterators and generators. **Practical 4** Write a Python program to validate email addresses and phone numbers using regular expressions. **Practical 5** Write a Python program demonstrating decorators.	
Unit-II	
Practical 6 Write a Python program for date and time manipulation using the datetime module. **Practical 7** Create a Python class demonstrating encapsulation and abstraction. **Practical 8** Write a Python program demonstrating multiple inheritance and method overriding. **Practical 9** Write a Python program demonstrating operator overloading. **Practical 10** Develop a Python application to perform CRUD operations using SQLite.	
Unit-III :	
Practical 11 Write a Python program demonstrating advanced exception handling using custom exceptions. **Practical 12** Develop a GUI application using Tkinter for student information management. **Practical 13** Write a Python program demonstrating multithreading. **Practical 14** Develop a simple client-server application using socket programming. **Practical 15** Develop a basic web application using Flask with database connectivity.	

Books Recommended:

1. **Mark Lutz**, *Learning Python*, O'Reilly Media.
2. **Dusty Phillips**, *Python 3 Object-Oriented Programming*, Packt Publishing.
3. **Reema Thareja**, *Python Programming Using Problem Solving Approach*, Oxford University Press.

Course No. (DS/Mn-2/T/251) Advance Java

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/Mn-1/T/251	Mn	Theory	1	1	15		----	----	----

Title of the Course (DS/Mn-2/T/251)

Learning Objectives of the Course

LO1: To understand object-oriented programming concepts in Java.
LO2: To develop simple Java applications using file handling and exception handling.
LO3: To create basic GUI applications using AWT/Swing and event handling.
LO4: To understand basic database connectivity using JDBC.

Course Outcomes (COs) :

After completion of the course, students will be able to -
CO1: Understand the fundamental concepts of Java programming and apply object-oriented programming principles such as classes, objects, inheritance, and polymorphism.
CO2: Develop Java programs that implement exception handling and file handling techniques.
CO3: Design and implement basic GUI applications using AWT/Swing components and handle user interactions through event handling mechanisms.
CO4: Demonstrate the ability to create simple database-connected Java applications

Advance Java	Total Hrs: 15
Unit-I	5hrs
Introduction to Basic OOP Concepts: Review to basic java programming, Introduction to object-oriented programming, classes and objects, constructors, method definition and method calling, method overloading, inheritance (basic concepts), polymorphism and method overriding, packages and access modifiers.	
Unit-II	5hrs
File Handling and Exception Handling: Introduction to exception handling, types of exceptions, try, catch, finally blocks, throw and throws keywords, user-defined exceptions, introduction to file handling, file streams, byte streams and character streams, FileInputStream, FileOutputStream, FileReader and FileWriter, reading and writing data to files, basic file operations in Java programs.	
Unit-III :	5 hrs
Basic GUI Programming, Event Handling and Database Connectivity:	

Introduction to GUI programming in Java, AWT components, Layout managers, introduction to Swing components, Action Listener and basic event handling examples, introduction to JDBC, JDBC architecture, types of JDBC drivers, steps to connect Java with database, establishing connection using DriverManager, executing SQL queries, simple database connectivity example	

Books Recommended:

1. "Herbert Schildt – Java: The Complete Reference.
2. Cay S. Horstmann – Core Java Volume I Fundamentals.
3. E. Balagurusamy – Programming with Java
4. "Java: The Complete Reference" by Herbert Schildt, published by McGraw Hill Education India.

Course No. (DS/Mn-2/P/277) Practical based on Advance Java

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/Mn-2/P/277**	Mn	Practical	1	2	30		----	----	----

Title of the Course (DS/Mn-2/P/277) Practical based on Advance Java

Learning Objectives of the Course

LO1: Understand and apply object-oriented programming concepts such as classes, objects, constructors, inheritance, and polymorphism in Java.

LO2: Develop Java applications incorporating exception handling, file processing, graphical user interfaces, and event-driven programming.

LO3: Implement database connectivity and perform database operations using JDBC in Java applications.

Course Outcomes (COs) :

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

CO1: Design and develop Java programs using object-oriented programming principles and advanced Java features.

CO2: Create robust Java applications utilizing exception handling, file management, GUI components, and event handling mechanisms.

CO3: Develop database-driven Java applications by connecting to databases and performing CRUD operations using JDBC.

