PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Name of the Faculty: Science and Technology

NEP 2020

Syllabus: Entire Computer Science

Name of the Programme: B.Sc.[ECS]-II (Sem.–III and IV)

(Syllabus to be implemented w.e.f. June 2025)

B.Sc.[ECS] Part-II			Sem.-III							
Subject / Core Course	**Name and Type of the Paper**			**Hrs. / Week**			**Total Marks**	**UA**	**CA**	**Credits**
	Type	**Code**	**Name**	**L**	**T**	**P**				
Major	DSC1-3		Data Structures using C++	2	0	0	50	30	20	2
	Practical		Practical based on DSC1-3	0	0	2	25	15	10	1
	DSC1-4		Database Management Systems	2	0	0	50	30	20	2
	Practical		Practical based on DSC1-4	0	0	2	25	15	10	1
Minor	DSC2-3		Statistics for Data Science - I	2	0	0	50	30	20	2
	Practical		Practical based on DSC2-3	0	0	2	25	15	10	1
	DSC2-4		Advanced Python Programming	2	0	0	50	30	20	2
	Practical		Practical based on DSC2-4	0	0	2	25	15	10	1
Generic / Open Elective	GE3 / OE3		Operating Systems	2	0	0	50	30	20	2
Vocational and Skill Enhancement Courses	VSC1		Based on DSC1-3 and DSC1-4	0	0	4	50	30	20	2
	VSC2		Based on DSC2-3 and DSC2-4	0	0	4	50	30	20	2
Ability Enhancement Course (AEC)	L2-1			2	0	0	50	30	20	2
Field Project/ RP/CC/Internship/ Apprenticeship/ Community Engagement & Services	CC2			2	0	0	50	30	20	2
Total				**14**	**0**	**16**	**550**	**330**	**220**	**22**

Subject / Core Course	Name and Type of the Paper			Hrs. / Week			Total Marks	UA	CA	Credits
	Type	Code	Name	L	T	P				
Major	DSC1-5		Core Java	2	0	0	50	30	20	2
	Practical		Practical based on DSC1-5	0	0	2	25	15	10	1
	DSC1-6		Relational Database Management System	2	0	0	50	30	20	2
	Practical		Practical based on DSC1-6	0	0	2	25	15	10	1
Minor	DSC2-5		Statistics for Data Science - II	2	0	0	50	30	20	2
	Practical		Practical based on DSC2-5	0	0	2	25	15	10	1
	DSC2-6		Software Testing and Quality Assurance	2	0	0	50	30	20	2
	Practical		Practical based on DSC2-6	0	0	2	25	15	10	1
Generic / Open Elective	GE4 / OE4		Computer Networks	2	0	0	50	30	20	2
Vocational and Skill Enhancement Courses	VSC3		Based on DSC1-5 and DSC1-6	0	0	4	50	30	20	2
	VSC4		Based on DSC2-5 and DSC2-6	0	0	4	50	30	20	2
Ability Enhancement Course (AEC)	L2-2			2	0	0	50	30	20	2
Field Project/ RP/CC/Internship/ Apprenticeship/ Community Engagement and Services	FP1 / CEP1			0	0	4	50	30	20	2
Total				12	0	20	550	330	220	22

B.Sc.[ECS] Part-II   Sem.-IV

Abbreviations:

L: Lectures	**T**: Tutorials	**P**: Practical	**UA**: University Assessment	**CA**: College Assessment
Generic/ Open Electives: **GE/OE**		Skill Enhancement Courses: **SEC**		
Indian Knowledge System: **IKS**		Ability Enhancement Courses: **AES**		
Value Education Courses: **VEC**		Vocational Skill and Skill Enhancement Courses: **VSEC**		

Co-curricular Courses: **CC**	Field Project/ RP/CC/Internship/ Apprenticeship/ Community Engagement and Services: **FP / CEP**

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Type: DSC1-3 (Major)

B.Sc(ECS)-II (Semester III)

Course Title: Data Structure using C++

(Paper Code:)

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Credits: Theory – (2)	Practical's – (1)
Total Lectures: 30 Hrs.	**Contact Hrs. (L) :** 2
University Evaluation: 30 Marks	**Internal Evaluation:** 20 Marks

Course Outcomes:

1.	Understand basic data structures such as arrays, linked lists, stacks, and queues.
2.	To be familiar with fundamental data structures and with how these data structures can best be implemented, become accustomed to the description of algorithms in both functional and procedural styles.
3.	To know the complexity of basic operations like insert, delete, and search on these data structures.
4.	Ability to choose a data structure to model any data used in computer applications suitably.
5.	To solve problems involving graphs and trees.

Unit	Content	Lect.
I	**An Introduction to Data Structures:** Introduction, Definition and Types of Data Structure. Abstract Data Type (ADT). **Array:** Single and two-dimensional arrays and operations **Stack:** Introduction to Stack, Operations of stack- Create, isempty, isfull, push, pop, display. Implementation of stack using an array (Static Implementation), Applications of Stack-Conversion of infix expression to postfix expression, Conversion of infix expression to prefix expression, Matching parenthesis in an expression (Checking expression is valid or invalid), Evaluation of postfix expression, Stack in recursion, Implementation of all applications of stack. **Queue:** Introduction to Queue, Operations of the queue- Create, isempty, isfull, insert, remove, display, Types of Queue- Linear Queue, Circular Queue, Deque (Double Ended Queue), Priority queue. Implementation of all types of queue using the array (Static Implementation), Difference between stack and queue, Applications of Queue. **Searching and Sorting:** Bubble sort, Selection sort, Merge sort, Radix sort, Quick sort, Linear search, Binary search, Complexity of these algorithms	15
II	**Linked Lists:** Introduction to Linked Lists, Difference between Array and Linked list. Types of linked list- 1) Linear linked list- Singly (Single) linear linked list and Doubly (Double) linear linked list. 2) Circular linked list- Singly (Single) circular linked list and Doubly (Double)	15

	circular linked list, Implementation of all types of linked list with operations- creation, insertion, deletion, traversing, searching, display, count, reverse, Implementation of stack using linked list (Dynamic stack), Implementation of queue using linked list (Dynamic queue), Applications of linked list.	
	Tree: Introduction to Tree, Introduction to Binary Trees, Types of Binary tree- Strictly Binary tree, Complete Binary tree, Extended (2-Tree) Binary tree, Binary expression tree, Binary Search tree, Heap Tree- Min heap tree, Max heap tree, AVL tree, Representation of Binary tree using- Array, Linked list, Operations of Binary search tree-Creating and inserting node, Searching node, Counting total nodes, Counting and displaying leaf nodes, Tree Traversal methods Preorder, Inorder, Postorder, Deletion of Nodes, Implementation of binary search tree, Applications of tree.	
Reference Books:		
1.	Tanenbaum: Data structures using C and C++	
3.	Data Structures and Algorithm Analysis in C++by Weiss, Weiss Mark Allen	
4.	Data Structures Through C++ by Yashavant Kanetkar	

Type: Practical(Major) **B.Sc(ECS)-II (Semester III)** **Course Title: Practical based on DSC1-3** **(Paper Code:)**	
Total Lectures: 30 Hrs.	**Contact Hrs. (P) :** 2
University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks

1.	Write a program to implement stack by using array. (Static Implementation of stack)
2.	Write a program, which reverses the string by using stack.
3.	Write a program to check the validity of an expression using stack.
4.	Write a program to evaluate the expression using stack.
5.	Write a program to implement linear queue by using array. (Static Implementation of queue)
6.	Write a program to implement circular queue.
7.	Write a program to implement singly linear linked list with its basic operations.
8.	Write a program to implement singly circular linked list with its basic operations.
9.	Write a program to implement stack by using linked list. (Dynamic implementation)
10.	Write a program to implement binary search tree with tree traversal methods.

