Department of Higher Education
Madhya Pradesh

Detailed Syllabus of

PG Diploma (Computer Science)
1-Year PG Diploma in Computer Science

Effective From July – 2025

Department of Higher Education, Govt of Madhya Pradesh

PG Diploma (Computer Science)

1-Year PG Diploma in Computer Science

First-Year

Scheme B-1 (For Courses of Science & Arts Discipline having Major Practicum Components)

Year/Semester		Course Level	Core Course / Dissertation	Credit	Practicum Courses	Credit	Internship/Apprenticeship/ Seminar OR VAC (CHEM / EESC)	Credit	Total Credit
First Year	Sem-I	400	**CC-11:** Computer Architecture and Operating System **CC-12:** Discrete Structures OR Computer Oriented Optimization Techniques	**6** **6**	**PC-11:** Object Oriented Programming using C++ **PC-12:** Information Security	**4** **4**	Internship/ Report writing (Communication Skills) with Seminars on Computer related topics	**2**	**22**
	Sem-II	400	**CC-21:** Software Engineering **CC-22:** Internet of Things OR Blockchain Technology	**6** **6**	**PC-21:** Data Structures using C++ **PC-22:** Database Management System	**4** **4**	Internship/ Report writing (Communication Skills) with Seminars on Computer related topics	**2**	**22**

PARTA :Introduction			
Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester: I	Session:2025-26
Subject :Computer Science			

1.	Course Code	CC-11	
2.	Course Title	Computer Architecture and Operating System	
3.	Course Type (Core Course/Practical Course)	Core Course	
4.	Pre-Requisite(if any)		
5.	Course Learning Outcomes (CLO)	**On completion of this course, learners will be able to:** 1. Understand basic computer architecture, instruction set and assembly language programming 2. Classify different types, design and architecture of operating system 3. Understand various operating system functions like process management, I/O management, and memory management 4. Solve numerical problems on Process Synchronization, CPU scheduling, Memory management and Disk management 5. Explore file management, protection and security concepts	
6.	Credit Value	**Theory**—6 Credits	
7.	Total Marks	Max.Marks:60+40	Min.PassingMarks:24+16

PARTB: Content of the Course

No. of Lectures (in hours per week) : 6 Hrs. per week

Total No. of Lectures : 90Hrs.

Module	Topics	No. of Lectures
1	A simple computer organization and instruction set, instruction formats, addressing modes, instruction cycle, instruction execution in terms of microinstructions, concepts of interrupt and simple I/O organization, Interrupt Driven data transfer, DMA (Direct Memory Access)., Concept of bus, data movement among registers, conditional data transfer, and data movement from/to memory. Design of simple Arithmetic & Logic Unit & Control Unit, and arithmetic and logical operations. Overview of Architecture of 8086 and assembly language programming. **Activity:…Quiz & discussion on digital number system and computer organization.**	18

II	Introduction: Evolution of operating systems (History of evolution of OS with the generations of computers), Types of operating systems, Multitasking, Timesharing, Multithreading, Multiprogramming and, Real time operating systems, Different views of the operating system, System Programmer's view, User's view, Operating system concepts and structure, Layered Operating Systems, Monolithic Systems. Processes: The Process concept, The process control block, Systems programmer's view of processes, Operating system services for process management, Scheduling algorithms, First come first serve, Round Robin, Shortest run time next, Highest response ratio next, Multilevel Feedback Queues, Performance evaluation of scheduling algorithms stated above **Activity:…Interactive question/answer session on operating system and its functions.**	18
III	Memory Management: Memory management without swapping or paging, Concepts of swapping and paging, Page replacement algorithms namely, Least recently used, Optimal page replacement, Most recently used, Clock page replacement, First in First out (This includes discussion of Belady's anomaly and the category of Stack algorithms), Modeling paging algorithms, Design issues for paging system, Segmentation, Segmented Paging, Paged Segmentation **Activity:…Quiz & discussion on memory organization and kinds of memories.**	18
IV	Inter-process Communication and Synchronization: The need for inter-process synchronization, Concept of mutual exclusion, binary and counting semaphores, hardware support for mutual exclusion, queuing implementation of semaphores, Classical problems in concurrent programming, Dining Philosopher's problem, Bounded Buffer Problem, Sleeping Barber Problem, Readers and Writers problem, Critical section, critical region and conditional critical region, Monitors and messages. Deadlocks: Concepts of deadlock detection, deadlock prevention, deadlock avoidance. Banker's Algorithm **Activity:…Discussion on operating system problems in real life situation like deadlock.**	18
V	File System: File systems, directories, file system implementation, security protection mechanisms. Input/output: Principles of I/O Hardware: I/O devices, device controllers, direct memory access. Principles of I/O software: Goals interrupt handlers, device drivers, and device independent I/O software. User space I/O Software. Disks: Disk hardware, Disk scheduling algorithms (namely First come first serve, shortest seek time first, SCAN, C-SCAN, LOOK and C-LOOK algorithms) Error handling, track-at-a-time caching, RAM Disks. Clocks: Clock hardware, memory-mapped terminals, I/O software. **Activity:…Quiz & discussion on file system and its functions .**	18
Keywords/ Tags:		
PART C: Learning Resources		
Textbooks, Reference Books, Other Resources		
Suggested Readings:		