Practical based on Advance Java	Total Hrs: 30
Unit-I	
Practical 1 Write a Java program to create a class and object to display student information using constructors. **Practical 2** Write a Java program to demonstrate method overloading for performing arithmetic operations. **Practical 3** Write a Java program to demonstrate inheritance by creating a base class and derived class. **Practical 4** Write a Java program to demonstrate method overriding (polymorphism) using two classes. **Practical 5** Write a Java program to demonstrate the use of abstract classes and abstract methods.	
Unit-II	
Practical 6 Write a Java program to demonstrate interfaces and multiple inheritance using interfaces. **Practical 7** Write a Java program to demonstrate exception handling using try, catch, and finally blocks. **Practical 8** Write a Java program to create a user-defined exception and handle it in a program. **Practical 9** Write a Java program to write data to a file using FileWriter or FileOutputStream. **Practical 10** Write a Java program to read data from a file using FileReader or FileInputStream.	
Unit-III :	

Practical 11 Write a Java program to copy the contents of one file to another file. **Practical 12** Write a Java program to create a simple GUI using AWT components such as Label, TextField, and Button. **Practical 13** Write a Java program to demonstrate event handling by displaying a message when a button is clicked. **Practical 14** Write a Java program to connect Java with a database using JDBC and display records from a table. **Practical 15** Write a Java program to perform Insert, Update, and Delete operations on a database table using JDBC.	

Books Recommended:

1. "Herbert Schildt – Java: The Complete Reference.
2. Cay S. Horstmann – Core Java Volume I Fundamentals.
3. E. Balagurusamy – Programming with Java
4. "Java: The Complete Reference" by Herbert Schildt, published by McGraw Hill Education India.

Course No. (DS/VSC/T/250) Web Designing

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course DS/VSC/T/250	VSC	Theory	1	1	15		----	----	----

Title of the Course (DS/VSC/T/250) Web Designing

Learning Objectives of the Course:

LO1: To understand the fundamentals of web technologies and develop basic web pages using HTML elements and structures.

LO2: Use of CSS techniques for designing structured, responsive, web pages.

LO3: To develop interactive and dynamic web pages using JavaScript for basic web applications and data handling.

Course Outcomes (COs) :

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

CO1: Understand fundamental concepts of web technologies and design basic web pages using HTML.

CO2: Apply CSS to design structured, responsive, and visually appealing web pages.

CO3: To use Java Script for developing dynamic web pages for basic web applications

	Total Hrs: 15
Unit-I	5 hrs
Introduction to Web Technologies and HTML • Basics of Internet and World Wide Web, World Wide Web Consortium (W3C), Web Architecture. • Web browsers and web servers • Client–Server architecture • Introduction to HTML • HTML document structure • Text formatting tags • Lists (ordered and unordered) • Hyperlinks and images • Tables and forms in HTML Introduction to HTML5 , Introduction to **semantic elements** (header, nav, section, article, footer)	
Unit-II	5hrs
Cascading Style Sheets (CSS) Introduction to CSS, Types of CSS (Inline, Internal, External), CSS syntax and selectors, Colors, fonts, and backgrounds, Box model and page layout Styling tables and forms, Introduction to responsive web design.	
Unit-III :	5 hrs
JavaScript for Interactive Web Pages: Introduction to Scripting and types, Introduction to JavaScript, Variables, operators, and data types, Conditional statements and loops, Functions in JavaScript, Event handling, Form validation, Introduction to Document Object Model (DOM), Basic data visualization on web pages.	

Books Recommended:

1. John Dean – *Web Programming with HTML5, CSS, and JavaScript*.

Online Resources:

1. https://drive.google.com/file/d/1L3tVGwLb_ZMbdfq7gmV75Ixl96CuOty0/view
2. https://files.addictbooks.com/wp-content/uploads/2024/04/Learning-Web-Design-5th-Edition.pdf
3. https://www.freecodecamp.org/

Course No. (DS/VSC/P/276) Practical based on Web Designing

Course No.	Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course **DS/DSC/P/276**	DSC	Practical	1	2	30		----	----	----

Title of the Course (DS/VSC/P/276) Practical based on Web Designing

Learning Objectives of the Course

LO1: To provide hands-on experience in designing structured web pages using HTML and HTML5 elements, including lists, tables, forms, multimedia, and semantic tags.

LO2: To develop practical skills in applying CSS for styling, layout design, and creating responsive and visually appealing web pages using different CSS techniques.

LO3: To enable students to build interactive web pages using JavaScript, including form validation, event handling, and basic programming constructs, culminating in a mini-project website.

Course Outcomes (COs) :

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

CO1: Design and develop basic web pages using HTML and HTML5 elements**.**

CO2: Apply **CSS** to create structured and visually appealing web pages.