<table>
<tr><td colspan="2" align="center">Type: DSC1-4 (Major)
B.Sc(ECS)-II (Semester III)
Course Title: Database Management System

(Paper Code:)</td></tr>
<tr><td>Credits: Theory – (2)</td><td>Practical's – (1)</td></tr>
<tr><td>Total Lectures: 30 Hrs.</td><td>Contact Hrs. (L) : 2</td></tr>
<tr><td>University Evaluation: 30 Marks</td><td>Internal Evaluation: 20 Marks</td></tr>
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Course Outcomes:

1.	Gain knowledge of database systems and database management systems software.
2.	Ability to model data in applications using conceptual modeling tools such as ER Diagrams and design database schema based on the model.
3.	Formulate, using SQL, solutions to a broad range of query and data update problems.
4.	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
5.	Be acquainted with the basics of transaction processing and concurrency control.
6.	Familiarity with database storage structures and access techniques.
7.	Analyse strengths and weaknesses of the applications of database technologies to various subject areas.

Unit	Content	Lect.
I	**Introduction to database management system:** Definition, limitations of the traditional file system, advantages of DBMS, components of DBMS, database users, database structure database architecture- 2-tier and 3-level (schema) tier architecture, instances, and schema, database languages, data independence, types of data models(hierarchical, network, relational, hybrid). **Conceptual design:** ER-model: entities, attributes and its types, relationship, relationship set, generalization, specialization, aggregation, Types of Dependencies, Normalization(1NF, 2NF, 3NF, BCNF, 4NF, 5NF), introduction and features of RDBMS, the difference between DBMS and RDBMS, 12 Codd's rules. **Relational algebra operations:** select, project, Cartesian product, union, set difference. **DDL commands:** create, alter, rename, truncate, drop. **DML Commands**-insert, update, delete, select statements using where clause. **DCL Commands-** grant, revoke, user creation: creating users granting and revoking permissions on database objects, rollback, commit and savepoint datatypes	15

	Operators: comparison, conditional, arithmetic, logical, set and special operators – in, not in, between, not between, like, not like, is null, is not null. **Built-in functions:** arithmetic, string, date and time, conversion, aggregate and general. **Clauses:** order by, group by, having clause. **Integrity constraints:** importance of data integrity, not null, unique, foreign key constraint, on delete cascade, check, default constraints.		
II	**Sub queries:** purpose and usage of a subquery, type of subqueries- single row, multiple rows, multiple columns, applying group functions in subqueries, in, any, some, all operators in sub queries. correlated sub-queries, handling data retrieval with exists and not exists operators. **Joins:** inner join, outer joins, Cartesian, self-join and lossless join. **Sequence:** creating, retrieving data, modifying, dropping sequences, synonyms. **Index-** Definition of index, advantages of indexing, types of index, creating index, retrieving data using index. **Pseudo columns:** Types of pseudo columns, currval and nextval, level, rowid, rownum. **Views:** types of views, relational views, object views, using views for DML operations, putting check constraints upon views, creation of read-only views, materialized views.	15	

	Reference Books:
1.	Database System Concepts by Korth Silberschetz
2.	Fundamentals of Database Systems by Elmsari, Navathe
3.	SQL, PL/SQL – The Programming Language of Oracle by Ivan Bayross
4.	Database Management System by Seema Kedar

	Type: Practical(Major)
	Type: Practical(Major)
	B.Sc(ECS)-II (Semester III)
	Course Title: Practical based on DSC1-4 **(Paper Code:)**

Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks

Database Management System:

A) salesman

Field Name	Datatype	Size	Description
sno	Varchar2	6	Primary Key
sname	Varchar2	20	Account Holders name
address	Varchar2	30	Residential address
address1	Varchar2	30	Permanent address
pincode	number	6	Pin code
dob	Date		Date of birth
state	char	20	State
doj	date		Date of Joining Must greater than Date of birth
department	Char	20	department name
salary	number	9,2	Salary of salesman

1.	Display List of all Salesmen.
2.	Display List of all Salesmen who have salary greater than 5000.
3.	Display List of all Salesmen by salary.
4.	Display List of all Salesmen whose address located in pune.
5.	Change the salary of Salesmen whose sno is 's00009' by 10000.
6.	Modify the name Raj to Rajkumar.
7.	Delete the records whose state is Andhrapradesh.
8.	Delete the salary that have salary small than 1000.
9.	Add the column mobile_no to salesmen.
10.	Change the size of salesmen s_name column by 30.
11.	List of all salesmen whoes address start with 'N'.
12.	List of salesmen whose Department is not Computer and HR.
13.	List of salesmen whose Mobile_no is 9423376798 or 9763658485.
14.	List of salesmen whose is join in month 'june'.
15.	List of salesmen whose salary is > 5000 and < 10000.
16.	Change the column name address1 t0 permanent address.

17.	List of salesmen whose salary in order of Highest and lowest.
18.	Display average salary of salesmen.
19.	Display List of salesmen whose salary is maximum,minimum and average salary by department wise.
20.	Display how many salesmen are working on computer department.
21.	Allocate 25 charters for name if remaining charters than charter are Right padded with ' * ' .
22.	Display the list of salesmen whose middle is sanjay;
23.	Display average salary of salesmen by computer department.
24.	Display list of salesmen who joined in 12-dec-2009 .
25.	How many salesmen working whose name is 'Dipak'.
26.	Display the state which contain 6 charter.
27.	Display all the salesmen whose salary is either 5000 or 10000.
28.	Display all salesmen whose s_name contain third letter ' n '.
29.	Delete the record whose pincode is NULL values.
30.	Remove all the constraints from salesmen.
31.	Change the table name salesmen to Salesmen_master.
32.	Display Total Amount of salary of salesmen.
33.	Display the list of salesmen with experience year;
34.	Display the User name in which salesmen_master is created.
35.	Find out the Total salary of salesmen who have joined in month 'March'.
36.	Rename the column pincode to ZIP.

Type: DSC 2-3 (Minor)
B.Sc(ECS)-II (Semester III)
Course Title: Statistics for Data Science-I
(Paper Code:)

Credits: Theory – (2)	Practical's – (1)
Total Lectures: 30 Hrs.	**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks	**Internal Evaluation:**20 Marks

Course Outcomes:

1.	Students will demonstrate proficiency in statistical analysis of data.
2.	Students will develop the ability to build and assess data-based models.
3.	Students will execute statistical analyses with professional statistical software.
4.	Students will demonstrate skills in data management.
5.	Students will apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

Unit	Content	Lect.
I	**Population and sample:** Concept of the statistical population with illustration, Concept of the statistical sample with illustration. **Sampling methods:** Simple Random Sample(SRS), Simple Random Sample With Replacement (SRSWR), Simple Random Sample Without Replacement (SRSWOR), stratified and systematic random sampling. **Data condensation and graphical methods:** Raw data- attribute, variable- discrete and continuous, constant. Classification- definition, objectives, principles of classification. Construction of frequency distribution, cumulative frequency distribution. **Graphical representation:** histogram, ogives, pie chart. **Measures of Central Tendency:** Concept of central tendency, the criterion for good measures of central tendency. **Arithmetic Mean(A.M.):** defition computation for ungrouped and grouped data, combined mean, weighted mean, effect of change of origin and scale, numerical examples, merits and demerits. **Median:** definition, computation for ungrouped and grouped data, graphical determination, numerical examples, merits and demerits. **Mode:** definition, computation for ungrouped and grouped data, graphical determination, numerical examples, merits and demerits.	15

