PANJAB UNIVERSITY, CHANDIGARH-160014(INDIA)

(Estd. Under the Panjab University Act VII of 1947—enacted by the Govt. of India)

FACULTY OF SCIENCE

SYLLABI

FOR

BACHELOR OF COMPUTER APPLICATIONS (B.C.A.)
(Under NEP)
(Multi-disciplinary/ Inter-Disciplinary)

(SEMESTER SYSTEM)
FOR
2026-27

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Sem	Level of Course	Course Code	Course Title	Credits			Total Credits
				Th	Pr	Total	
I	L-100	BCA-DSC-1 (Maj)-101A	Introduction to Web Technologies	2	--	4	24
		BCA-DSC-1 (Maj)-101P	Practical Based on BCA-DSC-1 (Maj)-101A	--	2		
		BCA-DSC-1 (Maj)-102	Fundamentals of Mathematical Statistics	4	--	4	
		BCA-DSC-1 (Min)-103	Problem Solving Through C	2	--	4	
		BCA-DSC-1 (Min)-103P	Practical Based on BCA-DSC-1(Min)-103	--	2		
		CSA-MDC-101/201/301/401	E-Commerce	3	--	3	
		AEC-1-101	English-1	2	--	2	
		CSA-SEC-101	Computer Fundamentals and Personal Computing Software	--	3	3	
		PUN-COMPL-1-101/HCP-COMPL-1-101	Punjabi-1 / HCP-1	2	--	2	
		CSA-VAC-101/201/301/401	Introduction to Blockchain Technology	2	--	2	
		CSA-VAC-102/202/302/402	Introduction to Computer Hardware	2	--		
		CSA-VAC-103/203/303/403	Digital Empowerment	2	--		
		CSA-VAC-104/204/304/404	Ethics of Artificial Intelligence	2	--		

- **One credit of theory lecture is of 1 hour duration and one credit of practical is of 2 hours duration.**
- **A student can opt one MDC, SEC and VAC out of given options respectively, unless specified.**
- **A student can opt for a MDC course subject to following conditions:**
  - **i. The student must not have studied that course in 10+2 level.**
  - **ii. The student must not have taken that course as a core subject.**

Sem	Level of Course	Course Code	Course Title	Credits			Total Credits
				Th	Pr	Total	
II	L-100	BCA-DSC-2 (Maj)-201	Computer Organization	4	--	4	24
		BCA-DSC-2 (Maj)-202	Introduction to Artificial Intelligence and Data Science	2	--	4	
		BCA-DSC-2 (Maj)-202P	Practical Based on BCA-DSC-2 (Maj)-202	--	2		
		BCA-DSC-2 (Min)-203	Object Oriented Programming using C++	2	--	4	
		BCA-DSC-2 (Min)-203P	Practical Based on BCA-DSC-2 (Min)-203	--	2		
		CSA-MDC-102/202/302/402	Management Information System	3	--	3	
		AEC-2-201	English-2	2	--	2	
		CSA-SEC-102/202/302	Desktop Publishing using GIMP	--	3	3	
		PUN-COMPL-2-201/HCP-COMPL-2-201	Punjabi-2 / HCP-2	2	--	2	
		CSA-VAC-101/201/301/401	Introduction to Blockchain Technology	2	--	2	
		CSA-VAC-102/202/302/402	Introduction to Computer Hardware	2	--		
		CSA-VAC-103/203/303/403	Digital Empowerment	2	--		
		CSA-VAC-104/204/304/404	Ethics of Artificial Intelligence	2	--		

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  - **i. The student must not have studied that course in 10+2 level.**
  - **ii. The student must not have taken that course as a core subject.**

Sem	Level of Course	Course Code	Course Title	Credits			Total Credits
				Th	Pr	Total	
III	L-200	BCA-DSC-3 (Maj)-301	Computer Architecture	4	--	4	24
		BCA-DSC-3 (Min)-302	Data Structures	2	--	4	
		BCA-DSC-3 (Min)-302P	Practical Based on BCA-DSC-3 (Min)-302	--	2		
		BCA-DSC-3 (Min)-303	Computer Oriented Numerical Methods	2	--	4	
		BCA-DSC-3 (Min)-303P	Practical Based on BCA-DSC-3 (Min)-303	--	2		
		BCA-DSC-3 (Maj)-304	Introduction to Machine Learning	4	--	4	
		AEC-3-301	English-3	2	--	2	
	L-100	CSA-MDC-103/203/303	Web Development/ Designing	--	3	3	
		CSA-MDC-104/204/304	Introduction to Information Technology	--	3		
		CSA-SEC-103/203/303	Backend Web Development	--	3	3	

- **One credit of theory lecture is of 1 hour duration and one credit of practical is of 2 hours duration.**
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- **A student can opt for a MDC course subject to following conditions:**
  - **i. The student must not have studied that course in 10+2 level.**
  - **ii. The student must not have taken that course as a core subject.**

Sem	Level of Course	Course Code	Course Title	Credits			Total Credits
				Th	Pr	Total	
IV	L-200	BCA-DSC-4 (Maj)-401A	Operating System Concepts	4	--	4	24
		BCA-DSC-4 (Maj)-402	Database Management System	2	--	4	
		BCA-DSC-4 (Maj)-402P	Practical Based on BCA-DSC-4 (Maj)-402	--	2		
		BCA-DSC-4 (Maj)-403	Information System Design and Implementation	4	--	4	
		BCA-DSC-4 (Maj)-404	Cyber Security	4	--	4	
		BCA-DSC-4 (Min)-405	Python Programming	2	--	4	
		BCA-DSC-4 (Min)-405P	Practical based on BCA-DSC-4 (Min)-405	--	2		
		AEC-4-401	English-4	2	--	2	
	L-100	CSA-VAC-101/201/301/401	Introduction to Blockchain Technology	2	--	2	
		CSA-VAC-102/202/302/402	Introduction to Computer Hardware	2	--		
		CSA-VAC-103/203/303/403	Digital Empowerment	2	--		
		CSA-VAC-104/204/304/404	Ethics of Artificial Intelligence	2	--		

- **One credit of theory lecture is of 1 hour duration and one credit of practical is of 2 hours duration.**
- **A student can opt one MDC, SEC and VAC out of given options respectively, unless specified.**
- **A student can opt for a MDC course subject to following conditions:**
  - **i. The student must not have studied that course in 10+2 level.**
  - **ii. The student must not have taken that course as a core subject.**

- **One credit of theory lecture is of 1 hour duration and one credit of practical is of 2 hours duration.**

Sem	Level of Course	Course Code	Course Title	Credits			Total Credits
				Th	Pr	Total	
V	L-300	BCA-DSC-5 (Maj)-501	Internet of Things	4	--	4	24
		BCA-DSC-5 (Maj)-502	Data Warehouse and Data Mining	4	--	4	
		BCA-DSC-5 (Maj)-503	Java Programming	2	--	4	
		BCA-DSC-5 (Maj)-503P	Practical based on BCA-DSC-5(Maj)-503	--	2		
		BCA-DSC-5 (Maj)-504	Linux Operating System	2	--	4	
		BCA-DSC-5 (Maj)-504P	Practical based on BCA-DSC-5(Maj)-504	--	2		
		BCA-DSC-5 (Maj)-505	C # with .NET framework	2	--	4	
		BCA-DSC-4 (Maj)-505P	Practical based on BCA-DSC-5(Maj)-505	--	2		
		Internship Work/Community Work	Internship/Project Work	--	4	4	

Sem	Level of Course	Course Code	Course Title	Credits			Total Credits
				Th	Pr	Total	
VI	L-300	BCA-DSC-6 (Maj)-601	Computer Networks	4	--	4	24
		BCA-DSC-6 (Maj)-602	Big data Analytics	4	--	4	
		BCA-DSC-6 (Maj)-603	Computer Graphics and Multimedia	2	--	4	
		BCA-DSC-6 (Maj)-603P	Practical based on BCA-DSC-6(Maj)-603	--	2		
		BCA-DSC-6 (Maj)-604	Web Development using PHP	2	--	4	
		BCA-DSC-6 (Maj)-604P	Practical based on BCA-DSC-6(Maj)-604	--	2		
		BCA-DSC-6 (Maj)-605	Cloud Computing	4	--	4	
		BCA-DSC-6 (Min)-606	Discrete Mathematical Structure	4	--	4	

- **One credit of theory lecture is of 1 hour duration and one credit of practical is of 2 hours duration.**

FIRST SEMESTER

Title: Introduction to Web Technologies
Paper Code: BCA-DSC-1(Maj)-101A

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-100			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: This course enables students to create webpages using HTML, CSS and JavaScript.

Learning Outcomes:
After completing this course students will be able to:

i. Get familiar with the terms related to Web Technologies.
ii. Use of HTML in front-end web development.
iii. Understanding the role of CSS in styling web pages.
iv. Know about the basics of Java Script.

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT-I

Web Terminology: Web Server; Web Client/ Browser, Understanding how a Browser communicates with a Web Server, Internet, Intranet, Extranet, WWW, URL

Introduction to HTML: Structure of an HTML program, Paragraph Breaks, Line Breaks; Emphasizing material in a Web Page (Heading Styles, Drawing Lines); Text Styles (Bold, Italics, Underline); Other Text Effects (Centering (Text, Images etc.); **Lists:** Unordered List, Ordered Lists, Definition lists; **Adding Images:** Adding images using Border, Width, Height, Align, ALT Attributes; **Tables:** Caption Tag, Width, Border, Cell padding, Cell spacing, BGCOLOR, COLSPAN and ROWSPAN Attribute

UNIT-II

Linking Documents: Anchor tag, External Document References, Internal Document References and Image Maps.

Frames: Understanding frames, creating frames, Targeting Named Frames

Forms: Attributes of Form element, Input elements: Text, Password, Button, Submit Button, Reset Button, Checkbox, Radio, TextArea, Select and Option.

Cascading style sheets (CSS): Style tag, Link tag, Types of CSS: In-Line, Internal and External.

UNIT-III

Java Script: Features, tokens, data types, variables, operators, control constructs, Built-in and user-defined Functions; strings, arrays, core language objects, client- side objects, Applications related to client-side form validation

Built-In Objects in JavaScript: The String Object, The Math Object, and The Date Object; User-defined Objects: Creating a User-defined Object, Instances, Objects within Objects.

UNIT-IV

Web Development Tools: Overview of Web Development Environment, Code Editors and IDEs, Features of Modern Editors, popular open-source tools for web development, creating a website using IDE, Incorporating HTML, CSS and JavaScript in Web Pages, benefits of using built-in templates, Steps for deploying a website.

Suggested Reading:

1. Wanger & Wyke, "JavaScript Unleashed", Pearson, Latest reprint New Delhi.
2. Bayross, Ivan, "Web Enabled Commercial Application Development using HMTL, JavaScript, DHTML and PHP", BPB Publications, New Delhi.

Practical Based on Paper- BCA-DSC-1(Maj)-101A)

Paper Code: BCA-DSC-1(Maj)-101P

Time Duration: 3 Hrs. **Number of Practical Hours:** 60

Note: Paper will be set at the time of examination. Due weight-age may be given to the Practical note-book and Assignments in evaluation.

Title : Fundamentals of Mathematical Statistics

Paper Code : BCA–DSC-1(Maj)-102

Th	Pr	Cr	
4	-	4	Theory External Marks: 90
			Theory Internal Marks: 10
Level: L-100			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objective: To teach the students the basic techniques of Statistical Methods and to develop students ability to solve various Financial, Scientific and Engineering fields' problems.

Learning Outcomes:

After completing the Course students will be able to

i. Understand the basics of Data Collection and Statistical Techniques
ii. Use and calculate various measure of central tendency, mean, median, mode, range, deviation.
iii. Understand the basics of correlation, measuring techniques and its type.
iv. Gain an insight into regression analysis, its type and methods of calculation.

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.
v. The student can use only Basic (Non-programmable) type of Calculator.
vi. Log tables are allowed. Students may be provided the same for computation.

