SWAMI RAMANAND TEERTH

MARATHWADA UNIVERSITY, NANDED - 431 606

(**Structure and Syllabus of Two Years PG Degree Program with Multiple Entry and Exit Option**)

TWO YEAR MASTERS PROGRAMME IN MASTER of SCIENCE

Subject: Data Science

Under the Faculty of

Science and Technology

Effective from Academic year 2024 – 2025

(As per NEP-2020)

Swami Ramanand Teerth Marathwada University

Nanded

Faculty of Science and Technology

NEP-2020 Oriented Structure of Post Graduate Programs

(as per NEP 2020)

M.Sc. Data Science

(2 years full time PG Programs)

Introduced from Academic Year 2024-2025

Program code: MSCDS

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power",*** is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve the **3Es, the *equity, the efficiency and the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the *cumulative grade point average* (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the *Choice Based Credit System* (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high caliber graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science-based to the discipline-specific-based curriculum. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the Government of Maharashtra regarding NEP-2020. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship*** program for science background students is praise worthy and certainly help the students to imbibe first-hand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil

Dean, *Faculty of Sci & Tech.*

M.Sc. Data Science

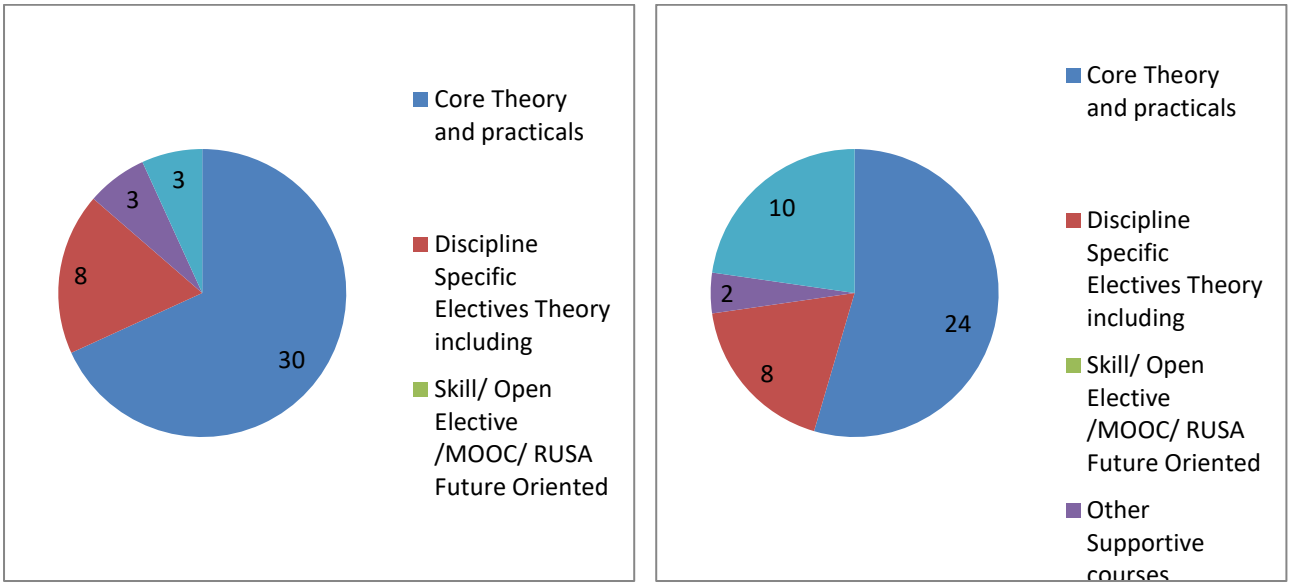
M.Sc. Data Science (2years) program / degree is a specialized program in latest advances in data science issues. It builds the student on higher studies and research awareness in overall computational science fields so as to become competent in the current race and development of new computational sciences. The duration of the study is of four semesters, which is normally completed in two years.

NEP-2020 pattern: The M.Sc. Data Science program as per NEP-2020 and CBCS (Choice based credit system) pattern, in which choices are given to the students under electives. The students can choose open electives from the wide range of options to them.

Eligibility and Fees: The eligibility of a candidate to take admission to this is as per the eligibility criteria fixed by the University. More details on admission procedure and fee structure can be seen from the prospectus of the college / institution as well as on website of the University.

Credit Pattern: Every course has corresponding grades marked in the syllabus structure. There are 22 credits per semester. A total of 88 credits are essential to complete this program successfully. The Grading pattern to evaluate the performance of a student is as per the University rules.

Every semester has a combination of Theory (core or elective) courses, internship, other relevant courses, major project and Lab courses. The number of hours needed for completion of theory and practical courses as well as the passing rules, grading patterns, question paper pattern, number of students in practical batches, etc shall be as per the recommendations, norms, guidelines and policies of the NEP-2020, UGC, State Government and the SRTM University currently operational. The course structure is supplemented with split up in units and minimum numbers of hours needed for completion of the course, wherever possible. Under the CBCS pattern, students would graduate M.Sc. Data Science with a minimum number of required credits which includes compulsory credits from core courses, open electives and program specific elective course. All students have to undergo lab / practical activities leading to specific credits and project development activity as a part of professional UG program.



FY and SY credit patterns

PEO, PO and CO Mappings

1. **Program Name** : M.Sc.(DS) Campus , Sub Centre

2. **Program Educational Objectives**: After completion of this program, the graduates / students would

PEO I :Technical Expertise	Implement fundamental domain knowledge of core courses for developing effective computing solutions by incorporating creativity and logical reasoning.
PEO II : Successful Career	Deliver professional services with updated technologies in computational science based career.
PEO III :Hands on Technology and Professional experience	Develop leadership skills and incorporate ethics, team work with effective communication & time management in the profession.
PEO IV :Interdisciplinary and Life Long Learning	Undergo higher studies, certifications and research programs as per market needs.

3. Program Outcome(s): Students / graduates will be able to

PO1: Apply knowledge of mathematics, science and algorithm in solving Computer problems.

PO2: Generate solutions by understanding underlying computer application environment

PO3: Design component, or processes to meet the needs within realistic constraints.

PO4: Identify, formulate, and solve problems using computational temperaments.

PO5: Comprehend professional and ethical responsibility in computing profession.

PO6: Express effective communication skills.

PO7: Recognize the need for interdisciplinary, and an ability to engage in life-long learning.

PO8: Actual hands on technology to understand it's working.

PO9: Knowledge of contemporary issues and emerging developments in computing profession.

PO10: Utilize the techniques, skills and modern tools, for actual development process

PO11: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings in actual development work

PO12: Research insights and conduct research in computing environment.

4. **Course Outcome(s):** Every individual course under this program has course objectives and course outcomes (CO). The course objectives rationally match with program educational objectives.

The mapping of PEO, PO and CO is as illustrated below

5. Mapping of PEO& PO and CO

Program Educational Objectives	**Thrust Area**	**Program Outcome**	**Course Outcome**
PEO I	Technical Expertise	PO1,PO2,PO3,PO6	All core courses
PEO II	Successful Career	PO4,PO5,PO11,	All discipline specific electives courses
PEO III	Hands on Technology and Professional experience	PO8,PO10	All Lab courses
PEO IV	Interdisciplinary and Life Long Learning	PO7,PO9,PO12	All open electives and discipline specific electives

The detailed syllabus is as below,

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 oriented Structure of Two years Post Graduate Program

Subject : Data Science

Introduced from Academic Year 2024-2025

Program Year and Sem	**Level**	**Semester**		**Faculty**			**Other courses**				
First year common for all PG programs in the School			**Major / Mandatory /**		**Electives/**		**RM**	**OJT/FP/**	**RP**	**Total Sem. credits**	**Cumu. Credits**
			Theory	**Practical**	**Theory**	**Practical**					
			(04 credits)	**(01credits)**	**(04 credits) (03+01)**		**(03credits)**	**(03 Credits)**	**(04 Credits)**		
			SCDS		**SCDS**						
M.Sc. DS	6.0	First Semester	SCDSC-401 SCDSC-402 SCDSC-403	SCDSCP-401 SCDSCP-402 SCDSCP-403	SCDSE-401	---------	SVECR-401 Research Methodology Compulsory	---------	---------	**22**	**22**
M.Sc. DS		Second Semester	SCDSC-451 SCDSC-452 SCDSC-453	SCDSCP-451 SCDSCP-452 SCDSCP-453	SCDSE -451	---------	---------	SCDSOJ-451	----------	**22**	**44**
PG Diploma			24credits + 06 Credits		06 credits +02 Credits		03credits	03credits	----------	**44 credits**	

Exit Option: After completion of First year as above with 44 credits, student will be awarded PG Diploma in Computer Science and Applications**

****(for students who have done 03 years UG program)**

****(available from AY 2024-2025)**

1. Abbreviations : **S- Science, CDS- DATA SCIENCE, D**iscipline **S**pecific **C**ore course (C- Core Course)
2. Abbreviations : **SCDSE- D**iscipline supportive **E**lective **C**ourse (E- Elective Course)
3. Abbreviations : SVECR: Research Methodology course
4. Abbreviations : SCDSOJ : On Job Training , Internship/ Apprenticeship or Field Project
5. Abbreviations : SCDSR : Research Project

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 oriented Structure of Two years Post Graduate Program