	Quartiles: definition, computation for ungrouped and grouped data, graphical determination, Numerical problems. **Measures of Dispersion:** Concept of dispersion, absolute and relatives measures, **Range:** definition, computation for ungrouped and grouped data, Coefficient of range, numerical examples, merits, and demerits. **Standard Deviation(S.D.) and Variance:** definition, computation for ungrouped data and grouped data. **Coefficient of Variation(C.V.):** definition, computation for ungrouped data and grouped data, combined S.D. effect of change of origin and scale, merits and demerits, Numerical problems.	
II	**Correlation and Regression:** Bivariate data, Concept of correlation, types of correlation, cause and effect relation. **Methods of Studying Correlation:** **a) Scatter Diagram Method:** definition, interpretation. **b) Karl Pearson's coefficient of correlation** (r) definition, limits for 'r', interpretation of r, effect of change of origin and scale, numerical examples. **Regression:** concept, definition, lines of regression, Derivation of lines of regression by least square method, properties of regression coefficients, interpretation of regression coefficients. **Non-linear regression:** fitting of lines of regression, fitting of second degree curve ($Y = A + BX + CX^2$), fitting of exponential curve ($Y = A B^x$), numerical problems.	15

Reference Books:	
1.	Fundamentals of Statistics by Goon Gupta, Das Gupta.
2.	Statistical Methods by S. P. Gupta
3.	Business Statistics by S. Shaha
4.	Fundamentals of Mathematical Statistics by Kapoor and Gupta
5.	Programmed Statistics by B. L. Agarwal

	Type: Practical (Minor)	
	B.Sc(ECS)-II (Semester III)	
	Course Title: Practical based on DSC2-3	**(Paper Code:)**
	Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
	University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks
1.	Write Python scripts to illustrate the concepts of statistical population and sample. Generate a random sample from a given population and calculate sample statistics (mean, median, mode, variance, etc.), then compare them with population parameters.	
2.	Implement Python functions to simulate different sampling methods and analyze their effectiveness using statistical metrics.	
3.	Develop Python functions to process and condense data. Convert raw data into variables (discrete and continuous), create frequency distributions (ungrouped and grouped), and calculate cumulative frequency distributions.	
4.	Develop Python scripts to process raw data into frequency distributions and plot histograms and ogives. Analyze graphical representations to interpret data trends.	
5.	Solve numerical problems related to data condensation and graphical methods using Python. Compute frequencies and cumulative frequencies, and plot histograms for given datasets. Analyze and interpret graphical representations to conclude data distributions.	
6.	Write Python functions to compute measures of central tendency: I. Arithmetic Mean (AM) for ungrouped and grouped data II. Median for ungrouped and grouped data using formulas and graphical methods III. Mode for ungrouped and grouped data, including handling multimodal distributions	
7.	Write Python scripts to compute relative measures of dispersion: I. Coefficient of Range and Coefficient of Variation for datasets with different scales and origins II. Discuss the impact of scale and origin changes on these measures	
8.	Write Python script to plot scatter diagram when $r = -1$, $r = 0$ and $r = +1$.	
9.	Develop Python functions to compute Karl Pearson's coefficient of correlation. Calculate the correlation coefficient (r) for given datasets and validate calculations against theoretical limits ($-1 \le r \le 1$).	
10.	Develop Python scripts to perform regression analysis for given datasets. Interpret regression results.	

<table>
<tr><td colspan="3" align="center">Type: DSC 2-4 (Minor)
B.Sc(ECS)-II (Semester III)
Course Title: Advanced Python Programming

(Paper Code:)</td></tr>
</table>

	Type: DSC 2-4 (Minor) B.Sc(ECS)-II (Semester III) Course Title: Advanced Python Programming (Paper Code:)	
	Credits: Theory – (2) Practical – (1)	
Total Lectures: 30 Hrs.		**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks		**Internal Evaluation:** 20 Marks
Course Outcomes:		
1.	To know advanced conditional and looping statements in Python.	
2.	To understand the Regular Expression for pattern matching.	
3.	To understand the parsing of JSON, CSV, Excel files.	
Unit	**Content**	**Lect.**
I	**Advanced conditional and looping statements-** List comprehension, Dictionary comprehension, Use of global, local and nonlocal in functions, Lambda/ Anonymous functions, Higher order functions, Type hinting, filter (), map (), reduce () functions, Recursive functions, Iterables, Iterators and Generators, itertools functions- Infinite iterators- count(), cycle(), repeat(), Iterators terminating on the shortest input sequence- accumulate(), batched(), chain(), chain.from_iterable(), compress(), dropwhile(), filterfalse(), groupby(), islice(), pairwise(), starmap(), takewhile(), tee(), zip_longest() , Combinatoric iterators-product(), permutations(), combinations(), combinations_with_replacement(), Closures and Decorators, @property decorator, Magic methods, *args and **kwargs, Memory management, Garbage collection, Shallow copy Vs Deep copy. **Regular expression-** Introduction to regular expression, Advantages and Operations, Specify pattern using RegEx-Meta characters- Square brackets [], Period '.', Dollar '\$,' Star '*', Plus '+', Question Mark '?', Curly braces '{}', Alternation '|', Group '()', Backslash '\', Sequence characters in RegEx- '\A', '\b', '\B', '\d', '\s', '\S', '\w', '\W', '\Z'. functions and constants in re module- findall(), split(), sub(), subn(), search(). Match object- match.group(), match.start(), match.end() and match.span(), match.re and match.string, match…case Statement, Raw string using r prefix.	**18**
II	**Advanced file handling-** Use of with statement, Serialization and Deserialization, **working with json file-** json file, json module, convert dict to json string, convert dict to json file, convert json string to dict, convert json file to dict. **Working with CSV Files-** CSV File, csv module, reading csv file with csv, Reading CSV	**12**

	files into a dictionary with csv, Writing CSV files with csv, Writing CSV file from a dictionary with csv. **Working with excel file-** Basic excel terminology, installing openpyxl, Reading excel spreadsheets, Creating a Simple Spreadsheet, Basic Spreadsheet Operations- Adding and Updating Cell Values, Managing Rows and Columns- insert row, delete row, insert column, delete column. Managing Sheets, Freezing Rows and Columns, Adding Filters, Adding Formulas, Adding Styles, Conditional Formatting, Adding Images- Install pillow module, add image into spreadsheet. Adding Charts like Barchart, Linechart, Pie-chart into spreadsheet.	
Reference Books:		
1.	Programming through Python, M. T. Savaliya, R. K. Maurya, G. M. Magar, STAREDU Solutions	
2.	Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, Arno D.B. Meysman, et al.	
3.	Python Programming: An Introduction To Computer Science, Fourth Edition Grayscale Indian Edition, Zohn Zelle	

	Type: Practical(Minor)
	B.Sc(ECS)-II (Semester III)
	Course Title: Practical based on DSC2-4 **(Paper Code:)**
Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks
1.	Write a program to demonstrate list comprehension.
2.	Write a program to demonstrate dictionary comprehension.
3.	Write a program to demonstrate global, local, nonlocal keywords.
4.	Write a program to demonstrate anonymous functions.
5.	Write a program to demonstrate filter, map, reduce functions.
6.	Write a program to demonstrate any five itertools functions.
7.	Write a program to demonstrate decorators.
8.	Write a program to demonstrate findall, sub, split, search functions in regular expression.
9.	Write a program to demonstrate match…case statement.
10.	Write a program to convert dict to JSON string.