UNIT – I

Basic Statistics: Types of Statistics, Different Statistical Techniques, Uses and Limitations of statistics, Collection of Data: Sources of collecting primary and Secondary Data, Graphs of Grouped Frequency Distribution, Tabulation of Data: Parts of Table.

Measures of Central Tendency: Kinds of measures of central tendency (statistical averages or averages):

Arithmetic Mean: Simple Arithmetic Mean, Methods of calculating Simple Arithmetic Mean, Arithmetic Mean in case of Individual Series, Discrete series and continuous series,

Geometric Mean: Simple Geometric Mean, Methods of calculating Simple Geometric Mean, Geometric Mean in case of Individual Series, Discrete series and continuous series

Harmonic Mean: Simple Harmonic Mean, Methods of calculating Simple Harmonic Mean, Harmonic Mean in case of Individual, Discrete series and continuous series

UNIT – II

Median: Methods of Calculating Median in case of Individual, Discrete series and continuous series.

Partition Value: Quartile, Percentiles.

Mode: Methods of Calculating Mode in case of Individual Series, Discrete series and continuous series.

Measures of Dispersion: Computation of Range, Computation of Inter Quartile Range,

Computation of Percentile Range. Mean Deviation, Computation of Mean Deviation, Standard Deviation, Calculation of Standard Deviation, Variance, Standard Deviation for individual Series, Discrete Series and Continuous Series, Coefficient of Standard Deviation and coefficient of variation, Correcting incorrect Standard Deviation

UNIT – III

Correlation Analysis: Correlation Analysis: Definition, Types of Correlation: Positive, Negative, Simple, Multiple, Partial, Total, Linear and Non-Linear. Need of Correlation Analysis, Techniques for Measuring Correlation: Scatter Diagram Method, Graphic Method, Karl Pearson's Coefficient of Correlation; Correcting incorrect coefficient of correlation, Calculating Spearman's coefficient of Correlation (Rank correlation): Coefficient of concurrent deviation.

UNIT – IV

Regression Analysis (Linear Regression): Definition, Types of Regression Analysis: Simple, Multiple, Partial, Total, Linear and Non-Linear, Objectives of Regression Analysis, Methods of obtaining regression analysis: Regression Lines, Regression Equations. Methods of obtaining regression equations: Normal Equations, Regression Coefficient, Properties of Regression Coefficient.

Suggested Readings:

1. Das, N. G., 2017: Statistical Methods, McGraw Hill.
2. David M. Levine, 2017: Business Statistics: A First Course, Pearson.
3. Gupta, S.P., 2023: Statistical Methods, Sultan Chand & Sons.
4. Gupta S.C, Kapoor V.K., 2020: Fundamentals of mathematical Statistics, Sultan Chand & Sons.
5. Jain T. R., Aggarwal S.C., 2023: Business Statistics and Mathematics, VK Global Publication.

Title: Problem Solving Through C
Paper Code: BCA-DSC-1(Min)-103

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-100			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The objective of this course is to make the student understand programming language concepts, mainly control structures, reading a set of data, stepwise refinement, function and arrays. The main emphasis of the course is on problem solving aspect**.**

Learning Outcomes

On successful completion of the course, students will be able to:

i. Understand the programming concepts.
ii. Learn the C programming in practical usage.
iii. Solve programming problems using C programming language.
iv. Gain the in-depth knowledge of strings, arrays, functions and file handling etc.
v. Develop applications based on programming concepts.

Note:

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT – I

Fundamentals of C Languages: History of C, Character Set, Identifiers and Keywords, Constants, Types of C Constants, Rules for Constructing Integer, Real and character Constants, Variables, Data Types, rules for constructing variables.

Operators and Expressions: C Instructions, Arithmetic operators, Relational operators, Logical operators, Assignment Operators, Type Conversion in Assignments, Hierarchy of Operations, Standard and Formatted Statements, Structure of a C program, Compilation and Execution.

UNIT – II

Decision Control Structure: Decision making with IF-statement, IF-Else and Nested IF, The else-if Clause.

Loop Control Structure: While, do-while, for loop and nested-for loop; Case Control Structure: Decision using switch, The goto statement.

Functions: Library functions and user defined functions, Global and Local variables, Function Declaration, Calling and definition of function, Methods of parameter passing to functions, recursion, Storage Classes in C.

UNIT – III

Arrays: Introduction, Array declaration, accessing values in an array, initializing values in an array, Two-Dimensional Arrays, initializing a 2-Dimensional Array, Passing array elements to a function: Call by value and call by reference, Arrays of characters, Basic operations on Arrays, Using matrices in arrays, Passing an Entire Array to a Function.
Pointers: Pointer declaration, Address operator "&", Indirection operator "*", Pointer and arrays, Pointers and 2-Dimensional Arrays, Pointer to an Array, Passing 2-D array to a Function, Array of Pointers.

UNIT – IV

String Manipulation in C: Declaring and Initializing string variables, Reading and writing strings, String Handling functions (strlen(), strcpy(), strcmp(), strcat()).
Structures and Unions: Declaration of structures, Structure Initialization, Accessing structure members, Arrays of structure, Nested structures, Structure with pointers, Union.
Files in C: Introduction, Opening and Closing files, Basic I/O operation on files.

Suggested Readings:

1. E. Balagurusamy : Programming in ANSI C, McGraw Hill, New Delhi.
2. Yashavant Kanetkar : Let us C, BPB Publications, New Delhi.
3. Schildt H: The Complete Reference C, Fourth Edition, McGraw Hill, New Delhi.
4. Yashavant Kanetkar: Pointers in C, BPB Publications, New Delhi.
5. Byron S. Gottfried : Programming in C, McGraw Hills Publishers, New York.
6. M.T. Somashekara : Programming in C, Prentice Hall of India.

Title : Practical Based on Paper – BCA-DSC-1(Min)-103
Paper Code: BCA-DSC-1(Min)-103P

Time Duration: 3 Hrs. **Number of Practical Hours:** 60

Note : Paper will be set at the time of examination. Due weight-age may be given to the Practical note-book and Assignments in evaluation.

SECOND SEMESTER

Title : Computer Organization
Paper Code : BCA-DSC-2(Maj)-201

Th	Pr	Cr	
4	-	4	Theory External Marks: 90
			Theory Internal Marks: 10
Level: L-100			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objective: This course will enable the student to understand the working of logic gates, boolean laws and the basics of digital logic circuits in computer hardware organization. The course will familiarize the student with design and implementation of electronic circuits used in internal computer hardware architecture for various arithmetic, logic and shift micro-operations of the microprocessor.

Learning Outcomes:
On successful completion of the course, students will be able to:

i Understand concept of number systems, binary arithmetic and computer codes with its application in digital design.
ii Learn characteristic and working of different logic gates.
iii Design and simplify logic circuits using boolean algebra and K Maps.
iv Demonstrate the working of various combinational and sequential circuits used as basic building blocks in internal hardware architecture.

Note :

i The Question Paper will consist of Four Units.
ii Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv All questions carry equal marks unless specified.

UNIT I

Number System and its conversion: Binary, Octal, Decimal, Hexadecimal; Binary Arithmetic: addition, subtraction, multiplication, division; 8 Bit Signed Arithmetic: signed magnitude, 1's and 2's complement method; Information Representation: fixed and floating point representation; Computer codes: types of codes, BCD, Excess-3, Gray Code, alphanumeric codes – ASCII, EBCDIC, Error detecting and correcting codes- parity, block parity, checksum, CRC and hamming codes.

UNIT II

Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR; Characteristics of Logic Gates: fan in/ fan out, propagation delay, power dissipation, noise margin; Basic Boolean Algebra: Boolean laws, duality principle, De Morgan's theorem, simplification of Boolean algebra; minterm and maxterms, standard form, conversion to canonical form, Karnaugh map and minimization techniques, Universal Gates: conversion of circuits in terms of NAND or NOR only.

UNIT III

Combinational Circuit Design – Adders: Half adder, Full adder, n-bit Parallel Adder, FA using two HAs; Subtractors: Half and Full Subtractor, n-bit FS by 1's and 2's Complement; Code Convertors: Decoder and Encoder; Chip Cascading: 4x16, 5x32 decoder using 2x4 and 3x8 decoders; Multiplexer, Demultiplexer and their applications.

UNIT IV

Sequential Circuit Design – Flip Flops: Bistable circuit, SR-FF, edge triggered with preset & clear, D Type FF, propagation delay, setup & hold time, JK FF, avoidance of race around condition in JK M/S FF, Toggle FF; Shift Registers: SISO, SIPO, PISO, PIPO ; Counters : Asynchronous counter, Up-Down counter, Synchronous counter, applications and comparison.

Suggested Readings:

1. M. Morris Mano, Digital Logic and Computer Design, Pearson India Edu. Services Pvt. Ltd.
2. Jain, R. P., Modern Digital Electronics, Tata McGraw Hill, New Delhi
3. Thomas L. Floyd, Digital Fundamentals – A Systems Approach, Pearson International.
4. F. J. Hill, G.R. Peterson, Introduction to Switching Theory & Logic Design, John Wiley & Sons Inc.

Title : Introduction to Artificial Intelligence and Data Science
Paper Code: BCA-DSC-2(Maj)-202

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-100			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The course will help students to learn the basics of Artificial Intelligence and Data Science. It further aims to make them analyze data using spreadsheets.

Learning Outcomes : On successful completion of this course, a student will be able to

i. understand basics of Artificial Intelligence and Data Science.
ii. analyze data using spreadsheet software.
iii. visualize, search and summarize the data using spreadsheet.

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT – I

Introduction to Artificial Intelligence (AI): Definition, Types of AI, History of AI, Applications of AI in healthcare, education and agriculture, Introduction to key technologies of AI: Machine Learning, Deep Learning, Natural Language Processing (NLP), Computer Vision, Robotics; Ethical issues and Future of AI. Problem Solving: AI problems, Agents and Environments, Structure of Agents.

UNIT – II

Data Science: Introduction to Data Science, evolution and need for Data Science, Types of Data, Data Science Applications in Various Fields, Data Science Life Cycle or Project Stages, Data collection, Data Pre-Processing Overview – Data Cleaning, Data Integration and Transformation, Data Reduction – Data Discretization, Data Storage and management, careers in Data Science

UNIT – III

Managing Datawith Spreadsheet Software: Creating a database, sorting& filtering data, custom sorting and advanced filtering, defining and grouping database ranges, applying data tools like data validation, removing duplicates, text to columns, Flash fill; Managing data using Math, statistical, Trigonometric, String/Text, Date and Time, logical and Database functions, Nested functions.

UNIT – IV

Data Visualization, Searching and Summarizing using Spreadsheet Software: Understanding Chart types, Creating Embedded Charts, formatting Charts: Changing Chart types, adding Titles, Legends and Gridlines, Printing Charts, searching data using HLOOKUP and VLOOKUP, summarizing data using pivot table, analyzing data using What-if Analysis: goal seek, scenario manager and data Table.

Suggested Readings:

1. D.Venu Gopal, Data Science and Artificial Intelligence for Beginners Paperback
2. Sudhir Reddy Navar, Introduction to AI/ML and Data Science Paperback
3. C. Raju, Data Science: A Beginner's Guide Paperback
4. Sharma, A, Essentials of AI and Soft Computing, PHI Learning, 2024
5. Kevin Knight, Elaine Rich, B. Nair - Artificial Intelligence, TMH
6. Manish Nigam, Data Analysis with Excel Paperback, BPB Publications
7. Mali, L. ,. Libre Office 5.1 Writer, Calc: Math Formula Book- Vol 1. Notion Press.
8. L. Winston Wayne, Microsoft Excel: Data Analysis & Business Model Paperback

Title: Practical Based on Paper – BCA-DSC-2(Maj)-202
Paper Code: BCA-DSC-2(Maj)-202P

Time Duration: 3 Hrs. **Number of Practical Hours:** 60

Note : Paper will be set at the time of examination. Due weight-age may be given to the Practical note-book and Assignments in evaluation.

Title: Object Oriented Programming using C++
Paper Code : BCA-DSC-2(Min)-203

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-100			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objectives: The course will enable students to write C++ programs using the more esoteric language features, utilize Object Oriented techniques to design C++ programs, use the standard C++ library, and explore advanced C++ techniques.