Subject: Data Science

Introduced from Academic Year 2024-2025

Program Year and Sem	**Level**	**Semester**		**Faculty**			**Other courses**				
Second Year is program specific for all PG programs in the School			**Major / Mandatory / SDSC**		**Electives / SDSC**		**RM /others**	**OJT/FP/**	**RP**	**Total Sem. credits**	**Cumu. Credits**
			Theory	**Practical**	**Theory**	**Practical**					
			(04 credits)	**(01credits)**	**(04 credits) (03+01)**		**(02 credits)**	**(04 credits)**	**(04 credits)**		
M.Sc. DS	6.5	Third Semester	SCDSC-501 SCDSC-502 SCDSC-503	SCDSCP-501 SCDSCP-502	SCDSE-501 (FROM SAME SCHOOL/DEPT)	---------	---------	---------	SCDSR-551 (04 credits)	**2 2**	**66**
M.Sc. DS	6.5	Fourth Semester	SCDSC-551 SCDSC-552	SCDSCP-551 SCDSCP-552	SCDSE-551 (FROM SAME SCHOOL/DEPT)	--------	SVECP -A551 Publication ethics	---------	SCDSR-552 (06 credits)	**22**	**88**
Exit Option: After completion of Second year as above with cumulative 88 credits, student will be awarded M.Sc. in Data Science Degree depending upon enrollment and completion of program specific core and electives courses ** ****(for students who have done 03 years UG program)**											

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-4545 oriented Structure of One year Post Graduate Program

For students who have completed 04 years UG

Subject: Computer Science, Computer Application, Data Science (CAMPUS)

Introduced from Academic Year 2027-2028

Program Year and Sem	**Level**	**Semester**		**Faculty**			**Other courses**				
			Major / Mandatory / SDSC		**Electives / SDSC**		**RM**	**OJT/FP/**	**RP**	**Total Sem. credits**	**Cumu. Credits**
			Theory	**Practical**	**Theory**	**Practical**					
			26 credits		08 credits		-------	------	44 credits	---	44 credits
One Year program specific courses			Contents will be announced later		Contents will be announced later		----------	----------	Contents will be announced later	-------	

M.Sc. Data Science
First Semester

Core Courses Code	Title	Remarks Credits
SCDSC-401	Advanced Computer System Architectures	04
SCDSC-402	Advanced Operating System Concepts	04
SCDSC-403	Advanced Programming Language Concepts	04
SCDSCP-401	Lab 1: ACSA Lab	01
SCDSCP-402	Lab 2: Windows & Linux Lab	01
SCDSCP-403	Lab 3: APLC Lab	01
SCDSE-401	**Chose any one** A. Data Analysis using Spreadsheet B. Mathematical Foundations for Computer Science C. Advanced Web Technology	03 Theory and 01 Lab
SVECR-401	Research Methodology	03

M.Sc. Data Science
Second Semester

Core Courses Code	Title	Remarks Credits
SCDSC-451	Computer Graphics and Multimedia	04
SCDSC-452	Database Essentials	04
SCDSC-453	Programming in C and Python	04
SCDSCP-451	Lab 4: CG Lab	01
SCDSCP-452	Lab 5: SQL Lab	01
SCDSCP-453	Lab 6: C & Python Lab	01
SCDSE-451	Chose any one A. Core and Advanced Java Programming B. Design and Analysis of Algorithms C. Information System Security	03 Theory and 01 Lab
SCDSOJ-451	On Job Training , Internship/ Apprenticeship or Field Project	03

Note [$$]: Contents of the courses in campus and affiliated colleges shall be different

Program Specific Syllabus: Third Semester
M.Sc. Data Science

Core Courses Code	Title	Remarks Credits
SCDSC-C501	Introduction to Data Science	04
SCDSC-C502	Mathematics and Statistics for Data Science	04
SCDSC-C503	Python Programming for Data Science	04
SCDSCP-C501	Lab 7: Data Science & Analytics Lab	01
SCDSCP-C502	Lab 8: Machine Learning using Python	01
SCDSE-C501	**Chose any one** A. Machine Learning B. Theory of Computation C. Internet of Things D. Subject relevant MOOC (NPTEL / SWAYAM / RUSA sponsored Future Oriented Courses / Other recognized [$$] E. Visual Programming Tools F. Digital Image Processing	03 Theory and 01 Lab **Note:** [$$] with prior consultation with the Director of the School in order to determine relevancy
SCDSR-C551	Research Project	04

Program Specific Syllabus: Fourth Semester
M.Sc. Data Science

Core Courses Code	Title	Remarks Credits
SCDSC-C551	Deep Learning	04
SCDSC-C552	Foundations of Large Language Models	04
SCDSCP-C551	Lab 9: Deep Learning & LLM Lab	01
SCDSCP-C552	Lab 10: Lab Based on Elective	01
SCDSE-C551	**Chose any one** A. Introduction to Generative AI B. Business Problem Solving & Predictive Modeling C. Emerging Trends in Data Science D. Computer Vision and Image Recognition E. Cloud Computing Tools and Techniques F. Distributed Computing G. Natural Language Processing	03 Theory and 01 Lab
SVECP -C551	Publication Ethics	02
SCDSR-C552	Research Project	06

M. Sc. DS First Year, Semester I and II *(Level 6.0) : Teaching Scheme*

Coures	Course Code	Course Name	Credits Assigned per course			Teaching Scheme (Hrs/ week) per course	
			Theory	Practical	Total	Theory	Practical
Major	SCDSC-401 to SCDSC-403 and SCDSC-451 to SCDSC-453	All Core Course	04	--	**04**	**04**	--
Elective	SCDSE-401 and SCDSE-451	All Elective Courses	03	--	**03**	**03**	--
Special Courses	SVECR-401 and SCDSOJ-451	Research Methodology and On Job Training	03	--	**03**	**03**	
Major Practical	SCDSCP-401 to SCDSCP-403 and SCDSCP-451 to SCDSCP-453	All Core labs	--	01	**01**	--	**02**
Elective Practical	SCDSEP-401 and SCDSEP-451	Elective lab	--	01	**01**	--	**02**
Total Credits per semester			**18**	**04**	**22**	**18**	**04**
Total credits per year			**36**	**08**	**44**	**36**	**08**

M. Sc. DS First Year , Semester I and II (Level 6.0) :Examination Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
		Continuous Assessment (CA)			ESA			
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
SCDSC401 to SCDSC-403 and SCDSC-451 to SCDSC-453	All core courses	20	20	`20	80	--	--	100
SCDSE-401 and SCDSE-451	All elective courses	15	15	15	60	--	--	75
SVECR-401 and SCDSOJ-451	Research Methodology	15	15	15	60	--	--	75
SCDSCP-401 to SCDSCP-403 and SCDSCP-451 to SCDSCP-451	All Core Labs	--	--	--	--	05	20	25
SCDSEP-401 and SCDSEP-451	All Elective labs	--	--	--	--	05	20	25

Guidelines for Course Assessment: M.Sc. DS

A. Continuous Assessment (CA) (20% of the Maximum Marks): This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score (col. 6).

B. End Semester Assessment (80% of the Maximum Marks): ***(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)***

1. **ESA Question paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

C. Question paper of campus and affiliated colleges shall be different

Note: Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45 lectures.

%%%%%

M.Sc. DS First Semester w.e.f AY 2024-2025

Course Code:	SCDSC-401	Advanced Computer System Architecture	Credits: 4	Hours required
Course pre-requisite:				
1. Basic knowledge of computer Hardware and digital electronics				
Course Objectives:				
2. To aware Computer System architecture 3. To learn data processing 4. To understand digital circuits and its use				
Course Outcome:				
1. Students will be able to handle the digital circuits 2. Students will be able to perform micro operations				
Unit-1:	**Register Transfer and Micro operations**			
1.1	Basic computer organization and design: instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory reference instructions, input-output and interrupt, design of accumulator logic.			08
1.2	Introduction to basic and advanced architecture of computers, basics of 8086 and advanced microprocessors, register transfer language, register transfer, bus and memory transfers, arithmetic micro operations, logic micro operations, and shift micro operations.			08
1.3	Programming the Basic Computer: Machine Language, Assembly Language, The Assembler Program Loops, Programming Arithmetic and Logic Operations, Subroutines, Input-Output Programming.			08
Unit-2:	**Central Processing Unit**			
2.1	Introduction to CPU logic, general register organization, stack organization, instruction formats, Complete computer description & design of basic computer.			08
2.2	Addressing modes, data transfer and manipulation, program control, reduced instruction set computer (RISC).			08
2.3	Pipeline and vector processing, parallel processing, pipelining, arithmetic pipelines, instruction pipelines			04
Unit-3:	**Input-Output Organization**			
3.1	Peripheral Devices, Input-Output Interface, Input-Output Processor, Serial Communication.			04
3.2	Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA),			04
Unit-4:	**Memory Organization**			
4.1	Memory Hierarchy, Main Memory, RAM and ROM, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.			04
4.2	Case studies of some contemporary advanced architecture for processors of families like Intel, AMD, IBM etc.			04
Text Book				
1.	William Stallings, Computer Organization and Architecture			
Reference Books				
1.	Andrew S. Tanenbaum, Structured Computer Organization,			

Course Code	SCDSC-402	Advanced Operating System	Credits: 4	Hours required
Course Prerequisite				
1. General understanding of software				
Course Objectives				
1. To learn the mechanisms of OS to handle processes and threads and their communication 2. To learn the advanced mechanisms involved in process , file and memory management in contemporary OS				
Course Outcome				
1. Students will be able to understand architectural components involved in OS design 2. Students will be able to configure existing operating systems				
Unit No.	**Unit Title**			
Unit-1:	**Operating systems overview**			
1.1	Introduction, operating system operations, process management, memory management, storage management, protection and security, distributed systems.			08
1.2	Operating system services and systems calls, system programs, operating system structure, operating systems generations.			08
Unit-2:	**Process management:**			
2.1	Process concepts, process state, process control block, scheduling queues, process scheduling, multithreaded programming, threads in UNIX, comparison of UNIX and windows.			08
2.2	Process synchronization, critical section problem, Peterson's solution, synchronization hardware, semaphores, classic problems of synchronization,			08
2.3	Readers and writers problem, dining philosophers' problem, monitors, synchronization examples (Solaris), atomic transactions. Comparison of UNIX and windows.			04
Unit-3:	**Memory management & file system:**			
3.1	Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, allocation of frames, thrashing, case study – WINDOWS, LINUX			08
3.2	Concept of a file, access methods, directory structure, file system mounting, file sharing, protection.			04
3.3	File system implementation: file system structure, file system implementation, directory implementation, allocation methods, free-space management, efficiency and performance, comparison of LINUX and windows.			04