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Type: GE3 / OE3 (Generic / Open Elective)

B.Sc(ECS)-II (Semester III)

Course Title: Operating Systems

(Paper Code:)

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Credits: Theory – (2)	
Total Lectures: 30 Hrs.	**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks	**Internal Evaluation:** 20 Marks

Course Outcomes:

1.	To understand the main components of an OS and their functions.
2.	To describe the functions of a modern OS concerning convenience, efficiency, and the ability to evolve.
3.	To make aware of different types of OS and their services.
4.	To learn different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.

Unit	Content	Lect.
I	Operating system: Definition of operating system, Types of Operating Systems-Batch, Multiprogramming, Time Sharing, Real-Time, Distributed, Parallel, OS Services, System components, and System Calls. **Process Management:** Concept of Process, Process states, Process Control Block, Context switching, Operations on Process.	10
II	**Process Synchronization and Deadlocks:** **Scheduling-** Concept of Process Scheduling, Types of Schedulers, Scheduling criteria, Scheduling algorithms Preemptive and Non-preemptive, FCFS, SJF, Round Robin, Priority Scheduling, Multilevel Queue Scheduling, Multilevel- feedback Queue Scheduling. **Process Synchronization:** The Producer Consumer Problem, Race Conditions, Critical Section Problem, Semaphores, and Classical Problems of Synchronization: Reader-Writer Problem, Dinning Philosopher Problem.	20

Reference Books:

1.	Operating System Concepts By Siberchatz and Galvin.
2.	Modern O.S. By Andrews Tanenbaum.
3.	Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, Greg Gagne.

Type: VSC1 (Vocational and Skill Enhancement Courses)	
B.Sc(ECS)-II (Semester III)	
Course Title: Based on DSC1-3 and DSC1-4	(Paper Code:)
Total Lectures: 60 Hrs.	Contact Hrs. (P) : 4
University Evaluation: 30 Marks	Internal Evaluation: 20 Marks

Array:

1.	Write a program that finds only even elements in an array.
2.	Write a program that finds only odd elements in an array.
3.	Write a program that finds the addition of matrices.
4.	Write a program that finds multiplication of matrices.
5.	Implementation of searching and sorting algorithms.

Stack:

1.	Write a program to check entered string is palindrome or not by using stack.
2.	Write a program to convert decimal number into binary number by using stack.
3.	Write a program to count total number of vowels present in string by using stack.
4.	Write a program which convert infix expression into prefix expression.
5.	Write a program which convert infix expression into Postfix expression.
6.	Write a program which check entered expression is valid or not.
7.	Write a program for evaluation of postfix expression.
8.	Write a program to calculate the factorial of the entered number by using recursion.
9.	Write a program to calculate the digit sum of the entered number by using recursion.
10.	Write a program to find face value of entered number by using recursion.

Queue:

1.	Write a program to implement Priority queue.
2.	Write a program to implement IRD (Input Restricted Deque)
3.	Write a program to implement ORD (Output Restricted Deque)

Linked List:

1.	Write a program to implement queue by using linked list. (Dynamic implementation)
2.	Write a program to implement doubly linear linked list with its basic operations.
3.	Write a program to implement singly circular linked list with its basic operations.
4.	Write a program to implement doubly circular linked list with its basic operations.

Tree:

1.	Write a program to implement BST with the following operations: I) Insert Node II) Count Leaf nodes

	III)Count Non-Leaf nodes
	IV) Count Total nodes
2.	Write a program to implement BST with the following operations: I) Insert Node II) Find Maximum node III) Find Minimum Node IV) Search node V) Display only odd nodes VI) Display only even nodes VII) Display leaf nodes VIII) Find the level of node IX) Find the degree of node X) Delete Node

Subquery and Join:

A] Table Structure of Account _Master

Field Name	Datatype	Size	Description
Accent	Varchar2	6	Primary Key
Acc_name	Varchar2	6	Account Holders name
Gender	Char	1	Either M or F
Op_Date	Date		The date on which the Account is opened
Chq_fac	Char	1	Cheque facility statue set Default 'N'
Cl_Date	Date		

B] Table Structure of Account _Transaction

Field Name	Datatype	Size	Description
Accent	Varchar2	6	Foreign Key
Tr_amount	Number	7,2	Transaction Amount
Tr_date	Date	1	Transaction Date
Chq_no	Varchar2	10	Cheque Number
Tr_type	Char	1	Receipt or Withdrawal

1.	Display all the details of account holders in ascending order of Op_date.
2.	Display the details of account holders who are having cheque facility and balance >4000.
3.	Display the details of account holders whose balance is between 4000 and 9000.
4.	Display the name and number of female account holder.
5.	Display the details of account holders whose 2nd char of name 'a'.
6.	Display the account of those who have deposited.
7.	Display the details of account holders those who have opened account in 2012.
8.	Display the no of female account holders having cheque facility.
9.	Display the details of 2nd min balance of account holder.

10.	Display the account_no, account_nm, transaction amount, transaction_type of all account holders.
11.	Display the details of account holders who is having maximum balance.
12.	Display the details of account holders whose month of opening the account and transaction are same.
13.	Display the details of account holders who have not made any transaction and whose name is starts with 'R'.
Synonym, Index, View:	
1.	Create a synonym for table student.
2.	Apply DML command on synonym.
3.	Destroy synonym.
4.	Create a view read only view.
5.	Create updateable view.
6.	Apply DML commands on updatable view.
7.	Create read only view for single table.
8.	Destroy view.
9.	Create a sequence for roll_no field in student table.
10.	Insert sequence into table.
11.	Create a cyclic sequence.
12.	Destroy sequence.
13.	Create a cluster table.
14.	Apply DML command on cluster table.
15.	Destroy cluster table.
16.	Create a simple index.
17.	Display an index.
18.	Create composite index.
19.	Create reverse index.
20.	Rebuild reverse index to normal index.
21.	Destroy index.
22.	Create type.
23.	Use type in table.
24.	Insert value for type in table.
25.	Display the table.
26.	Create array for name.
27.	Use array as data type in table.
28.	Insert value for array in table.
29.	Display table.

30.	Create user.
31.	Give grants to the user.
32.	Give grants to the user from own database.
33.	Give grant to a user from another user.
34.	Withdraw once given grant.
35.	Commit work done.
36.	Rollback to commit.
37.	Create savepoint.
38.	Rollback to the particular savepoint.

	Type: VSC2 (Vocational and Skill Enhancement Courses)
	B.Sc(ECS)-II (Semester III)
	Course Title: Based on DSC2-3 and DSC2-4 (Paper Code:)

Total Lectures: 60 Hrs.	**Contact Hrs. (P) :** 4
University Evaluation: 30 Marks	**Internal Evaluation:** 20 Marks

1.	Write a Python program to calculate mean, median, mode, variance, standard deviation, range, and interquartile range (IQR).
2.	Visualize data using histograms and scatter plots.
3.	Solve numerical problems involving measures of dispersion using Python. Compute and compare ranges, variances, standard deviations, and coefficients of variation for given datasets. Interpret results to conclude data variability and distribution.
4.	Develop Python functions to compute measures of dispersion: I. Range for ungrouped and grouped data II. Variance and Standard Deviation (SD) for ungrouped and grouped data III. Coefficient of Variation (CV) to compare variability across different datasets
5.	Implement Python functions to calculate and classify types of correlation: positive, negative, and zero correlation.
6.	Write a Python script to plot a scatter diagram when r = -0.85, r = 0 and r = 0.85.
7.	Write Python scripts to verify basic assumptions underlying the correlation coefficient (linearity, nonlinearity, etc.). Solve numerical problems involving correlation coefficient calculations and interpretation.
8.	Implement Python functions to calculate regression line of x on y using the method of least squares.
9.	Implement Python functions to calculate the regression line of y on x using the method of least squares.
10.	Build a simple linear regression model to predict outcomes (e.g., predict student scores based on study hours).