- Galvin P., J.L. Abraham Silberschatz. "Operating System Concepts". John Wiley & Sons Company, 1989. 4. Tanenbaum, A.S. "Modern Operating System", Prentice Hall of India Pvt. Ltd.1995.
- William Stallings "Operating Systems" , Prentice Hall of India Pvt. Ltd.
- Milenkovic, M., "Operating Systems - concepts and Design" McGraw Hill International EditionComputer Science series 1992.
- M. Morris Mano, "Computer System Architecture", PHI, 3rd edition, 1993
- Liu and Gibson, "8086/8088 Microprocessor Assembly Language"

Suggestive digital platform web links:

- http://www.facweb.iitkgp.ac.in/~shamik/spring2025/caos/caos2025_dtls.html
- https://www.academia.edu/87046049/Operating_system_concepts_10th
- https://os.ecci.ucr.ac.cr/ci0114/material/Stallings/Computer-Organization-Architecture-11th.pdf
- https://archive.nptel.ac.in/courses/106105214/

Suggestive equivalent online courses:

- https://onlinecourses.nptel.ac.in/noc25_cs154/preview
- https://onlinecourses.nptel.ac.in/noc20_cs04/preview

PARTD: Assessment and Evaluation

Internal Assessment: Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

PARTA: Introduction			
Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester : I	Session:2025-26
Subject: Computer Science			

1.	Course Code	PC-11	
2.	Course Title	Object Oriented Programming using C++	
3.	Course Type(Core Course/ Practical Course)	Practical Course	
4.	Pre-Requisite(if any)		
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Understand and Implement Basic C++ Concepts 2. Use Object-Oriented Features 3. Work with Operators, functions, pointers and Overloading. 4. Design and implement classes and objects. 5. Apply Inheritance, Polymorphism, and Exception Handling 6. Handle File Operations	
6.	Credit Value	Practical—4 Credits	
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40

PARTB: Content of the Course

No. of Labs (in hours per week):8Hrs.per week

Total No. of Labs : 120Hrs.

Module	Reference/Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.	No. of Labs
	Introduction to Object Oriented Programming Overview of structured programming approach, Object oriented programming approach, Characteristics of object oriented languages. **Basics of C++ programming :**C++ Program Structure, Character Set and Tokens, Data Type, Type Conversion, Preprocessor Directives, Namespace, Input/Output Streams and Manipulators, Dynamic Memory Allocation with new and delete, Control Statements. **Functions:** Function Overloading, Inline Functions, Default Argument, Pass by Reference, Return by Reference, Scope and Storage Class. **Pointers:** Pointer variables declaration & initialization, Operators in pointers, Pointers and Arrays, Pointer and Function. **Classes & Objects** A Simple Class and Object, Accessing members of class, Initialization of class objects: (Constructor, Destructor), Default Constructor, Parameterized Constructor, Copy Constructor, The Default Copy Constructor, Objects as Function Arguments, Returning Objects from Functions, Structures and Classes, Memory allocation for Objects, Static members, Member functions defined outside the class.	

	Operator Overloading : Fundamental of operator overloading, Restriction on operator overloading, Operator functions as a class members, Overloading unary and binary operator, Data Conversion (basic to basic, basic to user-defined, user-defined to basic, user-defined to user-defined) **Inheritance :**Introduction to inheritance, Derived Class and Base Class, Access Specifiers (private, protected, and public), Types of inheritance, Public and Private Inheritance, Constructor and Destructor in derived classes, Aggregation **Virtual Function, Polymorphism, and miscellaneous C++ Features :**Concept of Virtual functions, Late Binding, Abstract class and pure virtual functions, Virtual Destructors, Virtual base class, Friend function and Static function, Assignment and copy initialization, Copy constructor, This pointer, Concrete classes, Polymorphism and its roles. **Function Templates and Exception Handling:** Function templates, Function templates with multiple arguments, Class templates, templates and inheritance, Exceptional Handling (Try, throw and catch), Use of exceptional handling. **File handling :**Stream Class Hierarchy for Console Input /Output, Unformatted Input /Output, Formatted Input/Output with ios Member functions, Formatting with Manipulators, Stream Operator Overloading, File Input/output with Streams, Opening and Closing files, Read/Write from File, File Access Pointers and their Manipulators, Sequential and Random Access to File, Testing Errors during File Operations.	
I	**USE of IKS in programming** **Basic C++ Programs** Swap two numbers, Find the Size of (int, float, double, and char), Fahrenheit to Celsius, Find Simple Interest, Area And Perimeter of Rectangle **Control Flow Programs** Factorial of a Number, Reverse a Number, Whether a Number is a Palindrome or Not, Check Armstrong Number, For Fibonacci Number, Make a Simple Calculator **Pattern Printing Programs** Print Simple Full Pyramid Pattern, Inverted Pyramid, Triangle Pattern **Function Programs** Prime Numbers Between Two Intervals Using Function, Check Whether a Number Can be Express as Sum of Two Prime Numbers, Calculate the Factorial of a Number Using Recursion **Array Programs** Check if Two Arrays Are Equal or Not, Maximum and Minimum in an Array, Average of all the Elements Present in an Array, Merge Two ArraysPrint a 2D Array **Matrix Programs** Add Two Matrices, Check Whether Two Matrices Are Equal or Not, Compute the Sum of Diagonals of a Matrix **Pointers Programs** Array of Pointers, void Pointer, Function Pointer, this Pointer **String Programs** Find the Length of a String, Replace a Character in a String, Compare Two Strings	24
II	**Class and Object Programs** Create a Class and Object, Encapsulation, Abstraction in Class, Show Data Hiding in Class, Access Modifier, This Keyword in Class, Static keyword **Structures Programs**	24