CO3: Implement JavaScript to develop interactive web pages and perform form validation.

Practical based on Web Designing	Total Hrs: 30
Unit-I	
Introduction to Web Technologies and HTML Study of Interaction between Web Browser and Web Server. Create a basic HTML webpage with headings, paragraphs, line breaks, and text formatting tags. Create ordered lists, unordered lists, and hyperlinks connecting multiple HTML pages. Insert images and basic multimedia elements in a webpage. Design tables in HTML to display structured data. Create HTML forms using input elements such as text fields, radio buttons, checkboxes, password fields, and submit buttons. Create a webpage using HTML5 semantic elements such as <header>, <nav>, <section>, <article>, and <footer>.	
Unit-II	
CSS for Web Page Design Apply inline, internal, and external CSS to style a webpage. Use CSS properties such as colors, fonts, borders, margins, and backgrounds. Design webpage layouts using CSS box model. Create a styled webpage combining HTML5 and CSS.	
Unit-III :	
JavaScript for Interactive Web Pages Write JavaScript programs for basic arithmetic operations and display results on a webpage. Use conditional statements and loops in JavaScript. Implement form validation using JavaScript. Create an interactive webpage using JavaScript events.	

Books Recommended:

1. John Dean – *Web Programming with HTML5, CSS, and JavaScript*.

Online Resources:

1. https://drive.google.com/file/d/1L3tVGwLb_ZMbdfq7gmV75Ixl96CuOty0/view
2. https://files.addictbooks.com/wp-content/uploads/2024/04/Learning-Web-Design-5th-Edition.pdf
3. https://www.freecodecamp.org/

GE-OE-1 Introduction to Computing for Behavioural Sciences

(This course will be available for the students other than faculty of Science and Technology)

Credit: 2 **Total Contact Hours:** 30 Hours

Marks: 50

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Target Audience

Students from **Faculty of Humanities** and **Faculty of Commerce and Management**, with **no prior background in Computing**

Course Objectives:

- Understand core computing principles relevant to behavioural science research.
- Explain digital data structures, storage, and ethical issues in data management.
- Interpret how computing tools support survey research, experiment design, and data analysis.
- Gain foundational knowledge of programming logic, data formats, and digital workflows in behavioural research.

Course Outcomes (COs)

By the end of this course, students will be able to:

- **CO1:** Understand the fundamental concepts of computing, data representation, and the role of computing in behavioural sciences.
- **CO2:Explain** the role of computing in behavioural sciences, including key concepts like algorithms, data structures, and automation
- **CO3:** Apply basic programming concepts to solve problems relevant to behavioural data analysis.
- **CO4:** Utilize software tools and computational techniques for data organization, visualization, and interpretation in psychological and behavioural studies.
- **CO5:** Analyse and interpret behavioural data using statistical computing environments.
- **CO6:** Demonstrate the ability to design and implement simple computational models to study behavioural phenomena.
- **CO7:** Critically evaluate the ethical considerations in the use of computing technologies in behavioural sciences.

Course Modules

Module 1:Computing Foundations for Behavioural Science(10 Hours)

- What is computing? Computer vs. human cognitive processes

- Evolution of computing in behavioural sciences
- Overview of hardware and software systems
- Nature and types of data: nominal, ordinal, interval, ratio
- Data sources: observations, surveys, digital footprints
- Formats: text, numeric, tabular, structured and unstructured data
- File organization: folders, naming conventions, metadata
- Common file types in psychology research: CSV, XLSX, TXT
- Local vs cloud storage (Google Drive, Dropbox, OneDrive)

Module 2:Fundamentals of Algorithms ,Logic and Programming(10 Hours)

- Algorithms: flow of instructions
- Logical operators and control flow: if-else, loops
- Conceptual modeling of simple psychological experiments (e.g., Stroop task)
- Basic elements: variables, data types, expressions
- Working with data collections
- Examples using psychological concepts: e.g., storing reaction times
- Basics of data visualization
- Graph types and their psychological application (bar, line, histogram)
- Understanding data patterns and behavior through visual summaries

Module 3: Use of Computing in Behavioral Science Research ,Digital Ethics and Data Privacy(10 Hours)

- Behavioral experiments and digital tools
- Simulation in cognitive psychology
- Intro to software used in research labs (e.g., PsychoPy, OpenSesame)
- Informed consent and digital data
- Anonymity, confidentiality, data protection
- Overview of GDPR and data ethics in behavioral research

Reference Books :

1. Van Dierendonck, D. (2020). *Psychological Data Science: Understanding and Using Data in Behavioral Research*. Routledge.
2. Downey, A. B. (2015). *Think Python: How to think like a computer scientist* (2nd ed.). O'Reilly Media.
3. Miller, J. H., & Page, S. E. (2007). *Complex adaptive systems: An introduction to computational models of social life*. Princeton University Press.
4. Brysbaert, M. (2019). How to use PsychoPy for research. Cambridge University Press.