Learning Outcomes:
On successful completion of the course, students will be able to:
i. Understand the features and importance of object-oriented programming concepts.
ii. Use the concepts like inheritance, polymorphism, and dynamic binding to develop codes.
iii. Gets better understanding of developing reusable components using C++ programming.
iv. Develop of large software that needs bottom up and better modular approach.

Note :
i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT - I

Principles of Object-Oriented Programming (OOP): Introduction to OOP, Difference between OOP and Procedure Oriented Programming; Concepts: Object, Class, Encapsulation, Abstraction, Polymorphism and Inheritance, Applications of OOP. Special operators: scope resolution operator, Member Dereferencing Operators, Memory Management operators, Manipulators and Type cast operator.

Structure of a C++ Program, Classes and Objects: Class Declaration: Data Members, Member Functions, Private and Public members, Creating Objects, accessing class data members, Accessing member functions; Class Function Definition: Member Function definition inside the class declaration and outside the class declaration.

UNIT – II

Friend function, inline function, Static data members, Function Overloading, Arrays within a class. Arrays of Objects; Objects as function arguments: Pass by value, Pass by reference, Pointers to Objects.
Constructors: Declaration and Definition, Types of Constructors, (Default, Parameterized, Copy Constructors). Destructors: Definition and use.

Operator Overloading: Concept of Operator Overloading, Overloading unary and binary operators.

UNIT - III

Inheritance: Extending Classes Concept of inheritance, Base class, defining derived classes, Visibility modes: Public, Private and Protected; Types of Inheritance: Single inheritance: Privately derived, publicly derived; Making a protected member inheritable, multilevel inheritance, multiple Inheritance, ambiguity in multiple inheritance, Hierarchal Inheritance, Hybrid Inheritance, Nesting of classes.
Polymorphism: Definition, Application and demonstration of Data Abstraction, Encapsulation and Polymorphism, Static and Dynamic Polymorphism, Virtual Functions, pure virtual functions.

UNIT - IV

Exception Handling: Definition, Exception Handling Mechanism: Throwing mechanism and Catching Mechanism, Rethrowing an Exception
File Processing: Opening and closing of file, Binary file operations, structures and file operations, classes and file operations, Random file processing.

Suggested Readings :

1. E. Balagurusamy, Object Oriented Programming with C++, TMH.
2. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publishing Company.
3. Robert Lafore, Object Oriented Programming in Turbo C++, Galgotia Pub.
4. Salaria, R. S. : Object Oriented Programming Using C++, Khanna Book Publishing Co. (P.) Ltd., New Delhi.

Title: Practical Based on Paper – BCA-DSC-2(Min)-203
Paper Code: BCA-DSC-2(Min)-203P

Time Duration: 3 Hrs. **Number of Practical Hours:** 60

Note: Paper will be set at the time of examination. Due weight-age may be given to the Practical note-book and Assignments in evaluation.

SEMESTER III

Paper Title : Computer Architecture
Paper Code: BCA-DSC-3(Maj)-301

Th	Pr	Cr	
4	-	4	Theory External Marks: 90
			Theory Internal Marks: 10
Level: L-200			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objectives: This course will enable the student to understand the basic computer organization and its internal hardware architecture design.

Learning Outcomes:
On successful completion of the course, students will be able to:

i. Understand basic computer organization and its architecture.
ii. Learn how micro-operations, interrupt and instruction cycles are executed in logic circuits.
iii. Learn basic features, memory, input output organization of a simple microprocessor.

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT I

Definition of computer organization, design and computer architecture; Digital Systems: basic block diagram of computer; ALU design: Register Transfer Language, bus and memory transfer; Microoperations and their hardware implementation: Arithmetic microoperations - binary adder, binary adder-subtractor, binary incrementor, composite arithmetic circuit; Logic microoperations; Shift microoperations – 4-bit combinational shifter; Arithmetic Logic Shift Unit.

UNIT II

Basic Computer Organization: stored program organization, Von Neumann architecture; micro-operations and macro-operations; instruction code, instruction format, direct and indirect addressing; basic computer registers; Common bus system; Computer Instructions - memory reference, register reference, input output instructions; instruction cycle; interrupt cycle; types of interrupts; Introduction to assembly language, assembly language vs machine language.

UNIT III

Memory organization: memory hierarchy; RAM and ROM chips, memory connection to CPU; Associative memory; Cache memory and mapping procedures - associative, set associative and direct mapping; Virtual memory – paging and segmentation; Microprocessor architecture: 8086/8088 - features, block diagram, memory and register organization, flag register, addressing modes.

UNIT IV

Input-Output organization: input-output interface - connection of I/O bus to I/O devices, isolated I/O, memory mapped I/O; Asynchronous data transfer: source-initiated and destination-initiated strobe control and handshaking, Modes of transfer - programmed I/O data transfer, interrupt-initiated I/O data transfer; Direct Memory Access : DMA controller, DMA transfer.

Suggested Readings:

1. Mano, M. Morris: Computer System Architecture, Third Edition, Pearson Education India, 2007.
2. Mano, M. Morris, Contributor Mall, Rajib : Computer System Architecture, Revised Third Edition, Pearson Education India, 2017.
3. Stallings, William : Computer Organization and Architecture : Designing for Performance, 11th Ed. Pearson Education India, 2022.
4. Hayes , John P. : Computer Architecture and Organization, 3rd Ed, McGraw Hill Education, 2017.
5. Chaudhuri, P.Pal : Computer Organization and Design, 3rd Ed, Prentice Hall of India Learning Pvt. Ltd., 2008.

Paper Title: Data Structure
Paper Code: BCA-DSC-3(Min)-302

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-200			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: To teach the students various data structures and the basic operations performed using them. At the end of course the student will have complete knowledge of data structures, thus will be able to use them for solving real world problems.

Learning Outcomes:
On successful completion of the course, students will be able to:

i. Choose appropriate data structure as applied to specified problem definition.
ii. Handle various operations on different data structures.
iii. Analyze the time and space complexity of different data structures and their associated algorithms, using Big O notation.
iv. Identify and discuss the application of various data structures in real-world software development and systems.

NOTE:

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT - I

Basic Concepts: Introduction to Complexity, Data Structure and Data Structure operations. Applications of Data Structure, Basic data Structures.
Arrays: Introduction, Types of Arrays, Memory representation, Applications and operations.
Stacks: Introduction, memory representation, Applications and operations, Recursion.

UNIT - II

Linked List: Definition, Types of Linked List: Singly, Doubly, Header, Circular linked List, Operations -traversing, searching, inserting, deleting, operations on singly linked list and doubly linked list, memory representation, Applications, polynomial manipulation.
Queue: Introduction, Types, Memory Representation and Applications.

UNIT - III

Trees – Definition and Basic concepts, Representation in Contiguous Storage, Binary Tree, Binary Tree Traversal, Searching, Insertion and deletion in Binary trees, Binary Search tree. **Graphs**: Introduction, Memory Representation, Graph Traversal (DFS and BFS)

UNIT IV

Searching: Binary and Linear Search;
Sorting: Bubble sort, Insertion sort, Selection sort, Merge Sort, Quick sort. Comparison of various Searching and Sorting algorithms.

Suggested Readings:

1. Schaum Lipschutz, "Data Structures with C", Schaums' Outlines Series, Indian Edition, 2nd Edition, 2017, Tata McGraw Hill.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, 2018, W.H. Freeman and Company.
3. "Data Structures Through C" by Yashavant Kanetkar, 4th Edition, 2022, BPB publication.
4. "Data Structures and Algorithms using C" by R. S. Salaria, 2nd Edition, 2022, Khanna Publishing.
5. "Data Structures Using C" by E Balagurusamy, 1st Edition, 2017, Tata McGraw Hill.
6. Gilberg and Forouzan: "Data Structure-A pseudocode approach with C", 2nd Edition, 2005, Cengage Learning.
7. "Data Structures Using C" by Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, 1st Edition, 2019, Pearson Publication.

Paper Code: BCA-DSC-3(Min)-302P
(Practical Based on paper BCA-DSC-3(Min)-302)

Time Duration: 3 Hrs. Number of Practical Hours : 60

List of Practicals : Implementation of Programs in C for Data Structures

- Implementation of Program to perform the following operations on an Array
- Traversal
- Insertion
- Deletion

- Implementation of Program to sort the given list using:
- Bubble Sort
- Insertion Sort
- Selection Sort
- Merge sort
- Quick sort

- Implementation of Program to search an element using:
- Linear search
- Binary Search

- Program to Implement Stack using an array
- Program to implement Linear Queue using an array
- Program to Implement Circular Queue using an array
- Program to implement Linear Linked List
- Program to implement Doubly Linked List
- Program to perform Insertion in a Binary tree
- Program to perform Deletion in a Binary tree
- Program to perform Searching in a Binary tree
- Program to perform Traversal in Graph

Title: Computer Oriented Numerical Methods
Paper Code: BCA-DSC-3(Min)-303

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-200			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: To teach students essential techniques of numerical methods in order to solve complex mathematical problems with computer programs useful in various scientific and engineering applications.

Learning Outcomes:
On successful completion of the course, students will be able to:

i. Understand the importance of error analysis and how errors propagate in numerical computing of mathematical problems.
ii. Learn how to solve linear, non-linear equations, differential equations using numerical methods.
iii. Learn how to integrate and interpolate for given set of data.
iv. Learn algorithms to implement numerical methods when it's not possible to solve a problem analytically.

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.
v. The student can use only **Basic Scientific (Non-programmable and Non-storage) Calculator**.
vi. Log tables are allowed. Students may be provided the same for computation

UNIT I

Numerical and Error Analysis : Introduction, need of numerical methods, numerical analysis vs numerical methods ; Concept of exact and approximate numbers, accuracy and precision, significant digits ; Measures of Error: absolute error, relative error and percentage error; Types of error : blunder, modeling, inherent, numerical (round off, chopping and truncation) errors; Error Propagation in addition, subtraction, multiplication and division operations; Arithmetic of normalized floating point numbers and its error consequences.

UNIT II

Types of Equations : Linear, quadratic, higher degree polynomial equations, transcendental equations.
Non-Linear Equations: Methods to find solution of a non-linear equation : direct vs indirect method, bracketing vs open end iterative method ; Choosing initial approximation: largest possible root, search bracket, search interval; Termination criteria; Intermediate value theorem; Algorithm and methods to find roots of a non-linear equation : Bisection Method, False position method, Newton Raphson Method, Birge-Vieta Method.

UNIT III

Simultaneous Linear Equations: Algorithm and methods to find solution of simultaneous linear equations: Direct Methods – Gauss Elimination Method, Concept of Pivoting, Gauss-Jordan Method; Iterative Method – Gauss-Seidal Method.

Interpolation: Need of interpolation, interpolation vs extrapolation; Finite Differences – forward, backward, divided difference tables; Methods to interpolate for given value using Newton's Forward Difference Method, Newton's Backward Difference Method, Newton's Divided Difference Method and Lagrange's Method. Concept of Inverse Interpolation.

UNIT IV

Numerical Integration: Methods and algorithm of Newton-Cotes Integration Formulae: Trapezoidal Rule, Simpson's $1/3^{rd}$ Rule, Simpson's $3/8^{th}$ Rule.
Ordinary Differential Equations: Methods and algorithm to find solution of ODEs using Euler's Method, Runge–Kutta Methods - 2^{nd} order & 4^{th} order, Predictor Corrector Method - Modified Euler's Method.

Suggested Readings:

1. Rajaraman, V. : Computer Oriented Numerical Methods, 4^{th} Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2019.
2. Salaria, R.S. : Computer Oriented Numerical Methods : Theory, Problems, Algorithms & Implementation Using C, C++ & Python Languages, Sixth Edition, Khanna Publishers, New Delhi, 2023.