Unit-4:	**I/O system:**	
4.1	Mass storage structure - overview of mass storage structure, disk structure, disk attachment, disk scheduling algorithms, swap space management, stable storage implementation, tertiary storage structure.	04
4.2	I/O: Hardware, application I/O interface, kernel I/O subsystem, transforming I/O requests to hardware operations, streams, performance.	04
Text Books:		
1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition, Wiley India Private Limited, New Delhi.	
Reference Books:		
1.	Stallings (2006), Operating Systems, Internals and Design Principles, 5th edition, Pearson Education, India.	
2.	Andrew S. Tanenbaum (2007), Modern Operating Systems, 2nd edition, Prentice Hall of India, India.	
3.	Deitel & Deitel (2008), Operating systems, 3rd edition, Pearson Education, India	

Course Code	SCDSC-403	Advanced Programming Language Concepts	Credits: 4	Hours required
Course Prerequisite				
1. Some knowledge of computer programming languages				
Course Objectives:				
1. To help to understand the fundamental concepts of programming Languages. 2. To prepare students about the need and use of data structures 3. To prepare students to identify and apply data structures for problem solving				
Course Outcome:				
1. Understanding the evolution of programming languages. 2. Understanding object oriented languages, functional and logical programming languages				
Unit-1:	**The role of Programming Languages**			
1.1	Introduction to Languages, Basic types of languages (Machine, Assembly, High level Languages),			**08**
1.2	Toward Higher-Level Languages, Programming Paradigms, Language Implementation: Bridge the Gap.			**08**
Unit-2:	**Language Description: Syntactic Structure**			**08**
2.1	Expression Notations, Abstract Syntax Trees, Lexical Syntax: Tokens and Spellings			**08**
2.2	Context-Free Grammars, Grammars for Expressions, Handling Associativity and Precedence.			**04**
Unit-3:	**Structured Programming and Data representation**			
3.1	Need for Structured Programming, Syntax-directed Control Flow (conditional, Looping Construct, for, Selection Case) Design considerations: Syntax, Programming with Invariants.			**08**
3.2	The role of types, Basic types, Arrays: Sequence of elements, Records: Name Fields, Union and Variant Records, Sets, Pointers.			**02**
Unit-4:	**Procedure Activations and Logic Programming**			
4.1	Introduction to Procedures, Parameter-Passing Methods, Scope Rules for Names, Nested Scopes in the Source Text, Activation Records, Lexical Scope., Computing with relations,			**04**
4.2	Introduction to Prolog, Data Structure in Prolog, Programming Techniques, Control in Prolog, cuts.			**02**
4.3	Case studies of C, C++ and Java languages			**04**
Text Books:				
1.	Programming Languages Concepts and constructs- Ravi Sethi, Pearson Education.			
2.	Programming Language Design Concepts- D. A. Watt, Wiley Dream Tech.			
Reference Books				
1.	Programming Languages- A. B. Tucker, R. E. Noonan, 2nd Edition, TMH.			
2.	Programming Languages- K. C. Louden, 2nd Edition, Thomson Press.			

Course Code:	SCDSE-401 A Elective	Data Analysis using spreadsheets	Credits: 3 Theory and 01 Lab	Hours required
Pre requisite				
1. Knowledge of Use of computers for storing and retrieving data				
Course Objectives:				
1. Making students habitual of using computers for data storing and data analysis				
Course Outcome:				
1. Learn how to use spreadsheets built-in data analysis features, create charts and visualizations, and discover multiple ways to tell the stories hidden in the numbers				
Unit-1:	**Introduction to MS Excel**			
1.1	About Excel & Microsoft, Uses of Excel, Excel software, Spreadsheet window pane, Title Bar, Menu Bar, Standard Toolbar, Formatting Toolbar, the Ribbon, File Tab and Backstage View, Formula Bar, Workbook Window, Status Bar, Task Pane, Workbook & sheets			**08**
1.2	Selecting Columns & Rows, Changing Column Width & Row Height, Autofitting Columns & Rows, Hiding/Unhiding Columns & Rows, Inserting & Deleting Columns & Rows, Cell, Address of a cell, Components of a cell – Format, value, formula, Use of paste and paste special			**08**
Unit-2:	**Using Ranges and Formulas**			
2.1	Using Ranges, Selecting Ranges, Entering Information Into a Range, Using AutoFill			**08**
2.2	Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum, Advanced formulas			**08**
Unit-3:	**Spreadsheet Charts and Data Analysis**			
3.1	Creating Charts, Different types of chart, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table			**04**
3.2	Sorting, Filter, Text to Column, Data Validation Creating PivotTables, Manipulating a PivotTable, Using the PivotTable Toolbar, Changing Data Field, Properties, Displaying a PivotChart, Setting PivotTable Options, . Adding Subtotals to PivotTables			**04**
Unit-4:	**Advanced operations for data analysis**			
4.1	Moving between Spreadsheets, Selecting Multiple Spreadsheets, Inserting and Deleting Spreadsheets Renaming Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding , Protecting worksheets			**04**
4.2	Recording Macros, Running Macros, Deleting Macros			**04**
Lab	**Actual hands on for data analysis**			**12**
01 Credit Lab	Data analysis case studies leading to independent projects where students collect data, use Excel for recording data and create their own individual data analysis reports			
Reference Books				
1.	Excel Data Analysis For Dummies, 5th Edition, Paul McFedries			

Course Code:	SCDSE-401 B Elective	Mathematical Foundations for Computer Science	Credits: 3 Theory and 01 Lab	Hours required
Pre requisite				
1. Basic knowledge of mathematical concepts				
Course Objectives:				
1. Cultivate clear thinking and creative problem solving. 2. Thoroughly train in the construction and understanding of mathematical proofs. 3. Exercise common mathematical arguments and proof strategies.				
Course Outcome:				
1. At the end of the course student will be able to understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.				
Unit-1:	**Introduction**			
1.1	Sets, Venn diagrams, Operations on Sets, Laws of set theory, Power set and Products, Partitions of sets, The Principle of Inclusion and Exclusion.			**08**
Unit-2:	**Propositions and Logical Operations**			
2.1	Propositions &logical operations, Truth tables , Equivalence, Implications , Laws of logic, Normal Forms, Predicates & Quantifiers, Math.Induction.			**08**
Unit-3:	**Relations, Paths and Digraphs**			
3.1	Relations, Paths and Digraphs, Properties and types of binary relations , Operations on relations, Closures, Warshalls algorithm, Equivalence and partial ordered relations, Poset, Hasse diagram and Lattice			**08**
3.2	Functions: Types of functions – Injective, Surjective and Bijective Composition of functions , Identity and Inverse function, Pigeon-hole principle.			**08**
Unit-4:	**Permutations and Combinations**			
4.1	Permutations, Combinations, Elements of Probability, Discrete Probability and Conditional Probability,			**04**
4.2	Generating Functions and Recurrence Relations, Recursive Functions, Introduction to Functional Programming,			**04**
4.3	Graphs Definitions, Paths and circuits: Eulerian and Hamiltonian, Types of graphs, Sub Graphs Isomorphism of graphs.			**08**
Lab	**Use of Programming language / Packages for actual hands on**			
01 Credit Lab	Case studies leading to independent projects where students implement above mathematical concepts using a programming language or a package leading to a Lab Book			**12**
Text Book				
1	Discrete Mathematical Structures- C. L. Liu, Second Edition, McGraw-Hill			
Reference Books				
1.	Discrete Mathematical Structures- Y N Singh, Wiley-India Press.			
2.	Discrete Mathematics for Computer Scientists and Mathematicians- J. L. Mott, A.Kandel, Prentice Hall of India.			
3.	Discrete Mathematical Structures with Applications to Computer Science- Discrete Mathematics for Computer Scientists and Mathematicians, Tata Mcgraw-Hill.			

Course Code:	SCDSE-401 C Elective	Advanced Web Technology	Credits: 3 Theory and 01 Lab	Hours required
Pre requisite				
1. Basic knowledge of web sites and internet				
Course Objectives:				
1. Students must be able to understand art of programming a website				
Course Outcome:				
1. Students will understand basics of web development and will be in a position to independently develop a website				
Unit-1:	**Introduction to HTML**			
1.1	Introduction to basic concept, Internet domains, Client IP address, web client and server, The Phases of Web Site Development Creating Internet World Wide Web pages- HTML - Hypertext Markup Language , Basic HTML Concepts, Lists, Tables, linking documents frames, adding Graphics and multimedia. HTML Forms.			**08**
Unit-2:	**Introduction to CSS**			
2.1	Introduction To Style sheet, types of style sheets- Inline, External, Embedded CSS, color and background, text formatting attributes, CSS Border, margin properties, Positioning Use of classes in CSS, Div and span tag, Classes, use of external style sheets.			**08**
Unit-3:	**Introduction to Javascripts and XML**			
3.1	Intro to script, types, intro of JavaScript, JavaScript identifiers, operators, control & Looping structure, Intro of Array, Array with methods, form object, Math, String and Date Objects with methods User defined & Predefined functions, DOM objects, Window Navigator, , Event handling, Validations On Forms, introduction to cookies.			**08**
3.2	Intro & features of XML, XML writing elements, attributes etc. XML with CSS, DSO, XML Namespaces XML DTD, XML Schemas, Writing Simple sheets using XSLT, SAX & DOM Parsers, SOAP Introduction.			**08**
Unit-4:	**Introduction to PHP**			
4.1	Introduction, apache/IIS installation, setting and configuration PHP to work under apache/IIS, writing PHP, data types, variables, constants operators, arrays, loops, functions PHP Server variables, working with forms			**16**
Lab	**Use of Programming language / Packages for actual hands on**			
01 Credit Lab	Students must independently use a programming language / package / software to implement above concepts leading to design and development of a website			**12**
Text Book				
1.	Ivan Bayross, "Web enabled commercial application development using HTML, DHTML, JavaScript, PERL-CGI", BPB pub., 2nd Ed., 2000			
Reference Books				
1.	Hofstetter fred , "Internet Technology at work", Osborne pub. , 2004			
2.	Ivan Bayross , "HTML, DHTML, JavaScript, Perl & CGI" ,BPB pub. 3rd Ed.,2004			