Practical on Advanced Python Programming

1.	Write a program to demonstrate higher order functions.
2.	Write a program to demonstrate type hinting.
3.	Write a program to demonstrate recursive functions.
4.	Write a program to demonstrate iterators and generators.
5.	Write a program to demonstrate the use of *args and **kwargs arguments.
6.	Write a program to demonstrate difference between shallow copy and Deep copy.
7.	Write a program to demonstrate various functions of RegEx.
8.	Write a program to demonstrate functions of match object.
9.	Write a program to demonstrate parsing dict to JSON string.
10.	Write a program to demonstrate parsing dict to JSON file.
11.	Write a program to demonstrate parsing JSON string to dict.
12.	Write a program to demonstrate parsing JSON file to dict.

13.	Write a program to read CSV file to dict.
14.	Write a program to write CSV file from dict.
15.	Write a program to create simple spreadsheet and do the following operations- a) Adding cell values b) Updating cell values c) Insert row d) Delete row e) Insert column f) Delete column
16.	Write a program to create simple spreadsheet and do the following operations to manage the sheet- a) Freezing rows and columns b) Adding filter c) Adding formulaes d) Adding styles e) Adding images f) Adding barchart

Type: DSC1-5 (Major)		
B.Sc(ECS)-II (Semester IV)		
Course Title: Core Java		
(Paper Code:)		
Credits: Theory – (2)		**Practical's – (1)**
Total Lectures: 30 Hrs.		**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks		**Internal Evaluation:** 20 Marks

Course Outcomes:

1.	Knowledge of the structure and model of the Java programming language.
2.	Use the Java programming language for various programming technologies.
3.	Develop software in the Java programming language.
4.	Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements.

Unit	Content	Lect.
I	**Introduction to Java :** **Introduction-** History, Features of Java, Installation and configure JDK. JVM architecture, JRE, Structure of java program, Datatypes, variables, idetifiers, operators, keywords, java arrays, Control Statement- if, if-else, switch, for loop, while loop, do while loop, nested loop, break, continue, comments, java functions. **Object oriented Concepts-** class, objects, methods, constructor, naming conventions, static keyword, use of this keyword. **Inheritance:** Types of inheritance, use of super keyword, Access/Scope specifiers, Method overriding, Method overloading, Abstract classes, Final keyword, **Packages and Interfaces:** create and import package, Difference between classes and interfaces, runtime polymorphism, Wrapper classes.	**15**
II	**Exception handling:** Use of try, catch, finally, throw and throws keywords, Bulit-in exception classes, creating User defined exceptions, **Multithreading:** Concept, Life cycle of a thread, Thread class, Runnable interface, Methods in Thread class, sleep, interrupt, join, priority etc., Thread Synchronization, Usage of wait and notify() methods. **File IO programming:** Concept, Types of file, I/O stream classes, Readers and Writers classes, Console I/O, Object Stream and Serializable interface.	**15**

Reference Books:

1.	Core Java by Dr. R. Nageshwar Rao.
2.	James Gosling, Bill Joy, Guy L Steele Jr, Gilad Bracha, Alex Buckley The Java Language

	Specification, Java SE 8 Edition (Java Series), Published by Addison Wesley, 2014.
3.	Cay S. Horstmann, Gary Cornell, Core Java 2 Volume 2 - Advanced Features, 9th Edition, Printice Hall. 2013.
4.	Bruce Eckel, Thinking in Java, 3rd Edition, PHI, 2002.
5.	E. Balaguruswamy, Programming with Java, 4th Edition, McGraw Hill. 2009.

Type: Practical (Major) **B.Sc(ECS)-II (Semester IV)** **Course Title: Practical based on DSC1-5**		**(Paper Code:)**
Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks

1.	To find the sum of any number of integers entered as command line arguments
2.	To find the factorial of a given number
3.	To learn the use of a dimensional array by defining the array dynamically.
4.	To learn the use of length in the case of a two-dimensional array
5.	To convert a decimal to a binary number
6.	To check if a number is prime or not, by taking the number as input from the user.
7.	To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, the total number of integers is given as a command line argument.
8.	Write a program that shows the working of different functions of String and String Buffer classes like setCharAt(), setLength(), append(), insert(), concat(), and equals().
9.	Write a program to create a distance class with methods where distance is computed in terms of feet and inches.
10.	Modify the distance class by creating a constructor for assigning values (feet and inches) to the distance object. Create another object and assign the second object as a reference variable to another object reference variable. Further, create a third object, which is a clone of the first object.

Type: DSC1-6(Major) **B.Sc(ECS)-II (Semester IV)** **Course Title: Relational Database Management System** **(Paper Code:)**	

Credits: Theory – (2) Practical – (12)	
Total Lectures: 30 Hrs.	**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks	**Internal Evaluation:** 20 Marks

Course Outcomes:

1.	To Understand the PL/SQL architecture.
2.	To learn programming, management, and security issues of working with PL/SQL program units,
3.	To understand the built-in packages and user-defined packages.
4.	To write PL/SQL code for procedures, triggers, cursors, exception handling, etc.

Unit	Content	Lect.
I	**Introduction of Transaction**: ACID properties, transaction states, scheduling, and its types, conflict, and view serializability. **Introduction of Concurrency Control:** Problems of concurrency control, lock-based protocols, timestamp-based protocol, deadlock, and deadlock handling methods. **Introduction, recovery algorithms**: log base recovery, shadow paging, recovery with concurrent transactions, checkpoints or savepoints. **Query Optimization:** Overview Query Processing and Optimization – Heuristics and Cost Estimates in Query Optimization.	**15**
II	**Introduction to PL/SQL:** Advantages, Architecture, Datatypes, Variable and Constants, Using Built_in Functions, Conditional, Looping and Iterations Statements, Selection Case, Simple Case, Goto Label and exit, SQL Within PL/SQL. **Procedures in PL/SQL:** Stored Procedures, Procedure with Parameters (In, Out and In Out), Positional Notation and Named Notation, Dropping a Procedure. **Functions in PL/SQL:** Difference between Procedures and Functions, types of functions and parameter modes, **Packages in PL/SQL:** importance, advantages Implementing packages, Private and Public Objects in Package.	**15**

Cursor in PL/SQL: Types of Cursors, Cursor Attributes, Cursor with Parameters, Cursors with Loops Nested Cursors, Cursors with Sub Queries and Procedure. **Exceptions in PL/SQL:** Types of exceptions, Raise_Application_Error, Pragma_Autonomous_Transaction **Database Triggers in PL/SQL:** Types of Triggers, Row Level Triggers, Statement Level Triggers, Implementing triggers for various DML operations (insert, delete, update), DDL Triggers, Trigger Auditing.	