GE-OE-2 Data Analysis for Psychology

(This course will be available for the students other than faculty of Science and Technology)

Credit: 2 **Total Contact Hours:** 30 Hours

Marks: 50

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Target Audience

Students from **Faculty of Humanities** and **Faculty of Commerce and Management**, with **no prior background in Computing**

Course Objectives:

- Understand core computing principles relevant to behavioural science research.
- Explain digital data structures, storage, and ethical issues in data management.
- Interpret how computing tools support survey research, experiment design, and data analysis.
- Gain foundational knowledge of programming logic, data formats, and digital workflows in behavioural research.

Course Outcomes (COs)

By the end of this course, students will be able to:

- **CO1: Define and explain** core statistical concepts (e.g., p-values, effect sizes, confidence intervals) in psychological research.
- **CO2: Clean and prepare** raw psychological data (e.g., survey responses, experimental results) for analysis.
- **CO3: Conduct** descriptive and inferential statistics using software SPSS/JASP/R/Python).
- **CO4: Visualize data** effectively using APA-compliant graphs (bar charts, scatterplots, error bars).
- **CO5: Evaluate** the appropriateness of statistical methods in published psychology studies.
- **CO6: Interpret** statistical results in plain language
- **CO7: Discuss** the societal impact of algorithmic bias in psychological tools

Course Modules

Module 1: Foundations of Psychological Data Analysis(10 Hours)

- Research Design & Data Types(Experimental vs. correlational designs)
- Levels of measurement (nominal, ordinal, interval, ratio)
- Descriptive Statistics(Measures of central tendency & variability
- Data distributions (normal, skewed)

- Data Cleaning & Preparation(Handling missing data, outliers
- Recoding variables, reverse-scoring surveys
- Statistical Software Basics(Introduction to SPSS/JASP (GUI)

Module 2: Probability, Sampling and Hypothesis formulation(10 Hours)

- Introduction to probability and sampling
- Hypothesis Testing: t-tests (independent, paired), ANOVA (one-way, factorial)
- Effect sizes (Cohen's d, η^2) and power analysis

Module 3: Inferential Statistics(10 Hours)

- Correlation & Regression: Pearson's r, Spearman's rho, Linear regression (predicting outcomes)
- Non-Parametric Tests: Chi-square, Mann-Whitney U, Wilcoxon signed-rank
- Data Visualization: Creating APA-style graphs (bar charts, scatterplots) software like PsychoPy. JASP. Ethical considerations in data analysis

Reference Books :

1. Navarro, D. J., & Foxcroft, D. R. (2022). *Learning statistics with JASP: A tutorial for psychology students and other beginners*. https://learnstatswithjasp.com/
2. Cumming, G. (2012). *Understanding the new statistics: Effect sizes, confidence intervals, and meta-analysis*. Routledge.
3. Gravetter, F. J., & Wallnau, L. B. (2021). *Statistics for the behavioral sciences (11th ed.).* Cengage Learning.
4. Coolican, H. (2018). *Research methods and statistics in psychology (7th ed.).* Psychology Press.

GE-OE/T/03: Human-Computer Interaction & Behavioral Technology

(This course will be available for the students other than faculty of Science and Technology)

Total Credits: 02 **Total Contact Hours: 30 Hrs.**

Maximum Marks : 50

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Target Audience

Students from **Faculty of Humanities** and **Faculty of Commerce and Management**, with **no prior background in Computing**

Course Objectives:

- Demonstrate basic knowledge of humanities, social sciences, and technology concepts.
- Apply critical thinking and analytical skills to understand human behaviour and digital systems.
- Use basic digital literacy and information technology tools for learning and problem solving.
- Understand ethical values and responsible use of technology in society

Course Outcomes (COs)

By the end of this course, students will be able to:

CO1: Explain the basic concepts, importance, and components of Human-Computer Interaction.
CO2: Identify different types of computer interfaces and usability principles.
CO3: Understand human behaviour, perception, memory, cognitive factors in interaction with technology.
CO4: Describe the applications and ethical aspects of behavioural technology in modern digital systems.