	Pass or Return a Structure to/from a Function, Store Information of a Student in a Structure	
III	Overload Increment ++ and Decrement --, Overload Binary Operator + and - Add Two Complex Numbers, Show Inheritance	24
IV	Polymorphism in Class, Function Overloading, Function Overriding, Friend Functions, Virtual Destructor, Abstract Class, Create an Interface **Exception Handling Programs** Show Runtime Exceptions, Handle the Exception Methods, Handle the Checked Exceptions, Handle the Unchecked Exceptions, Handle Divide By Zero and Multiple Exceptions	24
V	**File Handling Programs** Create a New File, Create a Temporary File, Write Into a File, Rename a File, Make a File Read-Only, Copy one File into Another File, Append the Content of One Text File to Another, Get the List of Files in a Directory, Read Content From One File and Write it into Another File	24

Keywords/ Tags: Class and Object, Structures, Exception Handling , File Handling

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

1. E. Balagurusamy, "Object-Oriented Programming with C++", TMH 2013, 7th Edition.
2. Robert Lafore, Object Oriented Programming in C++, Fourth Edition, SAMS publications.
3. Herbert Schildt, C++ The Complete Reference, Fourth Edition, Tata McGraw Hill Publication.
4. The C++ Programming Language by Bjarne Stroustrup.
5. Deitel and Deitel, C++ How to Program, Third Edition, Pearson Publication.
6. Maria Litvin& Gray Litvin, "C++ for you", Vikas publication 2002.

Suggested Readings:

- Ashok N Kamthane, "Object-Oriented Programming with ANSI and Turbo C++", Pearson Education 2003.

Suggestive digital platform web links:

- NPTEL & MOOC courses titled Object oriented programming concepts using C++
- https://www.google.com/search?q=use+of+IKS+in+programming&rlz=1C1RXQR_enIN993IN993&oq=use+of+IKS+in+programming&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigATIHCAMQIRigATIHCAQQIRigAdIBCDkzNzJqMWo3qAIIsAIB8QWTMMU31BnSHg&sourceid=chrome&ie=UTF-8

Suggestive equivalent online courses:

- https://alison.com/course/introduction-to-c-plus-plus-programming
- https://swayam.gov.in/explorer

Suggestive online editors

- https://www.onlinegdb.com/online_c++_compiler
- https://replit.com/languages/cpp
- https://www.codechef.com/ide

PARTD : Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s):**60 Marks** Time: **3:00 hours**	
ClassTest	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

PARTA: Introduction			
Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester: I	Session:2025-26
Subject: Computer Science			

1.	Course Code	CC-12	
2.	Course Title	Discrete Structures	
	Course Type(Core Course/Practical Course)	Core Course	
4.	Pre-Requisite(if any)		
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Understand the basic concepts of set, function and mathematical reasoning. 2. Exposure to various counting techniques and its applications in computer science. 3. Develop an understanding about relations & its property and lattices. 4. Understand the concepts of graph and tree and their applications. 5. Develop the understanding of objectives and features of Vedic Arithmetic.	
6.	Credit Value	**Theory**—6 Credits	
7.	Total Marks	Max.Marks:60+40	Min.PassingMarks:24+16

PARTB: Content of the Course

No. of Lectures (in hours per week):6Hrs.per week

Total No. of Lectures : 90 Hrs.

Module	Topics	No. of Lectures
I	Vedic mathematics :History, salient features, Vedic mathematics formulas, 16 sutras and 13 sub sutras, terms and operations, Beejank, Vinculum Operations, High speed addition by using the concept of completing the whole and superfast subtraction by Nikhilam Sutram. Multiplication by Nikhilam Sutra, Anatyodarshkeyapi, Urdhav triyaghbhyam sutram, The Foundations: Logic, Sets and Functions: Introduction to set theory, mathematical logic, prepositions, prepositional equivalences, predicates and quantifiers. Importance of Quantifiers. The Foundations: Logic, Sets and Functions: Sets, set operations, fuzzy sets, functions, functions for computer science, sequences and summations. Logic and computation in ancient Indian texts. Mathematical reasoning: Introduction to Methods of proof, mathematical induction. Use of mathematical induction to solve different problems. Importance of recursions in computer science, scope of recursions, Recursive definitions,	18