Reference Books:	
1.	Database System Concepts by Korth Silberschetz
2.	Fundamentals of Database Systems by Elmsari, Navathe
3.	SQL, PL/SQL – The Programming Language of Oracle by Ivan Bayross
4.	Database Management System by Seema Kedar

	Type: Practical(Major) **B.Sc(ECS)-II (Semester IV)** **Course Title: Practical based on DSC1-6** **(Paper Code:)**	
	Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
	University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks
1.	Write a PL/SQL code to demonstrate the use of constant keyword.	
2.	Write a PL/SQL code to calculate simple interest.	
3.	Write a PL/SQL code to calculate Compound interest.	
4.	Write a PL/SQL code to calculate factorial by using a function.	
5.	Write a PL/SQL code to calculate Armstrong by using the procedure.	
6.	Create a cursor for updating the salary of employees by 5%.	
7.	Create a cursor to display the 5 highest earners.	
8.	Create a trigger for generating the primary key.	
9.	Create a trigger for generating a primary key when some data is already present.	
10.	To generate the exception when Data is not found in the table.	

Type: DSC2-5 (Minor) **B.Sc(ECS)-II (Semester IV)** **Course Title: Statistics for Data Science-II** **(Paper Code:)**			

Credits: Theory – (2)	**Practical's – (1)**
Total Lectures: 30 Hrs.	**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks	**Internal Evaluation:** 20 Marks

Course Outcomes:

1.	To understand the basic probability concepts and random variables.
2.	To understand the concept of a random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions.
3.	To understand various basic concepts on sampling distributions and large sample tests based on normal distribution.
4.	To get knowledge about inferences from Binomial and Poisson distributions as illustrations.
5.	To get knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts.
6.	To understand the chi-square test for independence of attributes and goodness of fit.

Unit	Content	Lect.
I	**Permutations and Combinations:** Principles of counting, Permutations of 'n' dissimilar objects taken 'r' at a time (with and without replacement), Permutations of 'n' objects not all different, Combinations of 'r' objects taken from 'n' objects, Numerical problems. **Probability:** Idea of deterministic and non-deterministic models, Sample space: types of sample space, Event: types of events, Classical definition of probability and its limitations, Axiomatic definition of probability, numerical examples. **Proofs of results:** $P(\phi) = 0$, $P(A^c) = 1\text{-}P(A)$, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, $P(A) \leq P(B)$ if A is subset of B. **Conditional probability:** concept and definition, multiplication law of probability. **Independence of events:** concept and definition, pairwise and complete independence (for 3 events), Partition of sample space and Baye's theorem, Numerical problems.	10
II	**Discrete Random Variable and standard Discrete Distributions:** Definition of discrete random variable(r.v.), Definition of Probability mass function(p.m.f.) , cumulative distribution function(c.d.f.), properties of c.d.f **Mathematical Expectation and variance of r.v.:** definition, Numerical problems.	20

Standard Discrete Distribution:

a) Binomial Distribution: Definition, mean and variance (Statement only), real-life situations, adaptive property and numerical examples.

b) Poisson Distribution: Definition, mean and variance (Statement only), real life situations, adaptive property and numerical examples.

Contentions Random variable and Standard Contentions Distributions:

Definition of Contentions random variable(r.v.), Definition of Probability density function(p.d.f.) , cumulative distribution function(c.d.f.), properties of c.d.f

Mathematical Expectation and variance of r.v.: definition, Numerical problems.

Standard Contentious Distributions:

a) **Uniform distribution:** definition, mean and variance, c.d.f., probability curve and numerical examples.

b) **Normal distribution:** definition, mean and variance, probability curve, Standard Normal Variable(S.N.V.), properties of normal distribution, distribution of (aX + b), (aX + bY + c) when X and Y are independent variables, computations of probabilities using normal tables.

c) **Sampling Distributions and Test of Hypotheses:**
Concepts of parameter, statistic, sampling distribution of a statistic, standard error. Sampling distribution of sample mean, standard errors of the sample mean, sample variance, and sample proportion. Null and alternative hypotheses, level of significance, Type I and Type II errors, their probabilities and critical region, confidence intervals, and p value. Tests of significance and confidence intervals for - single proportion, single mean.

Statistical Inference: Estimation and Hypothesis Testing (only concept).

Hypothesis Testing for a Single Population: The concept of hypothesis testing tests involving a population mean and population proportion (z test and t test).

Chi square test for independence of attributes and goodness of fit.

	Reference Books:
1.	Fundamentals of Statistics by Goon Gupta, Das Gupta.
2.	Statistical Methods by S. P. Gupta
3.	Business Statistics by S. Shaha
4.	Fundamentals of Mathematical Statistics by Kapoor and Gupta
5.	Programmed Statistics by B. L. Agarwal
6.	Statistical Methods by P. N. Arora,Summeet Arora, S. Arora
7.	Introduction to discrete probability and probability distributions by Madhav B. kulkarni, Surendra B. Ghatpande.

	Type: Practical(Minor)
	B.Sc(ECS)-II (Semester IV)
	Course Title: Practical based on DSC2-5 (Paper Code:)

Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks

Tools: Python / Matlab

1.	Implement a Python function to handle similar problems using factorials.
2.	Generate all possible arrangements of the word **"DATA"**.
3.	Calculate the number of 4-digit PIN codes that can be formed using the digits 0-9 (repetition allowed).
4.	Generate all possible 3-letter passwords from the alphabet (without repetition).
5.	Simulate 1,000 coin flips and calculate the probability of heads and tails.
6.	Simulate rolling a die 1,000 times and calculate the probability of each face (1-6).
7.	Simulate binomial trials (e.g., number of successes in 10 coin flips over 1,000 trials).
8.	Model the number of emails received per hour using a Poisson distribution.
9.	Conduct a one-sample t-test to determine if the average test score of a class differs from a national average.
10.	Conduct a chi-square test for independence using a categorical dataset.

Type: DSC2-6(Minor)	
Type: DSC2-6(Minor)	

Type: DSC2-6(Minor)

B.Sc(ECS)-II (Semester IV)

Course Title: Software Testing and Quality Assurance

(Paper Code:)

Credits: Theory – (2)	**Practical – (1)**
Total Lectures: 30 Hrs.	**Contact Hrs. (L) : 2**
University Evaluation: 30 Marks	**Internal Evaluation:** 20 Marks

Course Outcomes:

1.	List a range of different software testing techniques and strategies and be able to apply specific (automated) unit-testing method for the projects.
2.	Distinguish characteristics of structural testing methods.
3.	Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.
4.	Discuss about the functional and system testing methods.
5.	Demonstrate various issues for object-oriented testing.

Unit	Content	Lect.
I	**Introduction To Software Testing:**	**15**
	Importance or need of software testing	
	Differences between Manual and Automation Testing	
	Introduction to White Box Testing:	
	Advantages and Disadvantages of White box testing	
	Static Techniques: Informal Reviews, Walkthroughs, Technical Reviews, Inspection	
	Dynamic Techniques or Structural Techniques	
	Statement Coverage Testing, Branch Coverage Testing	
	Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing	
	Introduction to Black Box Testing:	
	Advantages and Disadvantages of black box testing	
	Black Box Techniques: Boundary Value Analysis, Equivalence Class Partition, State Transition Technique, Cause Effective Graph, Decision Table, Use Case Testing	
	Experienced Based Techniques: Error guessing, Exploratory testing Levels of Testing	
	Functional Testing	
	Integration Testing and types - Top Down , Bottom Up , Non Incremental	
	System Testing	
	Acceptance Testing- Alpha and Beta	
	Smoke Testing	