Course Code:	SVECR-401 compulsory	Research Methodology	Credits: 3 Theory	Hours required
Pre requisite				
1. Knowledge of research studies				
Course Objectives:				
1. To impart knowledge and skills needed for research methodology				
Course Outcome:				
1. Students will be able to scientifically undertake a research project				
Unit-1:	**Foundations of Research:**			
1.1	Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process			**04**
	Problem Identification & Formulation – Research Question – Investigation Question Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance			**04**
Unit-2:	**Research Design**			
2.1	Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.			**04**
Unit-3:	**Research Types and Measurements**			
3.1	Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.			**04**
3.2	Measurement: Concept of measurement–Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio			**04**
Unit-4:	**Core Research Concepts**			
4.1	Sampling methods and Practical considerations in sampling and sample size			**04**
4.2	Data analysis and data Preparation including standard methods of testing hypothesis of association			**04**
4.3	Interpretation of Data and Paper Writing –Journals, Impact factor of Journals, Ethical issues related to publishing, Plagiarism			**04**
4.4	Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.			**04**
4.5	Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism			**05**
Text Book				
1.	Research Methodology – C.R.Kothari			
Reference Books				
1.	Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition			
2.	Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press			

Course Code:	SCDSCP-401	Course Name: Lab-1	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSCP-402	Course Name: Lab-2	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSCP-403	Course Name: Lab 3	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Second Semester

Course Code:	SCDSC-451	Computer Graphics and Multimedia	Credits: 4	Hours required
Course pre-requisite:				
Knowledge of Computer graphics				
Course Objectives:				
1. To develop an understanding and awareness how issues such as content, information architecture, motion, sound, design, and technology merge to form effective and compelling interactive experiences for a wide range of audiences and end users.				
Course Outcome:				
1. Design two dimensional graphics. 2. Apply two dimensional transformations. 3. Understood Different types of Multimedia File Format				
Unit-1:	**Basics of Graphics**			
1.1	Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB YIQ CMY HSV HLS colour model; Colour selection. Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives			08
Unit-2:	**2D and 3D Graphics**			
2.1	Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.			08
2.2	Three dimensional concepts; Three dimensional object representations – Polygon surfacesPolygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -BSpline curves and surfaces.			08
2.3	Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.			08
Unit-3:	**Multimedia basics**			
3.1	Multimedia applications, Multimedia system architecture, Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases.			08
3.2	Compression and decompression − Data and file format standards − Multimedia I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.			08
Unit-4:	**Hypermedia**			
4.1	Multimedia authoring and user interface - Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems.			08
4.2	CASE STUDY: BLENDER GRAPHICS Blender Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures			04
Text Book				
1.	Donald Hearn and Pauline Baker M, ―Computer Graphics", Prentice Hall, New Delhi, 2007			

Course Code:	SCDSC-452	Database Essentials	Credits: 4	Hours required
Course pre-requisite:				
Understanding of data storages in computers				
Course Objectives:				
1. To understand the features of Relational database. 2. To describe data models and schemas in DBMS. 3. To use SQL- the standard language of relational databases for database				
Course Outcome:				
1. Confidence in creating own dataset and modeling their applications				
Unit-1:	**Basics of Databases**			
1.1	General Architecture of DBMS, Roles of DBA, Data Dictionary, Advantages and Disadvantages of DBMS.			08
1.2	Data modeling using Entity Relationship model, Discussions on data modeling using Relational Model, E-R to Relational Conversion.			08
1.3	Basics of Relational Algebra, selection, projection, division, cross product Operators Set Operators, Join and its types, writing Relational Algebra notations for user queries.			08
Unit-2:	**Normalization**			
2.1	Introduction to attributes, Keys, relationships and their types, Anomalies in databases, understanding Functional Dependencies(Determinant, partial, full, transitive, multi valued, etc),			08
2.2	Normalization process, First Normal form, Second Normal Form, Third Normal Form etc. , Boyce-Codd Normal Form, Fourth Normal Form, Fifth Normal Form.			08
Unit-3:	**SQL Essentials**			
3.1	Introduction to data retrieval languages, Discussions on SQL, Table , building blocks of SQL including data types, operators, expressions			04
3.2	DDL Statements, DML Statements, DCL Statements , TCL statements , SQL Functions ,			04
Unit-4:	**Advanced SQL**			
4.1	Introduction to Views, writing basic PL/SQL codes, table partitions,			04
4.2	Introduction to constraints, types of constrains, Integrity constraints, Data administration issues			04
Text Book				
1.	Database System Concepts- Silber Schatz Korth, Tata McGraw Hill.			
Reference Books				
1.	Introduction to Database management System- Bipin Desai, Galgotia P			

Course Code:	SCDSC-453	Programming in C and Python	Credits: 4	Hours required
Course pre-requisite:				
Knowledge of computer languages				
Course Objectives:				
To give skills for computer programming				
Course Outcome:				
Students will be able to solve problems using C and Python programming languages				
Unit-1:	**Introduction to programming paradigms**			
1.1	Applications of C Language, Structure of C program, C programming building blocks including Data Types , operators, expressions, evaluation of expressions, Input / Output statements, use of Assignment statements, Decision making statements, Looping statements in programming, Preprocessor directives and Compilation process			08
1.2	Introduction to Arrays, 1D and 2 D array concepts and their use in programming as well as in searching and sorting operations, various string operations			08
Unit-2:	**Advanced concepts in C**			
2.1	Understanding modular programming, dealing with some standard string and mathematical functions in programming, use of recursion using recursive functions , dealing with pointers, understanding parameter passing concept			08
2.2	Use of abastract data types, understanding use of structures and pointers typedef , dynamic memory allocation concepts, understanding storage classes and visibility.			08
Unit-3:	**Introduction to Python**			
3.1	Python installation and working of it, get familiar with python variables and data types, operator understanding and its usage, detail study of python blocks			08
3.2	Hands on with conditional blocks using if, else and elseif, hands on examples and study of looping with range, list and dictionaries, hands on to organize python code with function, modular approach in python, knowledge of various libraries in python with their research uses			08
Unit-4:	**Advanced concepts in Python**			
4.1	Handling if exceptions to handle the code cracks, handling and helping file operations, coding with the exceptional handling and testing Anonymous method, Properties, Indexers, Exception Handling			08
4.2	Procedural and Object-Oriented Programming, classes and working with instances, method overloading, polymorphism, importing internal module as well as external modules in the code packages understanding and their usage, hands on with lambda function in python coding with the use of functions, modules and external packages			04
Text Book				
2.	Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education,			
Reference Books				
1.	Starting Out with Python (2009) Pearson , Tonny Gaddis			

Course Code:	SCDSE-451 A Elective	Core and Advanced Java Programming	Credits: 3 Theory and 01 Lab	Hours required
Pre requisite				
1. Basic knowledge of computer programming				
Course Objectives:				
1. Cultivate clear thinking and creative problem solving using Java language .				
Course Outcome:				
1. At the end of the course student will be able to understand basics of core Java and advanced Java and to apply them in problem solving.				
Unit-1:	**Introduction to Java**			
1.1	Programming language types and paradigms, computer programming hierarchy, how computer architecture affects a language? , why java? ,flavors of java, java designing goal, role of java programmer in industry, features of java language, jvm –the heart of java , java's magic bytecode.			**08**
1.2	Installing java, java program development, java source file structure, compilation, executions.			
1.3	Lexical tokens, identifiers, keywords, literals, comments, primitive data types, operators assignments.			
Unit-2:	**Basic Java Programming**			
2.1	Class and object fundamentals , creating and operating classes and objects , understanding types of classes, code blocks, access control constructor, interfaces defining methods argument passing mechanism , method overloading, recursion, dealing with static members, use of "this " reference, other aspects related with complete understanding of classes and objects			**08**
Unit-3:	**Core Java**			
3.1	Inheritance in JAVA, types of inheritance in java, inheriting data members and methods , role of constructors in inheritance , overriding super class methods ,use of "super" , polymorphism in inheritance ,type compatibility and conversion implementing interfaces.			**08**
3.2	Organizing classes and interfaces in packages , package as access protection , defining package ,classpath setting for packages , making jar files for library packages import and static import naming convention for packages.			**08**
3.3	Introduction to threads , exceptions and event handling in Java			
Unit-4:	**Advanced Java**			
4.1	Utility methods for arrays ,observable and observer objects , date & times ,using scanner regular expression, input/output operation in java(java.io package),streams and the new i/o capabilities ,understanding streams, the classes for input and output, the standard streams, working with file object, file i/o basics, reading and writing to files, buffer and buffer management, read/write operations with file channel, serializing objects .			**04**
4.2	Introduction to jdbc,jdbc drivers & architecture, curd operation using jdbc,			**04**

	connecting to non-conventional databases.	
4.3	Web application basics, architecture and challenges of web application, introduction to servlet, servlet life cycle, developing and deploying servlets, exploring deployment , descriptor (web.xml), handling request and response.	**08**
Lab	**Use of Programming language / Packages for actual hands on**	
01 Credit Lab	Case studies / experiments leading to independent projects / work out where students implement above core and advanced Java concepts leading to a Lab Book	**12**
Text Book		
1	Discrete Mathematical Structures- C. L. Liu, Second Edition, McGraw-Hill Book	
Reference Books		
1.	Discrete Mathematical Structures- Y N Singh, Wiley-India Press.	
2.	Discrete Mathematics for Computer Scientists and Mathematicians- J. L. Mott, A.Kandel, Prentice Hall of India.	
3.	Discrete Mathematical Structures with Applications to Computer Science- Discrete Mathematics for Computer Scientists and Mathematicians, Tata Mcgraw-Hill.	