	recursive algorithms. **Activity:…Quiz**	
II	Combinatorics: The basics of counting, The sum rule, The product rule, The Pigeonhole Principle, Permutations with repetitions, Permutations without repetitions, Circular Permutations. Applications of combinations. Applications of Combinatorics to solve Committee problems, word problems, puzzle problems etc. Applications of Combinatorics to understand Telephone numbering plan, understanding Internet addresses, Advanced counting techniques, recurrence relations, solving recurrence relations, algorithm design, Basic understanding of complexities, basic problems of complexity of algorithms. **Activity:…Quiz**	18
III	Relations: Relation definition, Importance of relations in computer science, Relations and their properties, Unary relations, Binary relations, Ternary relations, n-ary relations and their applications, closures of relations, equivalence relations, partial ordering. Representing relations, relation matrix, relation graph, composite relation. Operations on relations – union, intersection and join. Concepts of least upper bond, Greatest lower bond, maximal element, minimal element, Greatest element, Least element of a partially ordered set, lattices, sub lattices, chains and antichains. **Activity:…Puzzles**	18
IV	Graphs: Introduction to Graphs, Importance of graph theory in computer science, Graph terminology, representing graphs, graph types, graph models, and graph isomorphism. Connectivity, Euler and Hamiltonian Paths, shortest path problems, planar graphs, graph colouring, chromatic number, Euler's formula, kuratowski's theorem. The four colour problem, Applications of Graph Colouring, Introduction to Trees, applications of trees, tree traversal, trees and sorting, Spanning trees, minimum spanning trees. **Activity:…Real Life Graph Applications & relevance to Computer Science**	18
V	Languages and Grammars: Introduction to Languages and Grammars, solving problems for validity of statements according to the grammar. Importance of Language theory in Computer Science, Importance of Derivation trees, solving problems of Derivation trees, Importance of Parsing, Phrase-Structure Grammars, Types of Phrase structure grammars. **Activity:…Problem Solving/Short cut methods through Vedic Maths**	18
Keywords/ Tags: Combinatorics, fuzzy sets, Lattice, Euler and Hamiltonian Paths, Graph, Derivation tree, Kuratowski's theorem, Graph Colouring.		

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

Suggested Readings:

- Kenneth H. Rosen "Discrete Mathematics and its Applications" , 5th edition , Tata McGraw-Hill
- Let us C, YashavantKanetkar, BPB Publications.
- Kolman, Busby & Ross "Discrete Mathematical Structures" ,5th edition Pearson Education.
- NarsinghDeo "Graph Theory with Applications to Engineering. & Computer Science", 4th edition, Prentice Hall of India.
- Discrete Structures, Logic and Computability by James L. Hein, 2nd edition, Narosa Publishing House.
- Discrete and Combinatorial Mathematics, 5th Edition by Ralph P. Grimaldi, Addison-Wesley Publication.
- S. B. Tirthaji, Vedic Mathematics, Motilal Banarsidass Private Limited

Suggestive digital platform web links:

- https://www.geeksforgeeks.org/discrete-mathematics-tutorial/
- https://www.tutorialspoint.com/discrete_mathematics/index.htm
- **https://www.vedicmaths.org/resources/books/e-books**

Suggestive equivalent online courses:

- https://onlinecourses.nptel.ac.in/noc21_cs65/preview
- https://www.coursera.org
- https://ocw.mit.edu/courses/6-042j

PARTD: Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

PARTA : Introduction				
Program: 1-Year PG Diploma		Class: PG Diploma (CS)	Semester:I	Session:2025-26
Subject: Computer Science				
1	Course Code	CC-12		
2.	Course Title	Computer Oriented Optimization Techniques		
3.	Course Type(Core Course/Practical Course)	Core Course		
4.	Pre-Requisite(if any)	Fundamental knowledge of linear programming problem, calculus and Mathematical models.		
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Get exposure to operations research and linear programming 2. Solve optimization problems 3. Design cost effective and efficient solutions using ptimization techniques		
6.	Credit Value	**Theory**—6 Credits		
7.	Total Marks	Max.Marks:60+40	Max.Marks:60+40	

PARTB: Content of the Course

No. of Lectures (in hours per week):6Hrs.per week

TotalNo.ofLectures:90Hrs.

Module	Topics	No.ofLectures
I	Optimization and Indian Knowledge System: Introduction of operation research. LP Formulations, Graphical method for solving LP's with 2 variables, Simplex method, Duality theory in linear programming and applications, Integer linear programming, dual simplex method. **Activity:…Quiz**	18
II	Transportation problem, Assignment problem. Dynamic Programming: Basic Concepts, Bellman's optimality principles, Dynamics programming approach in decision making problems, optimal subdivision problem. Sequencing Models: Sequencing problem, Johnson's Algorithm for processing n jobs through 2 machines, Algorithm for processing n jobs through 3 or more machines, Processing 2 jobs through n machines. **Activity:…Real World Applications of Operations Research**	18
III	Introduction to Game Theory : Strategy, Minimax and Maximin Criteria, Existence of Saddle Point, Game without Saddle Point, Mixed strategies, Solution of 2x2 games, Rectangular games, Concept and general rules for dominance, Two person zero sum game, Solution of a game by Simplex method. **Activity:…Quiz**	18

IV	Integer Programming : Integer Programming, Non – Linear Programming Techniques Kuhn – Tuker conditions with Non – negative constraints, Quadratic programming, Wolfe's Simplex method, Beal's method, Separable Convex programming, Separable Programming Algorithms. **Activity:…Quiz**	18
V	Applications of computer oriented optimization, Optimization in AI and ML, Introduction to the inventory problem, Deterministic Models, The classical EOQ (Economic Order Quantity) model, Inventory models. **Activity:…Exploring APIs, tools and Python support for AI/ML in optimization**	18