Paper Code: BCA-DSC-3(Min)-303P
(Practical Based on BCA-DSC-3(Min)-303)

Time Duration: 3 Hrs. **Number of Practical Hours : 60**

Programs in C/C++ for Numerical Methods :

1. Implementation of Program to find root of given non-linear equation using :
- Bisection Method
- False Position Method
- Newton Raphson Method
- BirgeVieta method

2. Implementation of Program to find solution of simultaneous linear equations :
- Gauss Elimination Method
- Gauss Jordan Method
- Gauss Seidal Method

3. Implementation of Program to interpolate for given value :
- Equal Intervals : Newton's Forward Difference / Newton's Backward Difference Method
- Unequal Intervals : Newton's Divided Difference Method / Lagrange'sMethod

4. Implementation of Program for Numerical Integration :
- Trapezoidal Rule
- Simpson's $1/3^{rd}$ Rule /Simpson's $3/8^{th}$ Rule

5. Implementation of Program to find solution of ODEs :
- Runge–KuttaMethod
- Euler's Method

Title: Introduction to Machine Learning
Paper Code: BCA-DSC-3(Maj)-304

Th	Pr	Cr	
4	-	4	Theory External Marks: 90 Theory Internal Marks: 10
Level: L-200			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objective: The course aims at introducing basic concepts of machine learning and implementation of machine learning algorithms.

Learning Outcomes:
On successful completion of the course, students will be able to:
i. Learning the basics of Machine Learning and its applications.
ii. Understanding of data preprocessing, regression use in machine learning and data reduction.
iii. Understanding of supervised learning algorithms and its implementation.
iv. Understanding of unsupervised learning algorithms and its implementation. Basic understanding of deep learning.

Note :
i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT-I

Introduction: Concept of Machine Learning, Supervised and Unsupervised learning, Training vs Test Data, Reinforcement learning, Designing a Learning System, Issues in Machine Learning, Applications of Machine Learning.

UNIT-II

Data Preprocessing: Understanding of data and its preprocessing, normalizing data, feature scaling and feature selection techniques, Overfitting, Data reduction using Principal Component Analysis.

UNIT-III

Supervised Learning: Concept of Classification, Decision tree, k-nearest neighbor, Naïve Bayes Classifier, Support Vector Machine, Neural Networks and backpropagation algorithm, Classification evaluation metrics.

UNIT-IV

Unsupervised Learning and Deep Learning: K-means Clustering, Limits of K-Means, DBSCAN, Concept of Deep Learning, Architecture of Convolutional Neural Networks and Recurrent Neural Networks.

Suggested Readings:

1. Andreas . C. Müller and S. Guido, "Introduction to Machine Learning with Python," O'Reilly, 2017
2. Amanda . Casari and Alice . Zheng, "Feature Engineering for Machine Learning," O'Reilly Media, Inc., 2018,
3. Sharma, A., Essentials of AI and Soft Computing, PHI Learning, 2024
4. Mitchell, T.M., Machine Learning, McGraw Hill Education, 2017.
5. Ian Goodfellow, Yoshua. Bengio, and Aaron. Courville, "Deep Learning," MIT Press, 2016
6. Alpaydin, E., Introduction to Machine Learning, MIT press, Fourth edition, 2020.

Paper Title: Operating System Concepts

Paper Code: BCA-DSC-4(Maj)-401A

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-200			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objective: The objective of the module is to make the student understand the basic concepts of an operating system mainly the functions of an operating system, various types of operating systems and how the operating system plays a significant role in various aspects of computing including hardware, memory and other computer resources.

Learning Outcomes:
On successful completion of the course, students will be able to understand:

a. Foundations of Operating Systems.
b. Process Management and Scheduling algorithms
c. Deadlocks and Banker's algorithm
d. Memory management techniques
e. Disk scheduling

Note:

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT - I

Operating Systems (OS): Introduction, its needs and services, Functions of an operating system, Types of OS: Single-User, Multi-user, batch system, Multiprogramming, Multiprocessing and Real time Operating Systems, Parallel systems; Distributed systems- peer-to-peer system, client-server system. Operating system structure- Monolithic, Layered, Microkernel, Modular, Hybrid. Concept and purpose of virtualization.

UNIT – II

Process Management: Introduction to Process, Program vs. Process, Process in Memory, PCB, Process States, CPU Scheduling: context-switch, dispatching, Types of schedulers- Long-term, medium-term, short-term Schedulers, Pre-emptive and Non-preemptive Scheduling, Scheduling Criteria and Algorithms: FCFS, SJF, Priority, Round Robin, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling.

Deadlocks: Necessary and sufficient conditions for Deadlocks, Introduction to methods for handling deadlocks, deadlock prevention, Resource Allocation Graph, deadlock avoidance, Wait-for Graph, deadlock detection and recovery.

UNIT - III

Memory Management: Address binding, Logical vs Physical address space, Memory Management Unit (MMU), Swapping, Fragmentation: External and Internal, Compaction, Introduction to Paging and Segmentation, Virtual Memory-Demand paging, , Pure Demand Paging, Introduction to Page Replacement algorithms: FIFO, Optimal Page replacement and LRU, Introduction to Thrashing.

UNIT - IV

I/O Systems and Device Management- I/O hardware and device drivers, Polling, Interrupt handling, buffering, spooling, and caching; Disk scheduling algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK; RAID levels.

Suggested Readings:

1. Peterson, J.L.& Silberschatz, A., Operating System Concept, Addison Wesley, reading.
2. A.S. Tenenbaum: Operating System: Design and Implementation PHI, 1989.
3. Brinch, Hansen, Operating System Principles, Prentice Hall of India
4. Haberman, A.N., Introducing to Operating System Design Galgotia Publication, New Delhi.

Title: Database Management System
Paper Code: BCA-DSC-4(Maj)-402

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-200			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: This course aims at giving the students the insight of the underlying concepts of database management system and implement them using Database software.

Learning Outcomes:
On successful completion of the course, students will be able to:

i. Gain a solid grasp of fundamental database concepts.
ii. Understand the basic elements of a relational database management system
iii. Master the basics of SQL and construct queries using SQL
iv. Understand the procedural programming concepts

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT - I

Basic Concepts: A Historical perspective, File Systems vs. DBMS, Characteristics of the Data Base Approach, Abstraction and Data Integration, Database users, Advantages and Disadvantages of DBMS, Database Systems Concepts and Architecture: Schemas and Instances, DBMS architecture and Data Independence, Database languages & Interfaces, DBMS functions and component modules, Entity Relationship Model: Entity Types, Entity Sets, Attributes & Keys, Relationships, Relationship Types, Roles and Structural Constraints, Design issues, weak entity types, E-R Diagrams. Design of an E-R Database Schema

UNIT - II

Relational Data Model: Relational model concepts, Integrity constraints over Relations, Relational Algebra - Basic Operations.
Conventional Data Model: An overview of Network and Hierarchical Data Models.
Relational Database Design: Functional Dependencies, Decomposition, Desirable properties of decomposition, Normal forms based on primary keys (1NF, 2NF, 3NF and BCNF)
RDBMS: Terminology, The 12 Rules (Codd's Rule) for an RDBMS.

UNIT - III

Understanding SQL-1: Data Types, Creating database and tables, Creating a Table with data from another table, Inserting Values into a Table, Updating Column(s) of a Table, Deleting Row(s) from a Table, Dropping a Column, Querying database tables, Conditional retrieval of rows, Working with Null Values, Matching a pattern from a table, ordering the result of Query; Inbuilt Functions : Aggregate functions - Grouping the Result of a Query, Character/String functions, date functions; creation and deletion of Views, Managing privileges with Grant and Revoke Command, COMMIT and ROLLBACK.

UNIT - IV

Understanding SQL-II: Querying Multiple Tables using various Joins, SET Operators: Union, Intersect, Minus; Introduction to Nested Queries

Procedural SQL: Creating, Executing and deleting procedures and functions, Variables and Constants, Scope and Visibility of a Variable, Assignments and Expressions, Operator Precedence, Conditional and Iterative Control, Cursor Management: Implicit/explicit Cursor Attributes; Exception Handling: Predefined Exceptions, User Defined Exceptions; Database Trigger: types of triggers, dropping triggers.

Suggested Readings:

1. Elmasri & Navathe: Fundamentals of Database systems, 2017, 7th Edition, Addison Wesley, New Delhi.
2. C.J.Date : An Introduction to Data bases Systems 8th Edition, 2003, Addison Wesley, New Delhi.
3. Korth & Silberschatz:Database System Concept,2010, 6thEdition, McGraw Hill International Edition
4. Bipin C.Desai : An Introduction to Database System, 2015, Galgotia Publication, New Delhi
5. Raghu Ramakrishnan & Johannes Gehrke: Database Management Systems, 2002, 3rd edition, Mcgraw Hill International Edition.
6. Ivan Bayross: SQL, PL/SQL, 2020, Fourth Edition, BPB Publication,New Delhi.
7. Paul DuBois, "MySQL Developer's Library", Fourth Edition, Addison Wesley.

Paper Code: BCA-DSC-4(Maj)-402P
(Practical Based on paper BCA-DSC-4(Maj)-402)

Time Duration: 3 hours **Number of Practical Hours: 60**

List of Practicals :

1. Define table with columns of different data types and apply primary key.
2. Insert records into a table.
3. Update records from table based on a condition.
4. Delete records from table based on condition.
5. Write queries to display all records, select specific columns, and filter results using `WHERE` conditions.
6. Retrieve data and sort it in ascending or descending order.
7. Use the `ALTER TABLE` statement to add, modify, rename and drop columns.
8. Create a foreign key in a child table that references the primary key of a parent table.
9. Insert data into a child table with a valid foreign key reference.
10. Calculate aggregates on columns such as finding the total sum, average, or number of records.
11. Use various date and time functions to manipulate and retrieve date and time values
12. Use `GROUP BY` to group records and then apply aggregate functions like `SUM()`, `AVG()`, etc.
13. Retrieve data from multiple tables by joining them using joins.
14. Use subqueries to retrieve data based on conditions from other queries.
15. Combine results from two or more queries using UNION or INTERSECTION. Ensure unique results using `UNION`.
16. Create a simple view to display a selected set of data from a table.
17. Use functions like `CONCAT()`, `LENGTH()`, `NOW()`, `ROUND()`, and others to manipulate and format data.
18. Create a function that takes two integers as input parameters and returns their sum.
19. Create a function that takes an integer input and returns 'Even' or 'Odd' based on whether the number is even or odd.
20. Create a function that calculates the average salary of employees from the `employees` table.
21. Create and call a stored procedure that prints the names of all students from the `student` table.
22. Create a stored procedure that takes multiple parameters and returns a result.
23. Write triggers for `INSERT`, `UPDATE`, and `DELETE` operations. Automatically execute actions before or after a data modification operation
24. Create a simple cursor to retrieve data from a table.
25. Create and use a cursor with a `SELECT` statement that retrieves multiple columns.

Information System Design and Implementation
BCA-DSC-4(Maj)-403

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-200			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objectives: To teach the students about the various aspects of Information Systems to be developed their analysis and design. The motive is to aware the learners about pre requisite of software development and associated paradigms. After completing this course student will be able to be analyse and design information systems.

Learning Outcomes:
On successful completion of the course, students will be able to:

i. To understand System Development Life Cycle and System Analyst role.
ii. Understanding of SRS, Flow diagrams and other necessary tools.
iii. Understand feasibility study, testing and quality assurance of projects.
iv. To know system implementation, maintenance and installation of projects.

Note :

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of NINE questions comprising TWO questions from each Unit and ONE compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt ONE question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT – I

Systems Concepts and Information Systems Environment: Definition and characteristics of a system. Elements of a system Environment: Boundaries and interface. Types of systems: Physical or Abstract Systems, Open and Closed System, Man-made information systems, Types of System Models.

System Development Life Cycle: Introduction to various phases-Recognition of Need, Feasibility Study, Analysis, Design, Implementation, Post– Implementation and Maintenance.

The Role of System Analyst: Skills of a System Analyst, Duties of the System Analyst.

UNIT – II

System Planning and the Initial Investigation: Bases for planning in system analysis, Initial investigation, determining the user's information requirements, Problem definition and Project Initiation, Background Analysis, Fact Finding, Fact Analysis, Determination of Feasibility.

Information Gathering: Introduction, Information Gathering tools: Review of Literature, Procedures and forms. On-site observation. Interviews and questionnaires.