	Regression Tesng- Unit , Regional, Full Non Functional Testing	
	Adhoc Testing	
	Performance Testing: Load Testing, Stress Testing, Volume Testing, Soak Testing	
	Recovery Testing	
II	**Test cases design Techniques:**	**15**
	Introduction to Test Case and Types.	
	Test Case Template	
	How to write a test case and examples	
	Preparing Review Report Software Test Life cycle	
	Software Test Life Cycle:	
	Writing Test Plan	
	Preparing Traceability Matrix	
	Writing Test Execution Report and Summary Report	
	Defect Life Cycle:	
	Bug/ Defect Life Cycle: Difference between Bug, Defect, Failure, Error	
	Defect Tracking and Reporting	
	Types of Bugs, Identifying the Bugs, Reporting the Bugs	
	Introduction to automated testing- Install and configure selenium testing tool, Case study: Design test case for login page, Internet Banking Login, and Online shopping.	
	TestNG Testing framework:	
	Introduction TestNG, Annotation, Methods, Create Auto Testcase, create auto report.	
Reference Books:		
1.	The art of Software Testing–Glenford J. Myers	
2.	Lessons learned in Software Testing– Cem Kaner, James Bach, Bret Pettichord	
3.	A Practitioner's Guide to Software Test Design- Lee Copeland	

Type: Practical(Minor)	
B.Sc(ECS)-II (Semester IV)	
Course Title: DSC2-6	**(Paper Code:)**
Total Lectures: 30 Hrs.	**Contact Hrs. (P) : 2**
University Evaluation: 15 Marks	**Internal Evaluation:** 10 Marks
1.	Write and test a program to handle alert, frame and windows
2.	Write and test a program to upload file.
3.	Write and test a program to download the file.
4.	Write and test a program to handing Menus.
5.	Write and test a program handling web table records.
6.	Write and test a program handling slider.
7.	Write and test a program color, fonts and size of text on a web page
8.	Write and test a program handling browser windows
9.	Write and test a program handling date picker.
10.	Write and test a program to provide a total number of objects present/available on the page.

<table>
<tr><td colspan="3" align="center">Type: GE4 / OE4 (Generic / Open Elective)
B.Sc(ECS)-II (Semester IV)
Course Title: Computer Networks

(Paper Code:)</td></tr>
<tr><td colspan="3" align="center">Credits: Theory – (2)</td></tr>
<tr><td colspan="2">Total Lectures: 30 Hrs.</td><td>Contact Hrs. (L) : 2</td></tr>
<tr><td colspan="2">University Evaluation: 30 Marks</td><td>Internal Evaluation: 20 Marks</td></tr>
<tr><td colspan="3">Course Outcomes:</td></tr>
<tr><td>1.</td><td colspan="2">Understand the fundamental components of data communication systems, including sender, receiver, transmission medium, message, and protocol.</td></tr>
<tr><td>2.</td><td colspan="2">Describe the concept of computer networks, their evolution, and the various uses of networks in modern society.</td></tr>
<tr><td>3.</td><td colspan="2">Identify key networking components such as hubs, switches, repeaters, bridges, routers, and gateways and understand their respective roles.</td></tr>
<tr><td>4.</td><td colspan="2">Compare various network topologies (bus, star, ring, mesh, hybrid) and types of networks (LAN, MAN, WAN).</td></tr>
<tr><td>5.</td><td colspan="2">Understand inter-networking concepts and how different networks communicate using protocols.</td></tr>
<tr><td>6.</td><td colspan="2">Explore various applications of the internet, such as email, web browsing, e-commerce, and cloud computing.</td></tr>
<tr><td>Unit</td><td align="center">Content</td><td>Lect.</td></tr>
<tr><td>I</td><td>Introduction to Data Communication and Networking: Data Communication: Components, Data Representation, Data Flow Communication Model Computer N/W: Introduction of Network, Uses of computer network N/W Components: Hubs, Switches, Repeaters, Bridges, Routers, Gateways. N/W Topologies, Types of Networks, Inter-networking, Applications of Internet.
Network Models: Protocols & Standards, Protocol Hierarchies, Design Issues of Layers, Services Primitives, Connection oriented and connection less services Reference Model: ISO-OSI reference model, TCP/IP reference model.</td><td>10</td></tr>
<tr><td>II</td><td>Physical layer: Signals-Analog and Digital Signals, Period, Frequency, Phase, Amplitude, Bandwidth, Bit Rate, Bit Length, Fourier analysis. Transmission Impairment-Attenuation, Distortion, Noise, Transmission Media-Guided Media-Magnetic Media, Twisted Pair, Coaxial Cable, Fiber Optic Cable, Unguided Media- Wireless Radio Waves, Microwaves, Infrared, Satellite Communication Analog Transmission-Modem, Digital Transmission-Pulse Code Modulation, Manchester and Differential Manchester Coding. Modulation and types- Amplitude, Frequency, Phase Transmission Mode-Parallel, Serial, Synchronous</td><td>20</td></tr>
</table>

	Transmission, Asynchronous Transmission. Multiplexing and types- Frequency, Time, Wavelength, Switching and types- Circuit, Message, Packet. **Data link layer:** Data link layer Design issues, Error Detection & CorrectionTypes of Errors, Hamming Distance, Error Detection-Parity Check, Cyclic Redundancy Check, Checksum Check Error correction, Data Link ControlFraming, Flow & Error Control, Protocols-Simplex, Stop and Wait, Stop and Wait ARQ, Go Back N ARQ, Selective repeat ARQ. Multiple Access Protocol-ALOHA, CSMA, CSMA/CD, CSMA/CA Channelization, FDMA, TDMA, CDMA	
Reference Books:		
1.	Computer Networking by Tannenbaum.	
2.	Data communication and networking by B A Forouzan	
3.	Computer Networks: A Systems Approach by Larry L. Peterson, Bruce S. Davie.	

	Type: VSC3 (Vocational and Skill Enhancement Courses)	
	B.Sc(ECS)-II (Semester III)	
	Course Title: Based on DSC1-5 and DSC1-6 **(Paper Code:)**	
Total Lectures: 60 Hrs.		**Contact Hrs. (P) :** 4
University Evaluation: 30 Marks		**Internal Evaluation:** 20 Marks
1.	Write a program to show that during function overloading, if no matching argument is found, then java will apply automatic type conversions (from lower to higher data type).	
2.	Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passed by reference and to learn use of final keyword .	
3.	Write a program to show the use of static variable, static method and static block.	
4.	Write a program to demonstrate the concept of boxing and unboxing.	
5.	Write a program to demonstrate Arithmetic Exception.	
6.	Write a program to demonstrate FileNotFound Exception.	
7.	Write a program to demonstrate ArrayIndexOutOfRange Exception.	
8.	Write a program to demonstate the use of throw and throws keyword.	
9.	Write a program to create a package and import it.	
10.	Write a program to demonstrate the use of Interfaces	
11.	Write a program to demonstrate dafualt and parametrised constructor.	
12.	Write a program to demonstrate the polymorphism.	
13.	Write ap rogram to demonstate the use of super keyword.	
14.	Write a program to demonstrate thread life cycle.	
15.	Write a program to demonstrate the inter-thread communication	
16.	Write program to count the number of ovels in the file.	
17.	Write a program to copy the content of one file and append in another file.	
Simple PL/SQL Block:		
1.	Write a PL/SQL code to calculate Area ,circumference and perimeter of circle.	
2.	Write a PL/SQL code to calculate Area andperimeter of rectangle.	
3.	Write a PL/SQL code to calculate Area and perimeter of Triangle.	
4.	Write a PL/SQL code to calculate Area and perimeter of Square.	
5.	Write a PL/SQL code to find out maximum no between two no's.	
6.	Write a PL/SQL code to find out maximum no between three no's.	
7.	Write a PL/SQL code to find out the minimum no between two no's.	
8.	Write a PL/SQL code to find out minimum no between three no's.	
9.	Write a PL/SQL code to find out given no is even or odd.	