Keywords/ Tags:

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

Suggested Readings:

- P.K. Gupta & D.S. Hira, "Operations Research", S.Chand& Co.
- Dr.S.Vijayakumari Saradha, Dr.S.Angelin Kavitha Raj, Dr.Ram Mohan N.R "Computer Oriented Optimization Techniques".
- K. Deb, "*Optimization for Engineering design algorithms and Examples* "

Suggestive digital platform web links:

- https://archive.org/details/operationsresear0000gupt
- https://www.viirj.org/specialissues/2025/SP2502/1.pdf

Suggestive equivalent online courses:

- https://onlinecourses.nptel.ac.in/noc19_ma29/preview

PARTD: Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

PARTA: Introduction			
Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester:I	Session:2025-26
Subject: Computer Science			

1.	Course Code	PC-12	
2.	Course Title	Information Security	
3.	Course Type(Core Course/Practical Course)	Practical Course	
4.	Pre-Requisite(if any)	Basic Programming knowledge using C++	
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Get hands on experience on Cipher problem related programming 2. Get exposure to various Information and Cyber security related techniques 3. Use cryptography algorithms and protocols to develop secured systems.	
6.	Credit Value	Practical—4 Credits	
7.	Total Marks	Max.Marks:100	Min.Marks:40

PARTB: Content of the Course

No. of Labs (in hours per week):8Hrs.per week

Total No. of Labs :120Hrs.

Module	Reference/Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.	No. of Labs
	Introduction to Information Security : Information Security Mindset, Key characteristics of security mindset, Benefit of security mindset, Attacks, Vulnerability, Security Goals, Security Services and mechanisms. Conventional Cryptographic Techniques : Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography. Symmetric and Asymmetric Cryptographic Techniques :DES, AES, RSA algorithms Authentication and Digital Signatures : Use of Cryptography for authentication, Secure Hash function, Key management– Kerberos Program Security : Non malicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, Man-in-the- middle attacks, Covert channels Security in Networks : Threats in networks, Network Security Controls– Architecture, Encryption, Content Integrity, Strong Authentication, Access	

	Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls, Personal Firewalls, IDS, Email Security–PGP,S/MIME	
I	Caesar Cipher Affine Cipher with equation = 3x+12	20
II	Play fair Cipher with key entered by user. Poly alphabetic Cipher	20
III	AutoKey Cipher Hill Cipher.	20
IV	Railfence technique Simple Columnar Transposition technique	20
V	Advanced Columnar Transposition technique. Simple RSA Algorithm with small numbers.	20
VI	Simplified DES Make a study of one IDS(Forex.Snort)	20

Keywords/ Tags:

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

1. Fundamentals of Information Security by Sanil Nadkarni
2. COMPUTER SECURITY, By Dieter Gollmann
3. Security in Computing, Fourth Edition, by Charles P. P fleeger, Pearson Education
4. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
5. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
6. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall

Suggestive digital platform web links:

- https://swayam.gov.in/explorer
- https://www.vssut.ac.in/lecture_notes/lecture1423183198.pdf

Suggestive equivalent online courses:

- https://nptel.ac.in/courses/106106141
- https://alison.com/tag/information-security
- https://nayakuch.wordpress.com/wp-content/uploads/2015/08/cryptography-network-security-atul-kahate.pdf

Suggestive online editors

- https://www.onlinegdb.com/online_c++_compiler
- https://replit.com/languages/cpp
- https://www.codechef.com/ide

PART D: Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: 40 Marks		End Term Examination(s) : 60 Marks Time: 3 hrs	
Class Test	Marks		
Presentation/Assignment/Quiz/	Marks		

Group Discussion			
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

PARTA: Introduction				
Program: 1-Year PG Diploma		Class: PG Diploma (CS)	Semester : II	Session:2025-26
Subject: Computer Science				
1.	Course Code	CC-21		
2.	Course Title	Software Engineering		
	Course Type(Core Course/Practical Course)	Core Course		
4.	Pre-Requisite(if any)			
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Understand the applications of software engineering processes and models. 2. Inculcate ability to plan, schedule and estimate software projects. 3. Develop skills for analysis and design of software projects using structured and object oriented approaches. 4. Apply testing and quality assurance mechanisms to produce and reliable system. 5. Ability to develop software systems using software engineering approaches.		
6.	Credit Value	**Theory**—6Credits		
7.	Total Marks	Max.Marks:60+40	Min.PassingMarks:24+16	

PARTB: Content of the Course

No. of Lectures (in hours per week):6Hrs.per week

TotalNo.ofLectures:90Hrs.