Course Code:	SCDSE-451 B Elective	Design and Analysis of Algorithms	Credits: 3 Theory and 01 Lab	Hours required
Pre requisite				
1. Knowledge of Data structures				
Course Objectives:				
1. Reinforce basic design concepts (e.g., pseudo code, specifications, top-down) 2. Knowledge of algorithm design strategies 3. Familiarity with an assortment of important algorithms 4. Ability to analyze time and space complexity				
Course Outcome:				
1. Ability to analyze algorithm 2. Ability to propose efficient algorithms 3. Ability to think on complexity issues				
Unit-1:	**Review of Algorithms and elementary data structures**			
1.1	Understanding basic data structures and their applications with more emphasis on graphs and trees, knowledge of algorithm and their complexity notations, emphasis on asymptotic notations			**08**
1.2	Complexity analysis for algorithms on graphs including DFS,BFS , shortest path algorithms like, the Bellman-ford algorithm, the Dijkstra algorithm ,the Floyd-Warshall algorithm, the Johnsons algorithm.			
1.3	Complexity analysis for algorithms on trees including, tree searching, inseartion of node / deletion of nodes in trees, traversing trees, binary search trees trees, AVL trees			
Unit-2:	**Divide and conquer mechanism**			
2.1	Introduction, general method, algorithm complexity analysis for binary search, merger sort, quick sort, Strassen s matrix multiplication.			**08**
Unit-3:	**Advanced algorithm design methods-1**			
3.1	Greedy method, general method, container loading knapsack problem, job sequence, introduction to spanning trees , minimum spanning trees ,growing a minimum spanning tree, the algorithms of Kruskal and Prim.			**08**
3.2	Dynamic programming, general method, applications 0/1 knapsack problem, travelling sales person problem			**08**
Unit-4:	**Advanced algorithm design methods-2**			
4.1	General Backtracking method, Applications- n-queen problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles			**04**
4.2	Introduction to String matching, Robin – Karp algorithm, Knuth – Morris Pratt algorithm,			**04**
4.3	Introduction to NP completeness , polynomial time , polynomial time verification , reducibility, NP completeness proofs ,NP completeness problems			**08**
Lab	**Use of Programming language / Packages for actual hands on**			
01 Credit Lab	Case studies / experiments leading to independent projects / work out where students implement above analysis of algorithm concepts leading to a Lab Book			**12**

Text Book		
1	Introduction to Algorithms, Corman , Leiserson and others , 2nd edition , PHI	
Reference Books		
1.	Data Structures, Lipschutz , Tata McGraw Hills	
2.	Design Methods and Analysis of Algorithms , S.K.Basu , PHI.	
3.	The Art of Computer Programming, Vol 1,2,3 , Dr.Kunth , Addison Wesley	

Course Code:	SCDSE-451 C Elective	Information System Security	Credits: 3 Theory and 01 Lab	Hours required
Pre requisite				
1. understanding of computer technology, including software, hardware, telecommunications and basics of internet				
Course Objectives:				
1. Identify and prioritize information assets. 2. Identify and prioritize threats to information assets. 3. Define an information security strategy and architecture.				
Course Outcome:				
1. Students will be able to plan for and respond to intruders in an information system. 2. Ability to describe legal and public relations implications of security and privacy issues. 3. Ability to present a disaster recovery plan for recovery of information assets after an incident.				
Unit-1:	**Understanding Attacks and Introduction to Security Mechanisms**			
1.1	Active attacks, passive attacks, social engineering, denial of service attacks, buffer overflow attacks, malware (viruses, trojan horses, worms)			**04**
1.2	Cryptosystems, authentication ("who you are, what you have, what you know"), intrusion detection, redundancy, disaster recover, security services, availability integrity, confidentiality authentication, non-repudiation			**04**
Unit-2:	**Terminology and Background of Cryptosystems**			
2.1	Cryptosystems, encryption, decryption, plain text and cipher text, encryption algorithms			**04**
2.2	Hash algorithms, hash concept, description of hash algorithms, message digest algorithms, secure secret key (symmetric) systems			**04**
2.3	The data encryption standard (DES), advance encryption standard (AES), block cipher operational modes, public key (asymmetric key) encryption systems concept and characteristics of public key encryption system, Rivest-Shamir-Adelman (RSA)			**04**
2.4	Introduction to digital signature algorithms, the digital signature standard (DSA), introduction to elliptic curve (EC,) cryptography			**04**
Unit-3:	**Key Management issues in security**			
3.1	Solving key distribution problem, diffie-hellman algorithm, key exchange with public key cryptography, public key infrastructure (PKI), concept of digital certificate, certificate authorities and it's roles, digital certificates types			**06**
3.2	Understanding important network security protocols and authentication protocols , knowledge of secure shell (SSH), IP security (IPSec) protocol, VPN, securing wireless networks, intruder detection and prevention, understanding malicious code (virus, worms, zombies etc.), preventing malware attacks, firewalls			**06**
Unit-4:	**The Internet Security**			

4.1	Web security, solving privacy problems ,solving authentication problems, secure socket layer (SSL) protocol secure payment protocols, secure electronic mail, pretty good privacy (PGP), secure/multipurpose internet mail extensions, handling spams (hoax, phishing, chain mails, financial) detection and prevention.	**06**
4.2	Security policy creation of policies (password, internet, e-mail and social network access policies etc.), threat analysis model, security auditing, enforcement legal issues, security awareness issues	**06**
Lab	**Use of Programming language / Packages for actual hands on**	
01 Credit Lab	Case studies / experiments leading to independent projects / work out where students implement above information system security concepts leading to a Lab Book / project report	**12**
Text Book		
1	Security in Computing (Fourth Edition)", Charles P. Pfleeger, Prentice-Hall International,	
Reference Books		
1.	Applied Cryptography Protocols, Algorithms, and Source Code in C (Second edition)", Bruce Schneier, John Wiley & Sons, Inc	
2.	Computer Security: Art and Science, Matt Bishop	

Course Code:	**SCDSCP-451**	**Course Name: Lab-4**	**Credits: 01**
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	**SCDSCP-452**	**Course Name: Lab-5**	**Credits: 01**
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSCP-453	Course Name: Lab 6	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSOJ-451	On Job Training , Internship/ Apprenticeship or Field Project	Credits: 03
Course Objectives: As per the University rules and policy			
Course Outcome: As per the University rules and policy			
Experiments As per the University rules and policy			

==0000==== First Year Ends====0000==

M. Sc. DS Second Year, Semester III and IV *(Level 6.0) : Teaching Scheme*

Coures	Course Code	Course Name	Credits Assigned per course			Teaching Scheme (Hrs/ week) per course	
			Theory	**Practical**	**Total**	**Theory**	**Practical**
Major	SCDSC-501 to SCDSC-503 and SCDSC-551, SCDSC-552	All Core Course	04	--	**04**	**04**	--
Elective	SCDSE-501 and SCDSE-551	All Elective Courses	03	--	**03**	**03**	--
Special Courses	SVECP-551	Publication Ethics	02	--	**02**	**02**	
Major Practical	SCDSCP-501, SCDSCP-502, SCDSE-501 and SCDSCP-551, SCDSCP-552, SCDSE-551	All Core labs	--	01	**01**	--	**02**
Research Project	SCDSR-551 and SCDSR-552		--	04 & 06	**04 & 06**	--	**04 & 06**
Total Credits per semester			**III Sem 15 IV Sem 13**	**III Sem 07 IV Sem 09**	**22**	**III Sem 15 IV Sem 13**	**III Sem 07 IV Sem 09**
Total credits per year			**28**	**16**	**44**	**28**	**16**

M. Sc. DS Second Year , Semester III and IV (Level 6.0) :Examination Scheme

Course Code (2)	**Course Name (3)**	**Theory**				**Practical**		**Total Col (6+7) / Col (8+9) (10)**
		Continuous Assessment (CA)			**ESA**			
		Test I (4)	**Test II (5)**	**Avg of (T1+T2)/2 (6)**	**Total (7)**	**CA (8)**	**ESA (9)**	
SCDSC501 to SCDSC-503 and SCDSC-551, SCDSC-552	All core courses	20	20	`20	80	--	--	100
SCDSE-501 and SCDSE-551	All elective courses	15	15	15	60	--	--	75
SVECP	Publication Ethics	15	15	20	--	--	--	50
SCDSCP-501, SCDSCP-502, and SCDSCP-551, SCDSCP-552	All Core Labs	--	--	--	--	05	20	25
SCDSEP-501 and SCDSEP-551	All Elective labs	--	--	--	--	05	20	25
SCDSR-551	Research Project	--	--	--	--	50	50	100
SCDSR-552	Research Project	--	--	--	--	75	75	150

Third Semester

Course Code:	SCDSC-501	Introduction to Data Science	Credits: 4 Theory	Hours required
Pre requisite				
1. Basic understanding of mathematics, including algebra and statistics. 2. Familiarity with programming fundamentals, preferably in a language like Python. 3. Some exposure to data analysis concepts and techniques would be beneficial.				
Course Objectives:				
1. Understand fundamental concepts and techniques of data science, including data manipulation, visualization, and analysis. 2. Develop skills in using programming languages like Python for data manipulation and analysis. 3. Gain hands-on experience with real-world data sets to apply data science techniques and interpret results effectively.				
Course Outcome:				
1. Demonstrate proficiency in basic data analysis techniques using tools like Python. 2. Apply data visualization methods to communicate insights effectively from various datasets. 3. Critically evaluate data science methodologies and their applicability in solving real-world problems.				
Unit-1:	**Introduction to Data and Data Science**			**15**
1.1	Overview of data science and its interdisciplinary nature Applications of data science in industry and academia			
1.2	What do data scientists do, Data science life cycle, Components of data science, Ethical considerations in data science			
Unit-2:	**Data Acquisition and Cleaning**			**15**
2.1	Data sources and formats, Data scraping and web crawling, Data cleaning techniques (handling missing values, outlier detection)			
2.2	Overview of data analysis, Types of data analytics, descriptive, predictive and perspective			
Unit-3:	**Exploratory Data Analysis (EDA)**			**15**
3.1	Descriptive statistics, Data visualization, Data visualization tools			
3.2	Univariate, Bivariate analysis, data preprocessing, data cleaning, data integration, data reduction, data transformation			
3.3	Correlation analysis, Dimensionality reduction			
Unit-4:	**Introduction to Big Data and Cloud Computing**			**15**
4.1	Challenges of big data and scalable data processing			
4.2	Introduction to cloud computing platforms (AWS, Google Cloud)			
4.3	Distributed computing frameworks (Hadoop,Spark)			
Text Book				
1	Data Science and Analytics with Python Programming by V. K. Jain, Khanna Book Publication.			