10.	Write a PL/SQL code to find out given no is Positive, Negative or Zero.
11.	Write a PL/SQL code to display the message when user entering no then displays the appropriate no in word (eg.1-one).
12.	Write a PL/SQL code to display for month name.
13.	Write a PL/SQL code to display for week day name.
14.	Write a PL/SQL code to display the grade of the student.
15.	Write a PL/SQL code to display for 1-10 numbers.
16.	Write a PL/SQL code to display for 1-10 numbers in descending order.
17.	Write a PL/SQL code to calculate the factorial of any no.
18.	Write a PL/SQL code to calculate sum of digits.
19.	Write a PL/SQL code to find given no is prime or not.
20.	Write a PL/SQL code to find given no is palindrome or not.
21.	Write a PL/SQL code to find given no is Armstrong or not.
22.	Write a PL/SQL code to find given no is composite or not.
23.	Write a PL/SQL code to find given no is strong or not.
24.	Write a PL/SQL code to find given no is perfect or not.
25.	Write a PL/SQL code to find face value of given no.
26.	Write a PL/SQL code to find area of circle and insert this area in to the table. (Take radius from table)
27.	Write a PL/SQL code to calculate addition, substation, division, and multiplication of any two no's.
28.	Write a PL/SQL code to find prim no bet 1 to 1000.
29.	Write a PL/SQL code to find perfect no bet 1 to 1000.
30.	Write a PL/SQL code to find strong no bet 1 to 1000.
31.	Write a PL/SQL code to find palindrome no bet 1 to 1000.
32.	Write a PL/SQL code to find Armstrong no bet 1 to 1000.
33.	Write a PL/SQL code to find composite no bet 1 to 1000.
34.	Write a PL/SQL code to find 1st 10 palindrome no's.
35.	Write a PL/SQL code to find 1st 10 composite no's.
36.	Write a PL/SQL code to print the multiplication table.
37.	Write a PL/SQL code to find given string palindrome or not.
Functions and Procedures:	
1.	Write a PL/SQL code for calculate Armstrong by using a function.
2.	Write a PL/SQL code calculate palindrome by using a function.
3.	Write a PL/SQL code for calculate reverse no by using the function.
4.	Write a PL/SQL code for calculate face value by using a function.

5.	Write a PL/SQL code for calculate the perfect no by using a function.
6.	Write a PL/SQL code for calculate the prime by using a function.
7.	Write a PL/SQL code for calculate strong no by using procedure.
8.	Write a PL/SQL code for calculate palindrome by using procedure.
9.	Write a PL/SQL code for calculate the perfect no by using the procedure.
10.	Write a PL/SQL code for calculate prime by using procedure.
11.	Write a PL/SQL code for calculate reverse no by using procedure.
12.	Write a PL/SQL code for calculate factorial by using function.

Cursor:

1.	Create a cursor for display 5 lowest earners.
2.	Create a cursor for calculation of area of circle and insert in to table. (Take radius from table)
3.	Create a cursor for transaction balance becomes less than 500 or the day is Sunday of transaction then display message transaction is not allowed.
4.	For display user defined message when the cursor not fetching row.
5.	For display user message when cursor fetching more than one row or one value.

Trigger:

1.	Create a trigger for backup.
2.	Create a trigger for display message when user enters <0 value in students roll_no column.
3.	Create a trigger for transaction if transaction balance becomes <500 or transaction day is Sunday then reject the transaction.

Exception Handling and package :

1.	To generate the exception Too many Rows are found in the table.
2.	To generate the exception for Duplicate index.
3.	To generate the exception for display value_Error.
4.	To generate user defined exception for divide by zero value.
5.	W.A. PL/SQL block to generate your own exception for more amounts withdrawing than balance.
6.	Create a package for combine function and procedure.

	Type: VSC4 (Vocational and Skill Enhancement Courses)
	B.Sc(ECS)-II (Semester III)
	Course Title: Based on DSC2-5 and DSC2-6 **(Paper Code:)**
	Total Lectures: 60 Hrs. **Contact Hrs. (P) :** 4
	University Evaluation: 30 Marks **Internal Evaluation:** 20 Marks
1.	Calculate the total number of outfit combinations given 4 shirts, 3 pants, and 2 pairs of shoes.
2.	Find the number of ways to arrange 5 people in a row.
3.	Implement a Python function using math.perm() and verify using itertools.permutations().
4.	Find the number of distinct ways to arrange the letters in **"STATISTICS."**
5.	Find the number of ways to choose 3 fruits from a basket of 6 different fruits.
6.	Generate all possible combinations of 3 elements from the list [A, B, C, D, E, F].
7.	Calculate the number of ways to select 3 candies from 5 types when repetitions are allowed.
8.	Find the number of ways 4 people can sit in 6 chairs (some chairs may remain empty).
9.	From a group of 12 players, find the number of ways to select a team of 5 players.
10.	If 2 players must always be included, how many possible teams can be formed?
11.	Use a dataset (e.g., medical dataset) to calculate the probability of having a disease given a positive test result using Baye's theorem.
12.	Generate random samples from a normal distribution and plot the Probability Density Function (PDF).
13.	Draw multiple random samples from a uniform distribution.
14.	Design test case for college admission Application
15.	Design test case for social networking sites.
16.	Design test case for MS-word application.
17.	Design test case for simple calculator.
18.	Design test case for ball pen.
19.	Design test case for Paint application.
20.	Design test case for ATM application.
21.	Install Selenium and integrated testng framework, Write a test suite containing minimum 4 test cases for login page.
22.	Write and test a program to sign up a specific web page.
23.	Write and test a program to update records of 10 students from Excel file.
24.	Write and test a program to select the number of students who have scored more than 60 in any one subject (or all subjects).
25.	Write and test a program to get the number of items in a list / combo box.
26.	Write and test a program to count the number of check boxes on the page checked and unchecked count.
27.	Write and test a program to count the number of links on the web page.
28.	Write and test a program for online payment transaction.

29.	Write and test a program create email account
30.	Write and test a program apply job on job portal.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

Equivalent Subject for CBCS Syllabus of B.Sc. (ECS) - II (Semester–III and IV)

Semester-III		
Sr. No.	Name of the CBCS Paper (w.e.f. 2023-2024)	Name of the New Paper as per NEP2020 (w.e.f. 2025-2026)
1	Data Structure using C++-I	Data Structure using C++
2	Linux OS and Shell Scripting	No Equivalence
3	Software Engineering	No Equivalence
4	Database Management System-I	Database Management System
5	Probability Theory	Statistics for Data Science-II (Sem.-IV)
6	Data Science with Python	Advanced Python Programming
7	Web Development using PHP	No Equivalence
Semester-IV		
Sr. No.	Name of the CBCS Paper (w.e.f. 2023-2024)	Name of the New Paper as per NEP2020 (w.e.f. 2025-2026)
1	Data Structure using C++ -II	No Equivalence
2	Core Java	Core Java
3	Software Testing	Software Testing and Quality Assurance
4	Database Management System-II	Relational Database Management System
5	Discriptive Statistics	Statistics for Data Science-I (Sem-III)
6	Data Analytic and Visualization	No Equvialnce

For Science faculty: CA- Continuous Assessment (Internal Examinations) of Total Marks: (40%)

The pattern / Examination nature may be as follows:

One internal examination of 40% marks or two examinations of 20% marks each.

Open book examination / Home Assignment / Classroom test / Seminar / Field Work report / Project Report etc.