Module	Topics	No. of Lectures
I	Introduction to Software Engineering and Software Processes: Software, Software Classifications and Characteristics, Software Crisis. What is Software Engineering? System Engineering Vs. Software Engineering, Software Engineering Challenges. Software Processes: Process model, Elements and Characteristics of Process model, Process Classification, Software Development Processes: SDLC, Waterfall, Iterative Waterfall, Prototyping, Incremental, Spiral, RAD, Agile Software Development: Principles, Practices & Methods; RUP process, Component-Based Development model etc. **Activity:…quiz on SDLF,RAD and Agile software developments**	18
II	Project Management and Planning: Project management essentials, Project success and failures, Project Life Cycle, Project team structure and organization, Software Configuration Management, Risk Management. Project planning activities: Metrics and Measurements, Project Size Estimation, Effort Estimation Techniques, Staffing and Personnel Planning, Project Scheduling and Miscellaneous Plans. **Activity:…group discussion on Project Life Cycle and Risk Management**	18
III	Requirements Engineering: Software Requirements, Requirements Engineering Process, Requirements Elicitation. Requirements Analysis: Structured Analysis, Object-oriented Analysis. Requirements Specification, Requirements Validation, and Requirements Management. **Activity:…Case study on requirement analysis**	18

IV	Software Design and Coding: Software Design Process, Characteristics of a Good Design, Design Principles, Modular Design (Coupling and Cohesion). Software Architecture. Design Methodologies: Function-oriented Design (Structured Design Methodology in brief). Object oriented Design using UML, Logical Design. **Activity:… Case study on UML process and design UML with any example.**	18
V	Software Testing, Quality and Maintenance: Testing Fundamentals, Test Planning, Black-Box and White-Box Testing strategy, Levels of Testing, Debugging Approaches. Quality Concept, Quality Factors, Verification and Validation, Quality Assurance Activities, Quality Standards: Capability Maturity Model (CMM). Software Reliability, Software Maintenance and Reengineering. **Activity:…group discussion on software quality management**	18

Keywords/ Tags: Agile Software Development, Configuration Management, Risk Management, Requirements Elicitation, Coupling and Cohesion, CMM.

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

Suggested Readings:

- Software Engineering: Concepts & Practices- Ugrasen Suman, C engage Learning, 2nd Edition.
- An Integrated Approach to Software Engineering- Pankaj Jalote, Narosa Publishing House.
- Software Engineering- Ian Sommerville, Pearson Education, New Delhi.
- Software Engineering Concepts-Richard E. Fairly, Tata McGraw Hill Inc. New York.

Suggestive digital platform web links:

- https://dl.acm.org/journal/tosem
- https://www.geeksforgeeks.org/software-engineering

Suggestive equivalent online courses:

- https://onlinecourses.nptel.ac.in/noc21_cs65/preview
- http://www.rspa.com/spi/
- https://sei.cmu.edu/

PARTD: Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

PARTA: Introduction			
Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester: II	Session:2025-26
Subject: Computer Science			

1.	Course Code	PC-21	
2.	Course Title	Data Structures using C++	
3.	Course Type(Core Course/Practical Course)	Practical Course	
4.	Pre-Requisite(if any)	Programming knowledge using C++	
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Implement Stack, Queue, Linked List Structures& tree traversals 2. Identify suitable data structures for software design based on required operations in problem domain 3. Solve real life problems by applying suitable data structures 4. Make use of vast classes and integrate them for problem solutions 5. Apply the knowledge of data structure in designing time & space efficient solutions for real life problems	
6.	Credit Value	**Theory**—4 Credits	
7.	Total Marks	Max.Marks:100	Min.PassingMarks:40

PARTB: Content of the Course

No. of Labs (in hours per week):8Hrs.per week

Total No. of Labs : 120Hrs.

Module	Reference/Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.	No. of Labs
	Data Structures Overview: Definitions, types (linear vs. non-linear, Homogeneous vs. Non-Homogeneous, Static vs. Dynamic), and applications of Data Structures. Abstract Data Types (ADTs): Concepts and implementation. Algorithm Analysis: Time and space complexity, Big O notation. Arrays: One-dimensional, two-dimensional, and multi-dimensional arrays, memory representation, and operations (insertion, deletion, searching, sorting). Linked Lists: Singly, doubly, and circular linked lists, operations, and applications. Stacks: Operations (Push, Pop, Traverse), applications (Recursive function-call stack, expression evaluation). Queues: Operations (Insertion, Deletion, Traversal), Circular Queue, Double ended Queue, applications (process scheduling). Trees: Definition, Binary trees, Binary Search Trees (BSTs), Tree traversals (inorder, preorder, postorder), and applications of Tree, AVL Tree. Graphs: Definition, Types of Graphs: Directed, Non-Directed, Connected, Non-Connected, Representation (adjacency matrix, adjacency list), graph traversals (BFS, DFS), and applications, Minimum Spanning Tree, Kruskal's Algorithm, Prim's Algorithm, Dijkastra's Algorithm. Heaps: Binary heaps, heap operations (insertion, deletion), and applications (priority queues). Sorting and Searching Algorithms:Sorting Algorithms: Bubble sort, insertion sort,	