Tools of Structured Analysis: SRS features and structure, Various tools of structured analysis: Data flow diagram (DFD), Data Dictionary, Decision tree and structured English, Decision table, Pros and cons of each tool, ER-Diagrams

UNIT - III

Feasibility Study: System Performance-statement of Constraints, Identification of Specific System Objectives, description of Outputs. Feasibility Study – Feasibility considerations, Steps in feasibility analysis. Feasibility Report.

System Design: The Process of Design – Logical and Physical Design, Design Methodologies : Structured Design, Functional Decomposition.

System Testing: Testing, System testing, test phases, types of System Testing, Whitebox and Blackbox testing techniques, Object-Oriented testing.

Quality Assurance: Quality assurance and its goals in its system life cycle, Levels of quality assurance, Trends in testing.

UNIT - IV

Implementation and Software Maintenance: Introduction, Conversion- Activity network for Conversion, File Conversion, User Training: Elements of user Training Post implementation review. Software Maintenance - Primary activities of a Maintenance Procedure, Reducing Maintenance Costs. Types of Software Maintenance.

Hardware and Software Selection: Types of Software, Procedure for Hardware/Software selection: Major phases in selection, Evaluation and Validation, Vendor Selection, Post–Installation Review. Software selection- Criteria for Software Selection, the evaluation process.

Suggested Readings:

1. WS Jawadekar and SS Dubey, Management Information System, McGraw Hill; Sixth edition 2020
2. Alan Dennis, Barbara Haley Wixom, Roberta M. Roth., Systems Analysis and Design, Edition 2018, John Wiley & Sons Inc.
3. Hardgrave Bill C., Siau Keng, Chiang Roger H.L., Systems Analysis and Design: Techniques, Methodologies, Approaches and Architectures, Edition 2017, M.E. Sharpe Publications.
4. E.M. Awad: Systems Analysis and Design, Edition 2015, Galgotia Publications

Paper Title: Cyber Security
Paper Code: BCA-DSC-4(Maj)-404

Th	Pr	Cr	
4	-	4	Theory External Marks: 90
			Theory Internal Marks: 10
Level: L-200			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Objective: The objective of this course is to understand the Cyber Security and its implications.

Learning Outcome: On successful completion of the course, students will be able to:

i. Understand the architecture and regulatory aspects of cyberspace and the key terminologies in cyber security.
ii. Identify and assess web-based attacks, network vulnerabilities, and exploit tools.
iii. Recognize and classify different types of cybercrimes and understand legal frameworks.
iv. Grasp data privacy principles, including compliance with regulations.

Note:

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT-I

Introduction to Cyber security: Defining Cyberspace, Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

Defining Cyber Security, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker, Controls, Authentication, Access Control and Cryptography.

UNIT-II

Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, E-mail Attacks.
Network Vulnerabilities: Overview of vulnerability scanning, Open, Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, Open VAS, Meta sploit. Networks Vulnerability Scanning (Netcat, Socat), Network Sniffers and Injection tools.

UNIT-III

Cyber-crime and Cyber law: Classification of cyber-crimes, Common cyber-crimes- cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransom-ware attacks, zero day and zero click attacks, Cybercriminals modus-operandi, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments, Cybercrime and offences, Organizations dealing with Cybercrime and Cyber security in India.

UNIT-IV

Data Privacy and Data Security: Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR), 2016 Personal Information Protection and Electronic Documents Act (PIPEDA), Social media- data privacy and security issues.

Firewalls and Packet Filters, password Cracking, Key loggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks.

Suggested Readings:

1. Cyber security and Cyber war: What Everyone Needs to Know" by P.W. Singer and Allan Friedman (2014)
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.(2011)
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform (2015).
4. Cybercrime and Digital Forensics: An Introduction" by Marjie T. Britz (3rd Edition, 2019)
5. Security and Privacy in Communication Networks" by Nosseir, Ekici, and Cavallaro (2021)
6. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.(2009)
7. Auditing IT Infrastructures for Compliance by Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.(2015)

Paper Title: Python Programming
Paper Code: BCA-DSC-4(Min)-405

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-200			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The objective of the module is to make the student understand the basic concepts of python programming language, lists, tuples, classes and dictionary. The module will enable students to do programming using the python library.

Learning Outcome: After the completion of the module, student will gain knowledge of:

i. The fundamental concepts of python programming, syntax and semantics.
ii. Using Lists, tuples, Dictionaries, functions in python.
iii. Creating and using Files in python.
iv. Using python modules and functions.

Note:

i. The Question Paper will consist of Four Units.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Unit and the Compulsory question.
iv. All questions carry equal marks unless specified.

UNIT – I

Introduction to Python Programming, Data Types, Operators, Expressions, Variables, Scope of a variable, Type Conversion in Python, if statement: simple if, if-else, if-elif-else chain, if statement with lists; Loops: Selection, Indentation, Repetition, Break and Continue statement, Nested Loops, while loop with lists and dictionaries, Strings: Introduction to String, String Operations, Transversal of string, Methods and Inbuilt Functions.

UNIT – II

Lists: Definition, Operations, Traversal, Methods and Inbuilt Functions, Nested Lists, Copying Lists, List as an argument, Mutable and Immutable Data types. Tuples: Introduction, Operations, Traversal, Methods and Inbuilt Functions, Nested Tuples

Dictionaries: Introduction, Traversal, Methods and Inbuilt Functions, Manipulating Dictionary.

UNIT – III

Function: definition, advantages, User defined functions: defining a function, passing arguments, return values, passing a list, Python standard Libraries.
Classes: creating and using a class, working with classes and instances, importing classes, Python standard library.

UNIT – IV

Exception Handling: exceptions and errors, try-except block, the else block, handling the ZeroDivisionError and FileNotFoundError exception.

File Handling: Introduction, Types of Files, Opening and Closing File, Writing to a file, Reading from a file, Setting offset in a file, Creating and Traversing a file.

Suggested Readings:

1. Learning Python, Mark Lutz 5th Edition, O'Reilly Media, Inc., 2015
2. Python Programming: A Complete Guide for Beginners to Master, Python Programming Language: A Complete Guide For Beginners To Master And Become An Expert In Python Programming Language, Brian Draper, Createspace Independent Pub; 1st edition, 2016
3. Python: Python Programming For Beginners - The Comprehensive Guide To Python Programming: Computer Programming, Computer Language, Computer Science , Adam Stark, CreateSpace Independent Publishing Platform, 2016
4. Python Essential Reference, David M Beazley, 4th edition, Pearson Education Inc., 2009.
5. Python Programming: An Introduction to Computer Science, John M Zelle, 2nd Edition ,2003
6. Python Crash Course, A Hands-On, Project-Based Introduction to Programming, Eric Maththes, 2nd Edition, No Starch Press, 2019

Paper Code: BCA-DSC-4(Min)-405P
(Practical based on paper BCA-DSC-4(Min)-405)

Time Duration: 3 Hrs. **Number of Practical Hours: 60**

List of Practicals:

1. Program to find the largest out of two numbers.
2. Program to find out whether a given number is even or odd.
3. Program to print the first ten natural numbers.
4. Program to find the factorial of a number.
5. Program to find out whether a given number is prime or not.
6. Program to find whether a given string is palindrome or not.
7. Program to implement string functions: len(), count(), join(),split()
8. Program to print all the elements of the list.
9. Program to reverse the elements of the list.
10. Program to find whether an element exists in the list or not.
11. Program to clear a list.
12. Program to copy a list
13. Program to find the largest and smallest element from a list.
14. Program to find the length of a tuple
15. Program to remove tuples from list
16. Program to sort tuples.
17. Program to create a dictionary, access dictionary items, add items to a dictionary, remove items from a dictionary, change items from a dictionary, find dictionary length.
18. Program to swap two numbers
19. Program to implement recursion
20. Simple Programs to implement classes and objects in python.
21. Program to handle exception ZeroDivsisonError and FileNotFoundError
22. Program to read and write to file.

FIFTH SEMESTER

Paper Title: Internet of Things
Paper Code: BCA-DSC-5(Maj)-501

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-300			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Course Objective: This course aims to provide students with knowledge of basic concepts, principles, and challenges in Internet of Things.

Learning Outcomes:
On successful completion of the course, students will be able to:
- Learn the fundamentals of the Internet of Things.
- Understand IoT Reference Architecture.
- Learn about the basics of IoT protocols
- Apply the concept of Internet of Things in a real-world scenario

NOTE:
- The Question Paper will consist of Four Units.
- Examiner will set a total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering the whole syllabus.
- The students are required to attempt **ONE** question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

UNIT – I

Fundamentals of IoT: Definition, Scope, Vision and evolution of IoT, IoT Conceptual Framework, Architectural view, Major Components of IoT Systems, Sources of IoT, M2M (Machine-to-Machine) Concept and Architecture, Applications in Smart System Design.

Design Principles for Connected Devices: IoT OSI Model, ITU-T Reference Model, communication technologies - Wireless and wired, Iot/M2M system layers, Data Management and Consolidation Gateway.

UNIT – II

Hardware for IoT: Sensors and types of sensor, Digital sensors, actuators, radio frequency identification (RFID) technology and applications, wireless sensor networks: Architecture and applications, participatory sensing technology. Network and communication aspects: Wireless medium access issues, MAC protocol- overview and survey, Routing Protocols for IoT (Proactive, Reactive, Hybrid protocols), Sensor deployment & Node discovery, Data aggregation & dissemination.

UNIT – III

Data Handling & Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage (SQL vs NoSQL, Cloud Storage, Edge Storage), Introduction to Hadoop. Data Analytics in IoT: Introduction and Need, Types of Data Analytics (Descriptive, Diagnostic, Predictive, Prescriptive), Local Analytics (on-device/edge), Cloud Analytics and Applications

UNIT IV

IoT Applications in Various Domains: Home Automation, Smart Cities and smart governance, Energy, Retail Management and Supply Chain, Logistics, Agriculture and precision farming, Health and Lifestyle Applications, Industrial IoT, IoT in Environmental Protection. Challenges and Ethics in IoT: Legal Challenges (privacy, data protection, intellectual property), IoT Design Ethics (security, trust, human-centric design), Emerging Standards and Future Directions.

Suggested Readings:

1. Olivier Hersent, David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", Wiley, 2012.
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, 2018.
3. Michael Miller "The Internet of Things" by Pearson, 2015.
4. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw-Hill, 2nd Edition, 2017.
5. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", 1ST edition, VPI publications, 2014
6. Adrian McEwen, Hakin Cassimally, "Designing the Internet of Things" Wiley, 2015.
7. Daniel Minoli, ― "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
8. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Paper Title: Data Warehouse and Data Mining
Paper Code: BCA-DSC-5(Maj)-502

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-300			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Course Objectives: The Course Objective is to provide students with a strong foundation about Data Warehouse & Data Mining and its various applications.

Learning outcomes:

- To understand multidimensional behaviour of data and Data Warehouse architectures
- To apply data pre-processing concepts to clean, integrate and transform different datasets, apply Data Mining methods to information systems and generate results for decision making systems.
- To analyze various Data Mining techniques for its applicability in other fields.

Note:

i. The Question Paper will consist of Four Sections.
ii. Examiner will set total of **NINE** questions comprising **TWO** questions from each Section and **ONE** compulsory question of short answer type covering whole syllabi.
iii. The students are required to attempt **ONE** question from each Section and the Compulsory question.
iv. All questions carry equal marks unless specified.

Unit I

Data Warehouse: Introduction to Data Warehouse, Characteristics of Data Warehouse, Difference between operational database systems and Data Warehouses, Data Warehouse roles and structure, Need of Data Warehouse.

Data Warehouse Architecture and its Components, A Multi-dimensional Data Model, Schemas for Multidimensional Databases (Star Schema, Snowflake Schema and Fact Constellations), OLAP Servers: ROLAP, MOLAP, HOLAP, Data Marts and its types

Unit II

Data Warehouse Design**:** Identifying facts and dimensions, designing fact tables, dimension tables and starflake schema; Partitioning Strategy – Horizonal, Vertical and Hardware Partitioning; Aggregation – Introduction, Steps to design summary tables;

Security, Backup and Recovery in Data Warehouse – Security Requirements, Hardware and Software Technologies for backup, backup strategies, disaster recovery; Testing the Data Warehouse – Developing a test plan, testing backup recovery, operational requirements, database and application.