Course Modules

Module 1: Introduction to Human-Computer Interaction:

Introduction to Human-Computer Interaction (HCI), Meaning and definition of HCI, Importance of HCI in modern technology, History and evolution of computer interfaces, Relationship between humans and computers, Components of HCI systems, Types of computer interfaces, Command Line Interface (CLI), Graphical User Interface (GUI), Voice User Interface (VUI), Touch interfaces, Basic concepts of usability, Applications of HCI in daily life, Examples of HCI such as ATM machines, mobile apps, websites and kiosks.

Module 2: Human Behaviour and Interaction Design:

Human factors in computing, Cognitive processes in interaction, Human perception, Attention and memory in technology use, User behaviour and user needs, Principles of user-centered design, Interaction styles in HCI, Menu based interaction, Form fill-in interaction, Direct manipulation interfaces, Importance of feedback and error prevention, Design principles for effective interfaces, Cultural and social factors affecting technology use, Behavioural impact of technology on users.

Module 3: Behavioural Technology and Applications:

Concept of behavioural technology, Technology and human behaviour relationship, Behaviour change through digital technology, Role of behavioural design in software and apps, Basics of user experience (UX) and user interface (UI), User feedback and evaluation techniques, Ethical issues in HCI and behavioural technology, Privacy and security concerns in digital systems, Applications of behavioural technology in education, healthcare, social media, e-commerce and smart devices, Future trends in HCI such as virtual reality, voice assistants and intelligent interfaces.

Reference Books :

1. Human-Computer Interaction – Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale (Free online chapters available)
2. Interaction Design: Beyond Human-Computer Interaction – Helen Sharp, Yvonne Rogers, Jenny Preece
3. The Glossary of Human-Computer Interaction – Interaction Design Foundation (Free online resource)

GE-OE/T/04: Digital Psychology and Emerging Technologies

(This course will be available for the students other than faculty of Science and Technology)

Total Credits: 02 **Total Contact Hours: 30 Hrs.**

Maximum Marks : 50

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Target Audience

Students from **Faculty of Humanities** and **Faculty of Commerce and Management**, with **no prior background in Computing**

Course Objectives:

- Understand the principles of digital psychology and analyse human behaviour in technology-mediated environments.
- Examine the impact of emerging technologies such as AI, VR, AR, IoT, and wearable devices on human cognition, behaviour, and well-being.
  Evaluate behavioural data, ethical considerations, and future technological trends in digital psychology and human-computer interaction.

Course Outcomes (COs)

By the end of this course, students will be able to:

CO1: Explain key concepts of digital psychology, online behaviour, and the psychological effects of digital technologies.

CO2: Analyse applications of emerging technologies in mental health, education, healthcare, and behavioural research.

CO3: Assess ethical, privacy, and societal implications of digital technologies while interpreting behavioural data and future technology trends.

Course Modules

Module 1: Foundations of Digital Psychology:

Introduction to Digital Psychology

- Concept and Scope of Digital Psychology
- Relationship between Psychology and Technology
- Human Behaviour in Digital Environments
- Digital Identity and Online Self-Presentation
- Social Media Psychology
- Technology Adoption and User Behaviour
- Psychological Impact of Digital Communication

Digital Well-being

- Screen Time and Mental Health
- Digital Addiction and Behavioural Dependence
- Cyberbullying and Online Harassment
- Digital Wellness and Healthy Technology Use

Module 2: Emerging Technologies and Human Behaviour:

Artificial Intelligence and Psychology

- Introduction to Artificial Intelligence
- AI in Mental Health and Behavioural Assessment
- Chatbots and Virtual Assistants
- Personalized Recommendation Systems
- Ethical Issues in AI-based Psychological Applications

Virtual and Augmented Reality

- Fundamentals of Virtual Reality (VR) and Augmented Reality (AR)
- VR in Therapy and Rehabilitation
- AR Applications in Education and Training

Module 3: Data Analytics and Ethics:

Behavioral Data Analytics

- Digital Footprints and Behavioral Data
- Data Collection Methods in Digital Environments
- Introduction to Behavioral Analytics
- Predictive Analysis of Human Behavior
- Data Visualization for Psychological Research

Ethics and Privacy

- Digital Privacy and Data Protection
- Ethical Issues in Digital Psychology Research
- Informed Consent in Digital Studies
- Algorithmic Bias and Fairness

Reference Books :

1. **Kent L. Norman**, *Cyberpsychology: An Introduction to Human-Computer Interaction*, Cambridge University Press.
2. **John Grohol**, *The Insider's Guide to Mental Health Resources Online*, Guilford Press.
3. **Sherry Turkle**, Alone Together, Basic Books.