	selection sort, merges sort, quick sort, and their time complexities. Searching Algorithms: Linear search, binary search, and their time complexities. Hashing: Hash tables, collision resolution techniques. Specialized Data Structures: B-trees, B+ trees, and their applications. File Structures: Sequential, indexed, and direct access files.	
I	Address calculation of an element in one and two dimensional array (row major order and column major order). Program for sparse matrix implementation.	24
II	Linked Lists :Singly Linked Lists, Circular Single Linked List, Doubly Linked List, Circular Doubly Linked List Stack :Stack and its operations PUSH & POP, Stack using Two Queues, Check for Balanced Parentheses, Convert Decimal Number to Binary, Evaluate an Expression, Tower of Hanoi using Binary Value, Program to Solve Tower of Hanoi Queue :Queue and its operations INSERT & DELETE, Circular Queue, Doubly Ended Queue, Queue using Two Stacks	24
III	Tree: Binary Search Tree and its operations, Self Balancing Binary Search Tree Expression Tree from Infix Expression, Find Deepest Left Leaf in a Binary Tree Mirror Image of a Binary Tree,AVL Tree Graph: Adjacency Matrix, Adjacency List, Inverse of a Graph Matrix, Transpose of a Graph Matrix, Number of Cycles in a Graph, Strongly Connected Components in Graphs, Cycle in a Graph using Graph Traversal, Graph using 2D Arrays, Graph using Linked List	24
IV	Searching: Linear, Binary, Interpolation, Sorting: Bubble, Selection, Insertion, Merge, Quick, . Hashing : Hash Table, Double Hashing, Chaining with Binary Tree, Linear Probing, Quadratic Probing, Direct Addressing Tables	24
V	B-Tree, B+ Tree, Sequential, indexed, and direct access files	24

Keywords/ Tags:

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

1. Data Structures Using C++, Second Edition by D.S. Malik
2. Yedidyah Langsam Moshe J. Augenstein, Aaron M. Tenenbaum,"Data Structures using C & C++", PHI New Delhi, 2nd Edition
3. Seymour Lipschutz, "Data Structures", Schaum's Outline Series, Tata Mc Graw Hill Publishing Company Ltd.
4. Theory & Problems of Data Structures by Jr. SymourLipschetz, Schaum's outline by TMH
5. Fundamentals of Data structures by Ellis Horowitz &SartajSahni, Pub, 1983,AW
6. Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman, Original edition, Addison-Wesley, 1999, Low Priced Edition.

Suggested Readings:

- Expert Data Structures with C++ by R. B. Patel (Author)

Suggestive digital platform web links:

- https://nptel.ac.in/courses/106102064

Suggestive equivalent online courses:

- https://onlinecourses.swayam2.ac.in/cec25_ma15/preview

Suggestive online editors

- https://www.onlinegdb.com/online_c++_compiler
- https://replit.com/languages/cpp
- https://www.codechef.com/ide

PARTD: Assessment and Evaluation			
Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks
Any Remarks/ Suggestions:			

PARTA: Introduction				
Program: 1-Year PG Diploma		Class: PG Diploma (CS)	Semester : II	Session:2025-26
Subject: Computer Science				
1.	Course Code	CC-22		
2.	Course Title	Internet of Things		
	Course Type(Core Course/Practical Course)	Core Course		
4.	Pre-Requisite(if any)			
5.	Course Learning Outcomes(CLO)	Upon completing the course, students will be able to: 1. Understand IoT concept 2. Gain knowledge of software components, hardware components and communication technologies involved in IoT. 3. Learn role of cloud computing and security requirements in IoT 4. Develop and evaluate the real life applications of IoT by preparing projects designed with the Arduino.		
6.	Credit Value	**Theory**—6Credits		
7.	Total Marks	Max.Marks:60+40	Min.PassingMarks:24+16	

PARTB: Content of the Course

No .of Lectures (in hours per week): 6 Hrs. per week

Total No. of Lectures : 90 Hrs.

Module	Topics	No. of Lectures
I	**Introduction to IoT:** Definition, Characteristics, IoT design principles, Physical Design of IoT - Hardware and Software components; Logical Design of IoT- functional blocks, IoT communication models, Communication APIs; IoT network architecture, IoT enabling technologies, Introduction to cloud computing in IoT, advantages and disadvantages of IoT, IoT implementation challenges. **Activity:…Quiz on IOT (based on frequently asked questions by potential employers)**	18
II	**Introduction to Arduino Programming**: Familiarizing with Arduino Interfacing Board, configuration and architecture, Arduino IDE installation, program structure, data types, variables and constants, operators, control statements and loops, functions, strings, time, arrays, function libraries: I/O functions, Character functions, Math library, Interrupts, Communications. Integration of Sensors and Actuators with Arduino; **Activity:…Summarization of Arduino Programming through case studies**	18
III	**Domain specific IoTs:** Introduction, home automation, cities, environment, energy, retail, logistics, agriculture, industry, health and lifestyle. **IoT and M2M:** Introduction, machine-to-machine Communication, difference between IoT and M2M; SDN and NFV for IoT - Software Defined Networking, Network Function Virtualization. **Activity:…Group Discussion on IoT and M2M**	18
IV	**Data Acquiring, Organizing and Processing**: Introduction, data generation, data acquisition, data validation; Data categorization for storage, various types of data stores, organizing the data, transactions, business processes, integration; Online transactions and processing, stream processing, real-time processing, event stream processing, business process, business intelligence, distributed business process, enterprise systems, service oriented architecture(SOA). **Activity:…Commercial/Scientific/Industrial Applications of data processing and organising through students participation**	18