Unit III

Data Mining: Fundamentals of Data Mining, Data Mining Functionalities. Technologies used in Data Mining, Knowledge Discovery Process, Data Mining Task Primitives, Major Issues in Data Mining, Data Objects and Attribute Types, Basic Statistical description of data, Data Visualization.

Data Preprocessing: Need for Preprocessing the Data, Major Tasks in Data Preprocessing - Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization and Concept Hierarchy Generation.

Unit IV

Classification: Introduction to Classification, Decision Tree Induction: How a Decision Tree Works, Types of Attributes, Characteristics of Decision Tree Induction; Rule-Based Classification; Bayesian Classification Methods – Bayes' Theorem, Naïve Bayes Classifier.

Cluster Analysis: Introduction, Types of Clustering, Types of Clusters, Requirements of Cluster Analysis, Overview of Basic Clustering Methods.

Information Privacy and Data Mining: Basic principles to protect information piracy, Primary aims of Data Mining Security, pitfalls of Data Mining, Ways to accomplish data mining security

Suggested Readings:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. Sam Anahory and Dennis Murray, "Data Warehousing in the Real World", Pearson.
3. Jiawei Han, Micheline Kamber and Jian Pie, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers.
4. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
5. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
6. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.

Paper Title: Java Programming
Paper Code: BCA-DSC- 5(Maj)-503

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-300			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Course Objective: This course aims to provide students with knowledge of all the programming concepts of the Java programming language.

Learning Outcomes: On successful completion of the course, students will be able to:
- Understand the fundamentals of Java programming.
- Apply Object Oriented programming concepts.
- Design and implement Java programs for complex problems

NOTE:
- The Question Paper will consist of Four Units.
- Examiner will set a total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering the whole syllabus.
- The students are required to attempt **ONE** question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

UNIT – I

Basic Principles of Object Oriented Programming: Introduction and Features of Java, Java Environment, Java Virtual Machine, Java Bytecode, Java Program Structure.

Basic Language Elements: Tokens, Character set, Identifiers, Keywords, Literals, Comments, Constants, Variables, Data types in Java, Creating the Java program, Compiling and Running the programs, Operators and Expressions, Type Conversions, Assignments; Input/output in Java: Basics, I/O Classes, Reading Console Input, Decision and Loop Control Statements, break, continue

UNIT – II

Classes and Objects in Java: Defining a Class, Creating Objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting of Methods.

Arrays & Strings in Java: Defining an Array, Initializing & Accessing Array, Multi–Dimensional Array, Defining String, Operations on Arrays and Strings, Creating Strings using String Class and StringBuffer Class

UNIT – III

Inheritance: Benefits of Inheritance, Types of Inheritance in Java, Extending a Class, Defining a subclass, Subclass constructor, Multilevel inheritance, Hierarchical inheritance, Overriding Methods, Visibility Control, Abstract Class and methods; Final variables and Methods, Final Class, Finalizer Methods, Interfaces: Defining and implementing interfaces.

Packages: Defining a Package, Organizing Classes and Interfaces in Packages, Importing Packages, CLASSPATH Setting for Packages, Access Protection in Packages, Standard Packages

UNIT IV

Exception Handling in Java: Basics of Exception-Handling, Types of Exception, Use of try and catch, Multiple catch statements, finally statement, Java Built-in and User Defined Exceptions, throw an exception explicitly, use of 'throws' in Exception Handling, finally, Checked and Un-Checked Exceptions.

Multithreaded Programming: Life cycle of a Thread, Creating Threads, Extending the Thread Class, Implementing a 'Runnable' Interface, creating multiple threads, thread priorities, synchronization.

Suggested Readings:

1. E Balagurusamy, Programming with JAVA, Tata McGraw-Hill, New Delhi.
2. Herbert Schildt, The Complete Reference, McGraw-Hill Education, New Delhi.
3. "JAVA 2 UNLEASHED, Tech Media Publications, New Delhi.
4. Patrick Naughton and Herbert Schlitz,"JAVA-2 Complete Reference" ,TMH, New Delhi.
5. Ivor Horton, "Beginning JAVA 2", WROX Publications, New Delhi.

Paper Code: BCA-DSC-5(Maj)-503P
(Practical based on Paper BCA-DSC-5(Maj)-503)

Time Duration: 3 Hrs. **Number of Practical Hours: 60**

List of Practical

1. Program to print a simple message.
2. Program to demonstrate data types and variables.
3. Program to demonstrate command-line arguments.
4. Program to demonstrate arithmetic operators (+, −, *, /, %).
5. Program to read input using Scanner.
6. Program to check even/odd using if-else.
7. Program to demonstrate relational and logical operators.
8. Program to print numbers from 1 to 10 using a loop.
9. Program to demonstrate break and continue in loops.
10. Program to create a simple class and object.
11. Program to access class members (variables & methods).
12. Program to demonstrate constructors.
13. Program to demonstrate constructor overloading.
14. Program to demonstrate method overloading.
15. Program to demonstrate static variables and static methods.
16. Program to demonstrate final variable, final method, final class.
17. Program to demonstrate abstract class and abstract method.
18. Program to demonstrate the finalize() method.
19. Program to create and display an array.
20. Program to find the sum of array elements.
21. Program to find the largest element in an array.
22. Program to create and print a 2-dimensional array.
23. Program to demonstrate simple String operations (length, concat, compare).
24. Program to reverse a string.
25. Program to show StringBuffer operations (append, insert, delete).
26. Program to demonstrate single inheritance.
27. Program to demonstrate multilevel inheritance.
28. Program to demonstrate hierarchical inheritance.

29. Program to demonstrate method overriding.
30. Program to demonstrate multiple inheritance using interfaces.
31. Program to demonstrate super keyword.
32. Program to demonstrate visibility (public, private, protected).
33. Program to create a user-defined package.
34. Program to import a package and use its class.
35. Program to demonstrate try-catch.
36. Program to demonstrate multiple catch blocks.
37. Program to demonstrate finally block.
38. Program to create a user-defined exception.
39. Program to demonstrate checked exception (FileNotFound).
40. Program to demonstrate unchecked exception (ArithmeticException).
41. Program to create a thread using the Thread class.
42. Program to create a thread using the Runnable interface.
43. Program to demonstrate multiple threads running together.
44. Program to demonstrate thread priorities.
45. Program to demonstrate synchronization.

Paper Title: Linux Operating System
Paper Code: BCA-DSC-5(Maj)-504

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-300			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The objective of this course is to introduce students to the fundamental concepts of Linux and its role as an open-source operating system. It also aims at providing command line proficiency and practical skills for using Linux.

Learning Outcomes:
On successful completion of the course, students will be able to:
- Use Basic Linux commands, manage files, directories, permissions processes, users and groups
- Write simple shell scripts for automation of tasks

Note:
- The Question Paper will consist of Four Units and one compulsory question.
- Examiner will set total of NINE questions comprising TWO questions from each Unit and ONE compulsory question of short answer type covering whole syllabi.
- The students are required to attempt ONE question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

Unit – I

Introduction to Linux: Operating System and its Functions, Proprietary Vs Open-Source Systems, History of Linux, Features of Linux, Difference between Linux, Windows and Unix; Introduction to Linux Distributions, Minimum System Requirements, Steps to install Linux, Architecture of Linux Operating System: Kernel, Shell, Introduction to various Linux Shells

Unit – II

Basic Linux Commands: Login, Logout, Shutdown commands, man, date, banner, who, who am i, cal, bc, prompt
Files and Directories: Types of Files in Linux, File Naming Conventions, Hierarchical File system: Concept of Root Directory, Home Directory, Parent and Child Directory, System Directories in Linux, Absolute & Relative File path
Managing Permissions: File and Directory permissions, chmod command (symbolic and octal mode), File and Directory Ownership : chown, chgrp, umask

Unit – III

Basic Linux File and Directory handling commands with options: pwd, ls, cd, mkdir, rmdir, cd, cat, cp, mv, rm, clear, cmp, comm, diff, find, using wildcards (*, ? and []) with various commands, Environment Variables
Process handling commands: Introduction to Processes, Foreground and Background processes, Managing Processes using fg, bg, kill, ps, sleep, nice, jobs, top
Redirection, Pipes and Filters: Input, output and Error Redirection, Concept of Pipe, tee command, Filtering data using head, tail, more, less, wc, sort, cut, paste, tr, grep

Unit – IV

System Administration activities: Managing Passwords with passwd command, Structure of password file, sudo and su command, File Backup and Compression: tar and gzip, User and Group Management: Commands to create, delete, modify users and groups in Linux, Structure of Group file, Managing disk space with df and du

Shell programming: Introduction to Shell Scripts, create shell scripts using gedit or any other text editor, save and run shell scripts, variables, using single, double or back quotes, echo and read commands, expr, command substitution, test command, Decision making constructs (if-else, if-elseif, case-esac), Different ways of evaluating Arithmetic expressions, Loops (while, for, until), tput clear, tput cup. Basic shell programs to manage strings.

Suggested Readings:

1. John Goerzen: Linux Programming Bible, IDG Books, New Delhi
2. Ryan Turne: Linux: The Ultimate Beginner's Guide to Learn Linux Operating System, Command Line and Linux Programming Step by Step
3. David Clinton: Ubuntu Linux Bible, Christop, Publisher: Wiley
4. Tim Parker: Linux Unleashed, SAMS
5. Andrew Mallett Mokhtar Ebrahim: Mastering Linux Shell Scripting - A practical guide to Linux command-line, Bash scripting, and Shell programming, Packt
6. Richard Blum, Christine Bresnahan: Linux Command Line and Shell Scripting Bible, Wiley

Paper Code: BCA-DSC-5(Maj)-504P
(Practical based on Paper BCA-DSC-5(Maj)-504)

Time Duration: 3 Hrs. **Number of Practical Hours: 60**

Note: Paper will be set at the time of examination. Due weight-age may be given to the practical notebook and Assignments in evaluation.

Suggested List of Practical Assignments

Write shell scripts to,

1. Display message "Hello World"
2. Display date and this month's calendar and shell used.
3. Display environment variables.
4. Change the values of environment variables.
5. Define, set, unset and display a variable
6. Make a variable read only Variable.
7. Assign values to variables using read command.
8. Accept a string to be searched in a given file.
9. Perform simple arithmetic operation.
10. Determines whether the file exits in home directory.
11. Accept user input for a scriptname and determine the permissions of the given file.
12. Input two string and assess whether one of the strings is null, both equal or not equal.
13. Create menus using a switch case statement to show system configurations like:
    a. Currently logged user and his log name
    b. Your current shell
    c. Your home directory
    d. our operating system type
    e. Your current path setting
    f. Your current working directory
    g. Show the Currently logged number of users
    h. About your os and version, release number, kernel version
    i. output username, time and date and Whois logged on.
14. Print the sum of five numbers using while loop.
15. Calculate result of 'n' students (while, do, expr).
16. Copy a file from one directory to another
17. Find smaller of two numbers.
18. Swap values of two variables.
19. Find the greatest number.
20. Find factorial of a number
21. Print sum of n numbers.
22. Print multiplication table.

Paper Title: C# with .NET Framework
Paper Code: BCA-DSC-5(Maj)-505

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-300			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The objective of this course is to familiarize students with the fundamental concepts of .NET Framework and C# Programming Language. It aims at enhancing programming skills of students with hands-on experience of using it with practical applications.