Reference Books		
1.	"Ethics of Big Data: Balancing Risk and Innovation" by Kord Davis and Doug Patterson	
2.	"Python for Data Analysis" by Wes McKinney	
3.	Data Science and Machine Learning by N. Meenakshi K. E. Rajakumari S.Hariharasitaraman	
4.	The Data Science Handbook: Advice and Insights from 25 Amazing Data Scientists Paperback by Carl Shan , William Chen	
5.	"Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani	
6.	"Data Science from Scratch: First Principles with Python" by Joel Grus O'Reilly Media, 2019.	

Course Code:	SCDSC-502	Mathematics and Statistics for Data Science	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in algebra, calculus, and basic mathematical concepts. 2. Solid understanding of probability theory and statistical methods. 3. Familiarity with programming languages such as Python for implementing mathematical and statistical algorithms.				
Course Objectives:				
1. Develop a deep understanding of mathematical and statistical concepts essential for data analysis and interpretation. 2. Acquire proficiency in applying mathematical and statistical techniques to solve data science problems. 3. Explore the role of mathematics and statistics in various data science applications, including machine learning and predictive modeling.				
Course Outcome:				
1. Demonstrate the ability to apply mathematical and statistical methods to analyze and interpret data effectively. 2. Communicate findings and insights from data analysis using appropriate mathematical and statistical terminology. 3. Critically evaluate and select appropriate mathematical and statistical techniques for addressing specific data science problems and scenarios.				
Unit-1:	**Mathematical Foundations**			**10**
1.1	Overview of data science, Importance of mathematics and statistics in data science,			
1.2	Calculus for Data Science-Limits, derivatives, and integrals, Optimization techniques, Applications of calculus in data analysis			
Unit-2:	**Linear Algebra**			**10**
2.1	Vectors and matrices, Matrix operations and transformations			
2.2	Eigenvalues and eigenvectors, Applications of linear algebra in data manipulation and analysis			
Unit-3:	**Probability Theory**			**20**
3.1	Probability basics, Random variables and probability distributions			
3.2	Joint, marginal, and conditional probabilities,			
3.3	Bayesian inference			
Unit-4:	**Statistical Inference**			**20**
4.1	Sampling distributions, Estimation techniques (maximum likelihood estimation)			
4.2	Hypothesis testing, Confidence intervals			
4.3	Regression Analysis			
	Text Book			
1.	"Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie,Robert Tibshirani			
	Reference Books			
1.	"Linear Algebra and Its Applications" by David C. Lay, Steven R. Lay, Judi J. McDonald			
2.	"Calculus: Early Transcendentals" by James Stewart			
3.	Introduction to Linear Algebra, Fifth Edition, Gilbert Strang,			
4.	“Linear Algebra and Learning from Data”, Gilbert Strang,Wellesley,Cambridge Press,			

5.	"Mathematics for Machine Learning" by Marc Peter Deisenroth, Cambridge Uni. Press	
6.	"Applied Statistics and Probability for Engineers", by Douglas Montgomery	

Course Code:	SCDSC-503	Python Programming for Data Science	Credits: 4 Theory	Hours required
Pre requisite				
1. Basic understanding of computer programming concepts and syntax. 2. Familiarity with fundamental data structures such as lists, tuples, and dictionaries. 3. Prior exposure to Python programming language or another similar language would be advantageous.				
Course Objectives:				
1. Master the fundamentals of Python programming language with a focus on its applications in data science. 2. Develop proficiency in using Python libraries such as NumPy, Pandas, and Matplotlib for data manipulation, analysis, and visualization. 3. Gain practical experience by implementing data science projects and exercises using Python programming techniques.				
Course Outcome:				
1. Demonstrate the ability to write efficient Python code to manipulate, analyze, and visualize data for various data science tasks. 2. Apply Python programming skills to solve real-world data science problems and effectively communicate findings. 3. Acquire a solid foundation in Python programming specifically tailored for data science applications, enabling further specialization and professional development in the field.				
Unit-1:	**Python Essentials**			**15**
1.1	Overview , Starting with Python, Installation of Python, Python IDE's.			
1.2	Data Types :Strings, Tuples, Lists, Dictionaries, Basic Operators, Control flow & conditional statements, Built-in Functions: Text, Numeric, Date			
1.3	User defined functions, Lambda functions			
Unit-2:	**NumPy**			**10**
2.1	Introduction, ndarray Object, Creating ndarrays, Array attributes of numpy, Indexing and Slicing,			
2.2	Iterating over Array, Array Manipulation, Mathematical Functions, Arithmetic Operations, Statistical Functions			
2.3	Sort Search and Counting Functions, Matrix Library: numpy.linalg module**.**			
Unit-3:	**Pandas**			**15**
3.1	What is pandas, Pandas Data Structures, Indexing in series, accessing rows, Attributes & Methods on a Series , Sorting of series by value and index			
3.2	Data Frame Attributes, Column Selection , Column Addition, Broadcasting, Data Frame methods, Sorting DataFrame with respect to index and values			
3.3	Filtering of rows in DataFrame based on conditions,Methods for filtering DataFrame, Customize and Reset the index, Row retrieval by loc Accessor and iloc Accessor, Methods for Data Extraction, GroupBy, Merging, Joining ,Concatenating Data Frames, Importing and Exporting files			
Unit-4:	**Visualization with Python**			**20**
4.1	Introduction to Data Visualization, Introduction to Matplotlib			
4.2	Basic Plotting with Matplotlib: Line Plots, Area Plots, Histograms/Density plots, Bar Charts/Stacked charts			
4.3	Pie Charts, Box Plots, Scatter Plots, Panel charts /subplots, Word Clouds, Seaborn and Regression Plots			

Text Book		
1.	Mastering python for data science, Samir Madhavan	
Reference Books		
1.	Python Data Analytics: With Pandas, NumPy, and Matplotlib	
2.	Hands-On Data Analysis with NumPy and Pandas By Curtis Miller	
3.	Data Science and Analytics with Python Programming by V. K. Jain, Khanna Book Publication.	
4.	"Python for Data Analysis" by Wes McKinney	
5.	"Python Data Science Handbook" by Jake VanderPlas	

Course Code:	SCDSE-501 A Elective	Machine Learning	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in programming languages such as Python or R. 2. Understanding of basic mathematical concepts including linear algebra, calculus, and probability theory. 3. Familiarity with data manipulation and analysis techniques, preferably using libraries like NumPy and Pandas.				
Course Objectives:				
1. Understand the fundamental principles and algorithms of machine learning, including supervised, unsupervised, and reinforcement learning. 2. Gain proficiency in implementing and evaluating machine learning models using popular libraries such as scikit-learn and TensorFlow. 3. Apply machine learning techniques to solve real-world problems, interpret model results, and make data-driven decisions.				
Course Outcome:				
1. Demonstrate the ability to apply machine learning algorithms to analyze and extract insights from various types of data. 2. Evaluate and compare the performance of different machine learning models for specific tasks and datasets. 3. Communicate effectively about machine learning concepts, methodologies, and results to both technical and non-technical stakeholders.				
Unit-1:	**Introduction to Machine Learning**			**20**
1.1	Introduction, Applications of ML, Supervised, Unsupervised,Reinforcement Learning, Process of executing the ML project, Stages of ML Project, Over fitting and Under fitting, Performance Metrics			
1.2	Concept of feature engineering, Regularization (LASSO, Elastic net and Ridge), Types of Cross validation (Train & Test, K-Fold validation etc.)			
1.3	Concept of optimization - Gradient descent algorithm, Loss/Cost & optimization functions, Tuning the parameters ,Python libraries for ML			
Unit-2:	**Supervised Learning**			**10**
2.1	Regression Analysis,Linear Regression,K-Nearest Neighbor,Decision Trees Ensemble Learning, Support Vector Regressor			
2.2	Classification, Logistic Regression, K-Nearest Neighbor, Naïve Bayes Classifier, Decision Trees, Ensemble Learning ,Support Vector Classifier			
Unit-3:	**Unsupervised Learning**			**20**
3.1	Clustering Algorithms,K-Means,Hierarchical Clustering,DBSCAN,Gaussian Mixture Models (GMM)			
3.2	Dimensionality Reduction,PCA,t-SNE,Autoencoders			
3.3	Anomaly Detection,Association Rule Learning, Apriori Algorithm, FP-Growth Algorithm			
Unit-4:	**Time Series Forecasting**			**10**
4.1	What is forecasting,Applications of forecasting, Time Series Components and Decomposition,Types of Seasonality, Important terminology:lag,lead, stationary,stationary tests,auto correlation & white noise, ACF & PACF plots, auto regression, differencing			
4.2	Classification of Time Series Techniques, Time Series Modelling & Forecasting			