Learning Outcomes:
On successful completion of the course, students will be able to:
- Understand basic concepts of .Net framework and C#
- Create menu-driven Applications and minor projects using C# and .Net Framework

Note:
- The Question Paper will consist of Four Units and one compulsory question.
- Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
- The students are required to attempt **ONE** question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

UNIT-I

Introduction to .NET Framework: The NET Framework Architecture, The Common Language Runtime (CLR), The Framework Class Library (FCL), The Common Languages Specification (CLS), The Common Type System (CTS), Garbage Collection (GC), .NET languages, Managed Code, Microsoft Intermediate Language (MSIL), JIT Compilation, Garbage Collection, .NET Namespaces

Introduction to Visual Studio.NET IDE: Menu bar, Tool Bar, Design Window, Code Editor, Solution Explorer, Server Explorer, ToolBox, Properties Window, Designing GUI using Window Forms and Common controls- Label, Textbox, Button, GroupBox, CheckBox, RadioButton, ListBox, ComboBox, Picture Box, Timer, DateTimePicker, Progress Bar; Introduction to Menus

UNIT-II

Fundamentals of C#: Features of C#, Keywords, Literals, Identifiers, Variables and constants, Data Types: Value Types and Reference Types, Operators and their Precedence, Comments, Branching and Looping Control Statements: - if, if-else, ladder if, switch; while, do-while, for, foreach; Jump statements- break, continue, Introduction to console applications
Procedures: Introduction, sub procedures, function procedures, event procedures, commonly used Form events, messagebox and inputbox function.

Arrays and Strings: Introduction to Arrays, Declaring and allocating arrays, Creating Strings, String Methods: len, right, left, ucase, lcase, ltrim, trim.

UNIT-III

Accessing Data with ADO.NET: Introduction to ADO.NET, ADO.NET Architecture, ADO.NET object model: Connected model and Disconnected model, Components, Understanding Provider classes, using Data Reader to read data from database, Data Adapter, Datasets, Connecting to and querying a data source, Viewing data using Data Grid View Control

UNIT-IV

Introduction to ASP.NET: Overview of ASP.NET framework, Stages in Web Forms Processing, Validation Controls: required field validator, range validator, compare validator, regular expression validator, custom validator, validator summary.

State Management: Managing state in web applications using Session object, Cookie and query string, Creating ASP.NET application, Introduction to web services

Suggested Readings

i. Balagurusamy, "Programming with C#", TMH
ii. Robert Powel, Richard Weeks, C# and the .NET Framework, Techmedia
iii. Michaelis, **Essential C# 12.0**. Addison-Wesley, 2023.
iv. Gerard Byrne, Target C#: Simple Hands-On Programming with Visual Studio 2022 Paperback
v. Mark J Price, C# 13 and .NET 9 - Modern Cross-Platform Development Fundamentals - Ninth Edition: or latest (Paperback)

Paper Code: BCA-DSC-5(Maj)-505P
(Practical based on paper BCA-DSC-5(Maj)-505)

Time Duration: 3 Hrs. **Number of Practical Hours: 60**

Note: Paper will be set at the time of examination. Due weightage may be given to the practical notebook and Assignments in evaluation. Practical should be based on the topics covered in Theory Paper.

SIXTH SEMESTER

Paper Title: Computer Networks
Paper Code: BCA-DSC-6(Maj)-601

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-300			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Course Objective: To provide students with a strong foundation in computer networking concepts, architectures, and protocols, and to equip them with practical skills in designing, analyzing, and securing networks.

Learning Outcomes:
On successful completion of the course, students will be able to:

- Know about the fundamental concepts, types of networks, and reference models (OSI & TCP/IP).
- Analyze transmission media, switching, and multiplexing techniques.
- Apply error detection, flow control, and medium access protocols in data communication.
- The routing algorithms, transport protocols, and application layer services.
- Evaluate network security mechanisms including firewalls, cryptography, and intrusion prevention.

Note :

- The Question Paper will consist of Four Units.
- Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
- The students are required to attempt **ONE** question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

UNIT – I

Computer Network: Types of Networks: LAN, MAN, WAN, Network Topologies: Bus, Star, Ring, Mesh, Tree, Hybrid, Modes of communication: Simplex, half duplex, full duplex, Uses of Computer Networks, OSI Reference Model, TCP/IP reference model, Comparison of OSI with TCP/IP model.
Physical Layer: Transmission media: Wired transmissions (Twisted pair, Coaxial cable, Fiber optics), Wireless Transmission (Radio, Microwave, and Infrared), Switching: (Circuit Switching, Message Switching, Packet Switching), Multiplexing: (Frequency Division, Time Division, Wave Length Division).

UNIT – II

Data Link Layer: Framing, Types of addresses: unicast, multicast, and broadcast; Address Resolution Protocol (ARP), Errors Detection and Correction Code: Check sum, CRC, Hamming code, Data Link Protocols for noisy and noiseless channels, Sliding Window Protocol: Stop and Wait ARQ, Go-back-N ARQ, Selective Repeat ARQ.

Medium Access Sub-Layer: Introduction to Static and Dynamic channel allocation, Random-access protocols ALOHA, CSMA, CSMA/CD, CSMA/CA, IEEE standards 802.3,802.11, Repeaters, Hubs,

Bridges, Switches, Routers, and Gateways.

UNIT – III

Network Layer: Design Issues, network layer addressing, network layer datagram, IP addressed Classes. Subnetting-Sub-network, Subnet mask, Routing Algorithm: Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Broadcast and Multicast routing, Congestion control: Principles of Congestion Control, Congestion prevention policies, Leaky bucket and Token bucket algorithms.

Transport Layer: Design issues, Elements of transport protocols: Addressing, Connection establishment and release, Flow control and buffering, Introduction to TCP/UDP protocols.

UNIT – IV

Application Layer: Domain Name system (DNS), DNS name space, DNS Servers, World Wide Web, HTTP, e-mail: Architecture and Services, Message Component, Multipurpose Internet Mail Extensions (MIME), Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP), Remote Login and File Transfer Protocol.

Network Security: Introduction to Network Security, Sniffing and Snooping, Firewalls, Intrusion Detection and Prevention, Introduction to Cryptography, Substitution Ciphers, Transposition Ciphers, Symmetric-Key Algorithms, Public-Key Algorithms (RSA), Digital Signatures.

Suggested Readings:

1. Andrew S. Tanenbaum, “Computer Networks”, Pearson Publication.
2. Behrouz A. Forouzan, “Data Communication and Networking”, Tata McGraw Hill.
3. Theodore S. Rappaport, “Wireless Communication: Principle and Practices”, Pearson Publication.
4. Charlie Kaufman, Radio Perlman, Mike Speciner, “Network Security”, PHI

Paper Title: Big Data Analytics
Paper Code: BCA-DSC-6(Maj)-602

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-300			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Course Objective:
The main objective of the course is to familiarize students with the fundamental concepts of Big Data, its characteristics, and real-world applications, Big Data analytics techniques, visualization tools and create awareness about data security, privacy, and ethical considerations in the use of Big Data.

Learning Outcomes:
After completing this course, students will be able to:
- Explain the concepts, characteristics, and applications of Big Data in various domains.
- Demonstrate the use of Big Data technologies such as Hadoop, Spark, and NoSQL databases for storage and processing.
- Understand basic data analytics and visualization techniques and tools like Python, Tableau, or Power BI.
- Evaluate challenges related to Big Data security, privacy, and ethics in practical contexts.

Note:
- The Question Paper will consist of 4 Units and 1 compulsory question.
- Examiner will set total of NINE questions comprising TWO questions from each Unit and ONE compulsory question of short answer type covering whole syllabi.
- The students are required to attempt ONE question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

UNIT – I

Basics of Data: Structured, Semi-structured, Unstructured, Characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), Traditional Data vs. Big Data, Applications of Big Data in real life (e-Commerce, Healthcare, Banking, social media), Introduction to Data Science, AI, and Business Analytics.

Unit II

Big Data Technologies, Hadoop Ecosystem Overview, HDFS (Hadoop Distributed File System): Concepts & File Operations, MapReduce Programming Model – Simple examples, Introduction to Apache Spark: RDDs, Data Frames, NoSQL Databases – Concepts, Introduction to MongoDB

Unit III

Data Analytics Techniques & Tools, Types of Analytics (Descriptive, Diagnostics, Predictive, Prescriptive), Need of Data Visualization, Tools for Big Data Analytics: Python (Pandas, Matplotlib), Features of Tableau and Power BI

Unit IV

Challenges, Ethics & Applications, Big Data Security & Privacy Issues, Data Governance & Legal Aspects (GDPR basics), Case Studies: Fraud Detection in Banking, E-commerce Recommendation (Amazon/Flipkart), Future Trends in Big Data

Suggested Readings

1. Big Data: Principles and Paradigms – Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi (Morgan Kaufmann, 2016).
2. Big Data Fundamentals: Concepts, Drivers & Techniques – Thomas Erl, Wajid Khattak, Paul Buhler (Prentice Hall, 2016).
3. Learning Spark: Lightning-Fast Big Data Analysis – Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia (O'Reilly Media, 2015).
4. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – Pramod J. Sadalage, Martin Fowler (Addison-Wesley, 2013).
5. Data Analytics Made Accessible – Anil Maheshwari (Amazon/Kindle, 2nd Edition, 2017).
6. Big Data Analytics – Seema Acharya, Subhashini Chellappan (Wiley India, 2015).

Paper Title : Computer Graphics and Multimedia
Paper Code: BCA-DSC-6(Maj)-603

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-300			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The objective of the course is to introduce basic computer graphics concepts and algorithms. The student will also learn about essential concepts used in developing multimedia applications.

Learning Outcomes:
- Understand fundamental concept of computer graphics.
- Understand display devices and other graphics hardware.
- Understand the concept of output primitives and apply algorithms.
- Understand the fundamentals of multimedia systems.

Note:
- The Question Paper will consist of Four Sections.
- Examiner will set total of NINE questions comprising TWO questions from each Section and ONE compulsory question of short answer type covering whole syllabi.
- The students are required to attempt ONE question from each Section and the Compulsory question.
- All questions carry equal marks unless specified.

Unit I

Introduction: Definition of Computer Graphics and Its Applications, **Video Display Devices**: Cathode Ray Tube, Raster Scan Displays, Random Scan Displays; Color CRT Monitors – Beam Penetration and Shadow Mask Technologies, Direct View Storage Tubes; Flat Panel Displays - Plasma Panel, LED, LCD; The RGB Colour Model, Interactive Input Devices, Display Processor, Graphics Cards: Components of a card, Accelerated Video cards, CGA, EGA and VGA.

Unit II

Output Primitives: Point plotting, Line-Drawing Algorithms – Line Equation, DDA Algorithm, Bresenham's Line Algorithm; Circle-Generating Algorithms – Defining a Circle, Midpoint Circle Algorithm, Bresenham's Circle Algorithm; Ellipse-Generating Algorithms – Defining an Ellipse, Midpoint Ellipse Algorithm; **Filled-Area Primitives** – Boundary-Fill and Flood-Fill Algorithm; **Attributes of Output Primitives**: Line Attributes, Character (Text) Attributes, Area-Fill Attributes.

Unit III

Introduction to Multimedia: Definition, Elements of Multimedia System, Need and benefits of using Multimedia, Use of multimedia in different fields, Identifying Multimedia elements: Text, Images, Audio, Video and Animation, Multimedia Hardware and Software, Making simple Multimedia with PowerPoint. Object Linking and embedding concept.

Development Tools: Types of development tools, Commercial tools, Stages of Multimedia Application Development.

Unit IV

Multimedia Graphics: Digital Image fundamentals, Raster vs Vector images, image file formats – BMP, JPG, PNG, GIF, TIFF, Image editing basics.
Multimedia Audio: Digital audio technology, Audio Editing basics, MIDI fundamentals, audio file formats.
Multimedia Video: Digital video fundamentals, Types of video signals, Analog and digital video, video file formats.

Suggested Readings:

1. Hearn and Baker, Computer Graphics C Version, Second Edition, PHI, New Delhi
2. Kanetkar Yashwant, Graphics Under 'C', BPB Publications
3. Judith Jeffcoate, Multimedia in Practice, Technology and Applications, PHI
4. Foley, Vandom, Fenier, Hughes, 'C'; Addison Wesley Publishers
5. Ian R. Sinclair, Multimedia on the PC (with CDROM), BPB Publications
6. Hillman, David, Multimedia Technology and Applications, ITP
7. Vaughan, Tay, Multimedia Making it Work, Osborne Publishers.
8. Ze-Nian, Li.Mark, S. Drew, Fundamentals of Multimedia, Pearson Education

Paper Code: BCA-DSC-6(Maj)-603P

(Practical based on paper BCA-DSC-6(Maj)-603)

Time Duration: 3 Hrs. **Number of Practical Hours: 60**

Note: Paper will be set at the time of examination. Due weightage may be given to the practical notebook and Assignments in evaluation. Practical should be based on the topics covered in Theory Paper.

Paper Title: Website Development Using PHP

Paper Code: BCA-DSC-6(Maj)-604

Th	Pr	Cr	
2	2	4	Theory External Marks: 45
			Theory Internal Marks: 05
Level: L-300			Number of Theory Hours: 30
Time Duration: 3 Hrs.			Practical External Marks: 50

Objective: The objective of the course is to enable students to understand how dynamic web applications are created by using PHP to process user input, manage server-side logic, and interact with databases. The course aims to develop skills in writing PHP scripts, handling forms, managing sessions, and implementing authentication, while also focusing on secure coding practices. Students learn to generate dynamic content, connect PHP with MySQL, and build functional, data-driven web pages.

Learning Outcomes:

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

- Understand the basics of server-side scripting and PHP execution.
- Write PHP scripts to process user input and generate dynamic web pages.
- Handle forms using GET and POST methods.
- Connect PHP applications to databases for data storage and retrieval.
- Use sessions and cookies for user login and state management.
- Apply basic security practices to prevent common web vulnerabilities.

Note:

- The Question Paper will consist of Four Units.
- The examiner will set a total of nine questions, including two questions from each unit and one compulsory short answer question covering the entire syllabus.
- Students are required to attempt one question from each unit and the compulsory question.
- All questions carry equal marks unless specified.

UNIT – I

Introduction to Server-Side Scripting and PHP: Client-side vs server-side scripting, Need of server-side scripting in dynamic web development, Overview of web servers, Role of PHP in web development, PHP Installation (XAMPP/WAMP).

PHP Basics: PHP Syntax and structure, PHP Variables, constants and data types, Embedded PHP in HTML, Operators, expressions, operator precedence, comments, echo and Print statement.

Control structures: Conditional statements: if, if-else, nested-if, switch; looping structures: for, while, do-while, foreach; break and continue.

UNIT – II

Functions: Built-in PHP functions, User defined functions: function definition, formal parameter vs actual parameter, variable scope, file inclusion Statements

Arrays: Indexed, Associative and Multidimensional Arrays; Creating Arrays, The array() construct; Accessing Array elements, Iterating with each() and foreach(), Iterative functions: current(), next(), prev(), reset(), end().

Strings: String declaration and syntax, string operators, concatenation and assignment, The heredoc syntax, common string functions : string cleanup functions, case functions, string replacement, finding characters and substrings.

UNIT - III

Working with Forms and User Input: Super global variables, creating forms using HTML, GET and POST methods, Retrieving form data in PHP, Validating user input, Handling file uploads in PHP.

Database Connectivity: Connecting to MySQL, MySQL Functions, Making MySQL queries, executing queries, fetching data sets, creating MySQL database with PHP; Integrating forms and Databases: Basic form submission to a database, editing data with an HTML form.

UNIT – IV

Sessions and Cookies: Understanding sessions, starting and ending sessions, working with session variables, encoding and decoding session variables, Introduction to cookies, creating and retrieving cookies, modifying and deleting cookies, cookie expiration and lifetime.

Error and Exceptional Handling: Types of PHP Errors (notice, warning, parse error), PHP Exceptions: try, catch and finally blocks, throwing an exception, creating custom exceptions, multiple catch blocks.

Suggested Readings:

1. PHP6 and MySQL Bible, Steve Suehring, Wiley India edition, 2015 reprint
2. PHP: The Complete Reference, "Steven Holzner", Tata McGraw Hill
3. PHP6, Apache, MySQL Web development, Timothy Boronczyk, Wiley India edition
4. Programming PHP, Rasmus Lerdorf, Kevin Tetroi (O'Reilly, ISBN 1565926102).
5. PHP, MySQL, and JavaScript: A Step-By-Step Guide to Creating Dynamic Websites by Robin Nixon O'Reilly Media
6. Core PHP Programming. Leon Atkinson (Prentice Hall, ISBN 0130463469).

Paper Code: CSA-DSC-6(Maj)-602P
(Practical based on paper CSA-DSC-6(Maj)-602)

Time Duration: 3 Hrs. **Number of Practical Hours:** 60

List of Practical

1. Write a PHP code to print your name, course, and current date & time.
2. Write a PHP code demonstrating variables and constants.
3. Write a PHP code to perform arithmetic operations (addition, subtraction, multiplication, division).
4. Create a PHP code to check whether a number is even or odd.
5. Write a PHP code to find the greatest number of any three given numbers using nested-if.
6. Write a PHP code to print the day of the week using a switch-case statement.
7. Write a PHP code to print multiplication table using loops.
8. Create indexed, associative, and multidimensional arrays and display their elements.
9. Write a PHP code to demonstrate various loop iterative functions.
10. Write a PHP code to demonstrate string cleanup functions
11. Write a PHP code to demonstrate string case functions.
12. Write a user-defined function to find the largest number in an array.
13. Write a PHP code to demonstrate file inclusion function – include()
14. Write a PHP code to demonstrate file inclusion function – require()
15. Create a form (using GET/POST) and display submitted user data on another page.
16. Write a PHP code to connect to a MySQL database
17. Create a registration form and insert the form data into a MySQL table.
18. Fetch and display all records from a database table in an HTML table.
19. Create a file upload form that allows users to upload an image with size/type validation.
20. Write a PHP code to create a cookie with a name, value and expiration time.
21. Write a PHP code that sets a cookie based on user input.
22. Write a PHP code to retrieve and display a session variable.
23. Demonstrate exception handling during database connection using try–catch.
24. Write a PHP code to Handle different types of exceptions using multiple catch blocks.
25. Write a PHP code to Create and throw a user-defined exception class.

Paper Title: Cloud Computing
Paper Code: BCA-DSC-6(Maj)-605

Th	Pr	Cr	
4	-	4	Theory External Marks: 90
			Theory Internal Marks: 10
Level: L-300			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Course Objective: The objective of this course is to introduce students the rationale behind the Cloud Computing revolution. It aims to familiarize students with various models, types, challenges of Cloud Computing, and realize importance of Virtualization, Cloud Security and other Cloud related technologies.

Learning Outcome:
On successful completion of the course, students will be able to:
- Describe various Cloud Computing platforms and service providers
- Be equipped with awareness of latest upcoming trends and technologies in Cloud Computing

Note:
- The Question Paper will consist of Four Units.
- Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
- The students are required to attempt **ONE** question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

Unit I

Introduction: Cloud-definition, characteristics of Cloud Computing, Origins of Cloud Computing, Benefits and Challenges of Cloud Computing
Cloud deployment models: Public, private, hybrid, community cloud, multi-cloud.
Cloud Infrastructure (Hardware and Software), Accessing the Cloud (Platforms, web applications, web APIs, Web browsers), understanding virtual machine in Cloud Computing

Unit II

Cloud Architecture: Layers in Cloud architecture, Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services, Desktop as a service, Network as a service.
Cloud Insights: Cloud Service Providers, Types and features of Cloud databases, regularity issues in Cloud Computing

Unit III

Virtualization: Definition, Type of Virtualization, Benefits, Limitations, Virtualization and Cloud, Virtual Appliance.
Cloud Security: Infrastructure Security, Data Security, Identity and Access Management, Privacy Management, Security as a Service on Cloud.
Cloud Programming and Software Environments: Cloud Programming Models (Service oriented model, Event driven model, serverless computing, Data centric Models).

Unit IV

Advance Concepts in Cloud: Energy Efficiency in cloud, Market Oriented Cloud Computing, Green cloud computing, Edge and Fog computing.

Migrating into a Cloud: Introduction, Broad Approaches to Migrating into the Cloud, the Seven-Step Model of Migration into a Cloud, Analyzing real world cloud migration: Case study of Netflix, Spotify, Dropbox.

Suggested Readings:

1. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi, Mastering Cloud Computing, Tata McGraw Hill, New Delhi
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy, O'Reilly
3. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall
4. Richard Hill, Laurie Hirsch, Peter Lake, Siavash Moshiri, Guide to Cloud Computing Principles and Practice, Springer.
5. Toby Velte, Anthony Velte, Robert C. Elsenpeter, Cloud Computing, A Practical Approach

Paper Title: Discrete Mathematical Structure
Paper Code: BCA-DSC-6(Min)-606

Th	Pr	Cr	Theory External Marks: 90
4	-	4	Theory Internal Marks: 10
Level: L-300			Number of Theory Hours: 60
Time Duration: 3 Hrs.			

Course Objective: The main objective of the course is to provide students with a strong foundation in mathematical logic, set theory, recurrence relations, and graph theory, enabling them to develop logical reasoning and problem-solving skills essential for Computer Science applications.

Learning Outcomes:
- Apply principles of propositional logic, predicates, and inference rules in problem-solving.
- Use set theory and relations to model and analyze mathematical structures.
- Formulate and solve recurrence relations in recursive algorithms.
- Represent and analyze graphs to solve real-world problems using shortest path and traversal methods.
- Demonstrate logical reasoning and analytical skills for Computer Science applications.

Note:
- The Question Paper will consist of Four Units.
- Examiner will set total of **NINE** questions comprising **TWO** questions from each Unit and **ONE** compulsory question of short answer type covering whole syllabi.
- The students are required to attempt **ONE** question from each Unit and the Compulsory question.
- All questions carry equal marks unless specified.

UNIT – I

Mathematical Logic: Propositions, logical connectives (conjunction, disjunction, negation, implication, biconditional), Compound Propositions, Truth Tables of Compound Propositions, Applications of Propositional Logic, Propositional Equivalences, tautology, contradiction, contingency, Laws of propositional algebra (Identity laws, Domination laws, Idempotent laws, Double negation law, Commutative laws, Associative laws, Distributive laws, De Morgan's laws, Absorption laws, Negation laws), Normal Forms, Predicates and quantifiers (universal and existential), Nested quantifiers, Rules of Inference.

UNIT – II

Set and Relations : Sets, Set Notation and Description, Empty set, Finite and Infinite Sets, Equal sets, subsets, , subset, basic set operations (union, intersection, complement, difference, Cartesian product), Power set, Universal set, Venn Diagrams, laws of set theory, partitions of sets, min sets, duality principle, The Inclusion-Exclusion Principle, **Relations**: Definition of relation, domain, range, Properties of relations (reflexive, symmetric, transitive, equivalence relation), Composition of Relations, Representation of relations: matrices, digraphs, Partial Orderings, Hasse diagram. **Functions:** Definition, Types of functions: injective, surjective and bijective; Compositions of functions.

UNIT – III

Recurrence: Introduction to Recursion and Iteration, Recurrence Relations and Recursive Algorithms, Linear-Recurrence Relations with Constant Coefficients, Homogeneous Solutions,

Particular Solutions, Total Solution, Solution by the Method of Generating functions.

UNIT – IV

Graph Theory: Introduction to graphs and Terminology (vertex, edge, degree, path, circuits and cycle), Types of graphs (infinite graph, finite graph, simple, multigraph, undirected, directed, weighted, complete, bipartite and planar), Graph representation (adjacency list, adjacency matrix, incidence matrix) Euler Paths and Circuits, Hamilton Paths and Circuits, Shortest Path problem: Dijkstra's Algorithm, Bellman-Ford Algorithm, Travelling Salesman Problem.

Suggested Readings:

1. Doerr A. and Kenneth L., Applied Discrete Structures for Computer Science, Galgotia Publications Pvt. Ltd.
2. Liu, C. L., 1985, Elements of Discrete Mathematics, McGraw Hill.
3. Seymour Lipschutz and Lipson, Discrete Mathematics, McGraw Hill.
4. Seymour Lipschutz and Lipson, :2000 Solved Problems in Discrete Mathematics, McGraw Hill.
5. Rosen, Kenneth H. Discrete Mathematics and Its Applications. 8th ed., McGraw-Hill Education.