	Techniques, Averages, ETS models -Holt Winter Methods, Seasonal Decomposition, ARIMA/ARIMAX/SARIMA/SARIMAX	
Text Book		
1.	"Machine Learning" by Tom M. Mitchell	
Reference Books		
1.	"Python Machine Learning by Example", Yuxi (Hayden) Liu,	
2.	"Machine Learning applications using Python: Case Studies from Healthcare, Retail and Finance" by Puneet Mathur	
3.	"Python Machine Learning Case Studies: Five Case Studies for the data Scientist" By Haroon.D	
4.	"Python Machine Learning" by Wei-Meng Lee	

SCDSE-501 B, C, D, E and F

Syllabus opted from M.Sc. Computer Science III Sem SCDSE-501 Elective

Course Code:	SCDSCP-501	Course Name: Lab-7	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSCP-502	Course Name: Lab-8	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSR-551	Course Name: Research Project	Credits: 04
Course Objectives: As per concerned supervisor of research project			
Course Outcome: As per concerned supervisor of research project			
Experiments As per concerned supervisor of research project			

Fourth Semester

Course Code:	SCDSC-551	Deep Learning	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in programming languages such as Python, with a strong foundation in data manipulation and analysis libraries. 2. Understanding of linear algebra, calculus, and probability theory, as deep learning heavily relies on these mathematical concepts. 3. Prior knowledge of machine learning concepts and algorithms, as deep learning builds upon these principles.				
Course Objectives:				
1. Develop an in-depth understanding of neural networks and their architectures, including feedforward, convolutional, and recurrent neural networks. 2. Gain proficiency in implementing deep learning models using frameworks like TensorFlow and PyTorch. 3. Explore advanced deep learning concepts such as generative adversarial networks (GANs), reinforcement learning, and transfer learning for solving complex problems in various domains.				
Course Outcome:				
1. Demonstrate the ability to design, train, and evaluate deep learning models for various tasks such as image recognition, natural language processing, and time series analysis. 2. Apply advanced deep learning techniques to solve real-world problems and optimize model performance. 3. Communicate effectively about deep learning methodologies, results, and implications, demonstrating a comprehensive understanding of the field.				
Unit-1:	**Neural Networks Basics**			**15**
1.1	Binary Classification, Logistic Regression, Gradient Descent, Derivatives, Computation graph			
1.2	Vectorization, Vectorizing logistic regression – Shallow neural networks: Activation functions, non-linear activation functions, Backpropagation			
1.3	Data classification with a hidden layer			
Unit-2:	**Deep Neural Networks**			**15**
2.1	Deep L-layer neural network, Forward and Backward propagation, Deep representations			
2.2	Parameters vs Hyperparameters, Building a Deep Neural Network (Application)			
2.3	Supervised Learning with Neural Networks – Practical aspects of Deep Learning: Train/Dev / Test sets, Bias/variance, Overfitting and regularization			
2.4	Linear models and optimization, Vanishing/exploding gradients, Gradient checking – Logistic Regression			
Unit-3:	**Convolution Neural Networks**			**15**
3.1	RNN and Backpropagation – Convolutions and Pooling			
3.2	Optimization algorithms: Mini-batch gradient descent, exponentially weighted averages			
3.3	RMSprop, Learning rate decay, problem of local optima, Batch norm – Parameter tuning process.			

Unit-4:	**Neural Network Architectures**	**15**
4.1	RNN, Adversarial NN, Spectral CNN, Self-Organizing Maps	
4.2	Restricted Boltzmann Machines, Long ShortTerm Memory Networks (LSTM)	
4.3	Deep Reinforcement Learning – TensorFlow, Keras	
Text Book		
1	"Deep Learning", Ian Goodfellow, Yoshua Bengio and Aeron Courville, MITPress,2016.	
Reference Books		
1.	"Deep Learning, A practitioner's approach", Adam Gibson and Josh Patterson, O'Reilly,	
2.	"Hands-On Learning with Scikit-Learn and Tensorflow" Aurelien Geron, O'Reilly, 2017.	
3.	"Deep Learning with Python", Francois Chollet, Manning Publications, 2018.	
4.	"Python Machine Learning by Example", Yuxi (Hayden) Liu, First Edition, 2017.	
5.	"Deep Learning with Python: A Hands-on Introduction" by Nikhil Ketkar	
6.	"Deep Learning with Applications Using Python" by Navin Kumar Manaswi	

Course Code:	SCDSC-552	Foundations of Large Language Models	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in programming languages such as Python, with experience in data manipulation and analysis libraries. 2. Understanding of natural language processing (NLP) concepts and techniques, including text preprocessing, tokenization, and feature engineering. 3. Familiarity with machine learning and deep learning fundamentals, especially neural network architectures and optimization algorithms.				
Course Objectives:				
1. Understand the theoretical underpinnings and practical applications of large language models, including transformer-based architectures. 2. Explore pre-training and fine-tuning techniques for large language models and their implications on various NLP tasks. 3. Gain hands-on experience in implementing and evaluating large language models using frameworks such as Hugging Face Transformers and TensorFlow.				
Course Outcome:				
1. Demonstrate proficiency in understanding and applying large language models to solve a variety of natural language processing tasks. 2. Critically evaluate the performance and limitations of large language models in different contexts, considering factors such as data biases and ethical implications. 3. Communicate effectively about the principles, methodologies, and applications of large language models to technical and non-technical audiences.				
Unit-1:	**Introduction to Large Language Models**			**15**
1.1	Overview of NLP,Evolution of language models, Importance of large-scale pre-training in NLP, Transformer Architecture-Self-attention mechanism, Positional encoding,Multi-head attention,Feed-forward networks			
1.2	Pre-training Large Language Models-Data collection and preprocessing, Masked language modeling objective,Training strategies and optimization techniques,Transfer learning and fine-tuning			
Unit-2:	**GPT (Generative Pre-trained Transformer) Models**			**15**
2.1	GPT architecture and variants,Text generation using GPT,			
2.2	Applications of GPT in language understanding and generation			
Unit-3:	**BERT (Bidirectional Encoder Representations from Transformers)**			**15**
3.1	BERT architecture and pre-training objectives,Masked language model (MLM) and next sentence prediction (NSP)			
3.2	Fine-tuning BERT for various NLP tasks			
Unit-4:	**Evaluation Metrics and Benchmarks**			**15**
4.1	Common evaluation metrics in NLP (e.g., accuracy, F1 score) Benchmark datasets and tasks (e.g., GLUE, SuperGLUE)			
4.2	Challenges in evaluating large language models			
4.3	Applications of Large Language Models-Text classification,Named entity recognition,Question answering,Summarization,Conversational agents			
Text Book				
1	"Attention is All You Need",Vaswani et al., 2017			
Reference Books				

1.	"The Illustrated Transformer" ,Alammar, 2018	
2.	Research papers and articles from top conferences (e.g., NeurIPS, ACL, EMNLP)	
3.	Online tutorials and documentation for TensorFlow and PyTorch	
4.	Open-source implementations of LLM(e.g., Hugging Face Transformers library)	

Course Code:	SCDSE-551 A Elective	Introduction to Generative AI	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in programming languages such as Python, with experience in data manipulation and analysis libraries. 2. Understanding of machine learning fundamentals, including supervised and unsupervised learning algorithms. 3. Familiarity with deep learning concepts, particularly neural networks and their architectures.				
Course Objectives:				
1. Develop a foundational understanding of generative artificial intelligence techniques, including generative adversarial networks (GANs) and variational autoencoders (VAEs). 2. Explore the applications of generative AI in various domains such as image generation, text generation, and creative content creation. 3. Gain hands-on experience in implementing and experimenting with generative AI models using frameworks like TensorFlow and PyTorch.				
Course Outcome:				
1. Demonstrate proficiency in understanding and applying generative AI techniques to generate realistic and diverse outputs across different domains. 2. Evaluate the strengths and limitations of various generative AI models and their applications in solving real-world problems. 3. Communicate effectively about generative AI concepts, methodologies, and potential implications to technical and non-technical stakeholders.				
Unit-1:	**Introduction**			**15**
1.1	Overview of generative models and their applications,Importance of generative AI in creative tasks and data augmentation			
1.2	Autoencoders- Basics of autoencoder architecture,Components,Training autoencoders for reconstruction and dimensionality reduction,Variational autoencoders (VAEs) for probabilistic latent space modeling			
Unit-2:	**Generative Adversarial Networks (GANs)**			**15**
2.1	Introduction to GAN architecture and components (generator and discriminator), Adversarial training and the minimax game,Training techniques for stable GAN training (e.g., Wasserstein GAN, spectral normalization)			
2.2	Conditional Generation and Style Transfer,Conditional GANs for controlled generation tasks,Image-to-image translation using conditional GANs, Style transfer and image manipulation using GANs			
Unit-3:	**Text Generation and NLP**			**15**
3.1	Sequence generation with recurrent neural networks (RNNs) and LSTM, Generative models for text generation (sequence-to-sequence models, GPT)			
3.2	Applications of generative AI in NLP tasks (e.g., language translation, text summarization)			
Unit-4:	**Creative Applications of Generative AI**			**15**
4.1	Art generation and style transfer, Music generation using recurrent neural networks,Design and architecture using generative models			
Text Book				
1	Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and			

	Play" by David Foster	
Reference Books		
1.	"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville	
2.	"Deep Generative Models: A Tutorial" by Ian Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville,Yoshua Bengio	
3.	"Generative Adversarial Networks: An Overview" by Ahmar Raza ,Muhammad Asif Habib	
4.	"Conditional Generative Adversarial Nets" by Mehdi Mirza and Simon Osindero	
5.	"Variational Inference and Deep Learning: A New Synthesis" by David Barber	
6.	"Generative Modeling" by Chuan-Sheng Foo and Benjamin Tan	

Course Code:	SCDSE-551 B Elective	Business Problem Solving & Predictive Modeling	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in data manipulation and analysis using tools such as Excel, SQL, or Python. 2. Understanding of basic statistical concepts and techniques for data analysis and interpretation. 3. Familiarity with machine learning concepts and algorithms, including supervised and unsupervised learning.				
Course Objectives:				
1. Develop skills to identify and define business problems amenable to predictive modeling and data-driven solutions. 2. Acquire proficiency in applying appropriate predictive modeling techniques to address business challenges effectively. 3. Explore strategies for interpreting and communicating predictive model results to support decision-making processes in business contexts.				
Course Outcome:				
1. Demonstrate the ability to utilize predictive modeling techniques to solve real-world business problems and make informed decisions. 2. Evaluate the performance of predictive models and their impact on business outcomes, considering factors such as accuracy, interpretability, and scalability. 3. Communicate effectively about the findings, insights, and recommendations derived from predictive modeling analyses to stakeholders in business environments.				
Unit-1:	**Predictive Modeling in Business**			**15**
1.1	Overview of predictive modeling, Applications in business, Business problem-solving framework, Ethical considerations in predictive modeling			
1.2	Data Collection and Preprocessing-Data sources and acquisition, Data cleaning, Preprocessing techniques, Handling missing values and outliers			
Unit-2:	**Exploratory Data Analysis (EDA)**			**15**
2.1	Descriptive statistics, Data visualization, Identifying patterns and relationships in the data			
2.2	Feature engineering and selection			
Unit-3:	**Supervised Learning Techniques**			**15**
3.1	Linear regression for predictive modeling, Classification algorithms (e.g., logistic regression, decision trees, random forests)			
3.2	Model selection and hyperparameter tuning, Evaluation Metrics for Predictive Modeling, Metrics for regression tasks (RMSE, MAE), Metrics for classification tasks (accuracy, precision, recall, F1-score),Cross-validation techniques			
Unit-4:	**Model Interpretability and Explainability**			**15**
4.1	Interpreting coefficients in linear regression, Feature importance analysis in tree-based models, Model-agnostic interpretability techniques			
4.2	Ensemble Learning , Ensemble methods (bagging, boosting, stacking), Applications of advanced techniques in business			
Text Book				
1	"Predictive Analytics for Business Strategy" by Jeff Wu and Andrew Ng			
Reference Books				

1.	"Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett	
2.	"Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel	
3.	"Python for Data Analysis" by Wes McKinney	

Course Code:	SCDSE-551 C Elective	Emerging Trends in Data Science	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in fundamental data science concepts and techniques, including data manipulation, analysis, and visualization. 2. Understanding of machine learning and deep learning methodologies and their applications in various domains. 3. Familiarity with emerging technologies and trends in data science, such as big data platforms, cloud computing, and AI ethics.				
Course Objectives:				
1. Explore recent advancements and emerging trends in data science, including big data analytics, artificial intelligence, and machine learning. 2. Understand the implications of emerging technologies such as edge computing, blockchain, and quantum computing on the field of data science. 3. Analyze case studies and real-world applications to evaluate the potential impact of emerging trends on industries and society.				
Course Outcome:				
1. Demonstrate a comprehensive understanding of the latest developments and trends in data science, including their theoretical foundations and practical applications. 2. Critically evaluate the potential opportunities and challenges associated with emerging technologies in the context of data science and its various applications. 3. Communicate effectively about emerging trends in data science, their implications, and potential strategies for leveraging them to drive innovation and solve complex problems in diverse domains.				
Unit-1:	**Introduction**			**15**
1.1	Overview of recent advancements and emerging technologies, Importance of staying updated in the field of data science, Ethical considerations			
1.2	Deep Learning and Neural Networks,Deep learning architectures: CNNs, RNNs, and Transformers,Transfer learning and pre-trained models,Advances in natural language processing and computer vision			
Unit-2:	**Reinforcement Learning**			**15**
2.1	Basics of reinforcement learning,Markov decision processes, Deep Q-Networks (DQN), Policy gradients,			
2.2	Applications in robotics, gaming, and autonomous systems			
Unit-3:	**Ethical AI and Data Science**			**15**
3.1	Bias, fairness, and transparency in machine learning algorithms,Ethical considerations in data collection, processing, and usage, Regulatory frameworks,Guidelines for ethical AI			
3.2	Data Science & Blockchain-Overview of blockchain technology, Smart contracts and decentralized applications (DApps), Applications of blockchain in data privacy, security, and authentication			
Unit-4:	**Data Science and IoT**			**15**
4.1	Interdisciplinary applications of data science in IoT ecosystems Sensor data analytics and predictive maintenance Edge computing and real-time analytics			
Text Book				

1	"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville	
Reference Books		
1.	"Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto	
2.	"Pattern Recognition and Machine Learning" by Christopher M. Bishop	
3.	"Ethics of Artificial Intelligence and Robotics" edited by Vincent C. Müller , Shannon Vallor	
4.	"Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher	
5.	"Internet of Things: Architectures, Protocols, and Applications" by Rajkumar Buyya, Amir Vahid Dastjerdi, and Antonios G. Alexandridis	

Course Code:	SCDSE-551 D Elective	Computer Vision and Image Recognition	Credits: 4 Theory	Hours required
Pre requisite				
1. Proficiency in programming languages such as Python, with experience in libraries commonly used for data manipulation and analysis. 2. Understanding of linear algebra and calculus, which are foundational for understanding computer vision algorithms and techniques. 3. Familiarity with machine learning concepts, particularly convolutional neural networks (CNNs), as they form the basis for many image recognition models.				
Course Objectives:				
1. Develop a comprehensive understanding of computer vision principles, algorithms, and techniques for processing and analyzing visual data. 2. Gain proficiency in implementing and evaluating image recognition models using deep learning frameworks such as TensorFlow and PyTorch. 3. Explore advanced topics in computer vision, including object detection, image segmentation, and image generation, and their applications in various domains.				
Course Outcome:				
1. Demonstrate the ability to apply computer vision techniques to solve a variety of image recognition tasks, such as object detection, classification, and segmentation. 2. Evaluate and compare the performance of different computer vision models and algorithms for specific image processing and analysis tasks. 3. Communicate effectively about the principles, methodologies, and results of computer vision and image recognition projects to technical and non-technical stakeholders.				
Unit-1:	**Introduction to Computer Vision**			**15**
1.1	Overview of computer vision,Image formation and representation, Image acquisition and preprocessing			
1.2	Image Processing Techniques, Image filtering and convolution, Edge detection and feature extraction,Image transformation and enhancement			
Unit-2:	**Image Classification**			**15**
2.1	Traditional machine learning classifiers (e.g., SVM, k-NN),Convolutional Neural Networks (CNNs) for image classification,Transfer learning for image classification			
2.2	Object Detection-Sliding window approach,Haar cascades and Viola-Jones algorithm,Region-based Convolutional Neural Networks (R-CNN)			
Unit-3:	**Deep Learning for Computer Vision**			**15**
3.1	Convolutional Neural Networks (CNNs) architecture and components, Training CNNs for image classification and object detection,Architectural variations: VGG, ResNet, Inception			
3.2	Image Segmentation-Thresholding and region-based segmentation,Semantic segmentation with Fully Convolutional Networks (FCNs), Instance segmentation with Mask R-CNN			
Unit-4:	**Applications of Computer Vision**			**15**
4.1	Facial recognition and emotion detection,Object tracking and surveillance Medical image analysis, Autonomous vehicles and robotics			
Text Book				
1	"Computer Vision: Algorithms and Applications" by Richard Szeliski			

Reference Books		
1.	"Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani	
2.	Research papers and articles from top conferences (e.g., CVPR, ICCV, ECCV)	
3.	OpenCV documentation and tutorials	
4.	Deep learning frameworks such as TensorFlow or PyTorch	
5.	Online courses and tutorials on computer vision topics	

SCDSE-551 E, F and G

Syllabus opted from M.Sc. Computer Science III Sem SCDSE-501 Elective

Course Code:	SVECP-551	Publication Ethics	Credits: 2 Theory	Hours required
Pre requisite				
Proficiency in academic writing and familiarity with the research publication process.				
Course Objectives:				
Enhance understanding of ethical principles and guidelines governing scholarly publishing practices.				
Course Outcome:				
Promote ethical behavior and integrity in academic publishing among students and researchers.				
Unit-1:	Publication ethics: definition, introduction and importance			**04**
Unit-2:	Best practices/standards setting initiatives and guidelines: COPE, WAME etc.			**04**
Unit-3:	Conflicts of interest			**04**
Unit-4:	Publication misconduct: Definition, concept, problems that lead to unethical behavior and vice versa, types			**04**
Unit-5:	Violation of publication ethics, authorship and contributorship			**04**
Unit-6:	Identification of publication misconduct, complaints and appeals			**04**
Unit-7:	Predatory publishers and journals			**04**
Text Book				
1	Research and **publication ethics, sultan chand publication**			

Course Code:	SCDSCP-551	Course Name: Lab-9	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSCP-552	Course Name: Lab-10	Credits: 01
Course Objectives: As per the Lab Manual circulated to students by the concerned Teacher			
Course Outcome: As per the Lab Manual circulated to students by the concerned Teacher			
Experiments As per the Lab Manual circulated to students by the concerned Teacher			

Course Code:	SCDSR-552	Course Name: Research Project	Credits: 06
Course Objectives: As per concerned supervisor of research project			
Course Outcome: As per concerned supervisor of research project			
Experiments As per concerned supervisor of research project			