V	**Data Analytics and Machine Learning for IoT:** Analytics phases - descriptive, predictive, and prescriptive analytics; Online analytical processing; Introduction to statistical and machine learning tools for data analytics; Introduction to Big data, Big data characteristics, Big data analytics, Apply data analytics to further enhance best practices of Indian Knowledge System **Role of the cloud in IoT:** Cloud Storage models and communication APIs for IoT, **Security in IoT:** Security challenges for IoT, IoT security practices. Minor Projects: Sample projects in Arduino: Agriculture, Healthcare, SCM, Connected Cars, Smart city, Smart Home. Application of Data Analysis in Astrology, Ayurveda etc. **Activity:…Group Discussion oncloud in IoT and Security in IoT**	18

Keywords/ Tags:

PART C: Learning Resources

Textbooks, ReferenceBooks,OtherResources

TEXT BOOKS:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things - A Hands-On Approach”, Universities Press (India) Private Limited, First edition, 2015.
2. MayurRangir, "Internet of Things - Architecture, Implementation and Security", Pearson India Education Services Pvt. Ltd. First edition, 2020.
3. Rajkamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill Education, India, First Edition, 2017.
4. Simon Monk, “Programming Arduino: Getting Started with Sketches”, McGraw Hill Publication; 1st edition, 2012.

REFERENCES:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press Inc., 2014.
2. Dr. OvidiuVermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, 2014
3. Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann, “Interconnecting Smart Objects with IP: The Next Internet”, Morgan Kaufmann Publishers, 2010
4. Michael Miller, “The Internet of Things - How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, Pearson Education Inc., 2015.
6. Tom Igoe, “Making Things Talk Using Sensors, Networks, and Arduino to see, hear, and feel your world”,Make Community, LLC; 3rd edition. 2017
7. Richard Blum, “Arduino Programming in 24 Hours”, Pearson Education; 1st edition, 2015.

Suggestive digital platform web links:

1. Arduino Tutorial available at : https://www.tutorialspoint.com/arduino/index.htm

PART D : Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
ClassTest	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

PARTA: Introduction

Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester:II	Session:2025-26

Subject: Computer Science

1.	Course Code	CC-22	
2.	Course Title	Blockchain Technology	
	Course Type(Core Course / Practical Course)	Core Course	
4.	Pre-Requisite(if any)	Basic understanding of computer systems, networking, and programming concepts.	
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Understand the evolution and purpose of blockchain and distributed ledger technologies. 2. Explain key blockchain components including data structures, hashing, and digital signatures. 3. Understand and compare different consensus algorithms used for block validation. 4. Explore the concepts behind cryptocurrencies, Bitcoin, Ethereum, and smart contracts. 5. Apply the knowledge of blockchain in real-world applications and analyze current trends and challenges.	
6.	Credit Value	**Theory**—6Credits	
7.	Total Marks	Max.Marks:60+40	Min.PassingMarks:24+16

PARTB: Content of the Course

No. of Lectures (in hours per week): 6Hrs.per week

Total No. of Lectures : 90 Hrs.

Module	Topics	No. of Lectures
I	Foundations of Blockchain and Distributed Systems - Introduction: Digital trust, decentralization, and transparency - History and need for blockchain - Centralized vs. decentralized systems - Distributed ledger technology (DLT) - Blockchain vs. Traditional Databases - Use-case discussion: Land records, healthcare, supply chains **Activity:…Quiz on Blockchain technology (based on frequently asked questions by potential employers)**	18
II	Blockchain Architecture, Hashing & Data Structures - Structure of a block: Header, timestamp, nonce, Merkle root- Blockchain linking and immutability - Cryptographic Hash Functions (SHA-256) - Public/Private Key Cryptography- Digital Signatures and Wallets - Merkle Trees and Proof of Integrity	18
III	Consensus Models and Network Validation - Importance of consensus in distributed networks - Proof of Work (PoW): Concept and limitations - Proof of Stake (PoS) and variants- Proof of Activity, Burn, and Elapsed Time (PoET) - Comparative study of consensus mechanisms - Sybil attack resistance and trust models **Activity:…Group Discussion on Cryptography**	18
IV	Introduction to Cryptocurrencies: Bitcoin &Ethereum - What is cryptocurrency? - Overview of Bitcoin: Transactions, mining, block rewards - Wallets and key management - Ethereum: Overview and differences from Bitcoin - Smart Contracts and Ethereum Virtual Machine (EVM) - Introduction to wallets: MetaMask, Mist	18

	Activity:…Summarization of Crypto currencies through case studies	
V	Blockchain Applications, Challenges & Future Scope- Real-world applications: Voting, banking, logistics, identity- Introduction to platforms: Hyperledger, Corda, IOTA (overview only) - Blockchain as a Service (BaaS) – Cloud integration - Scalability, interoperability, and regulatory challenges - research opportunities in blockchain - Interactive tools (e.g., Blockchain Demo, Ganache) **Activity:…Group Discussion on Blockchain challenges and Applications.**	18

Keywords/ Tags: Blockchain, Distributed Ledger, Hashing, Digital Signature, Cryptocurrency, Smart Contract, Consensus, Bitcoin, Ethereum, Hyperledger, DApps, Public Key

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

Suggested Readings:

1. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to BlockchainTechnology and Blockchain Programming', Create Space Independent PublishingPlatform, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and StevenGoldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction.Princeton University Press, 2016.
3. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin andcryptocurrency, IEEE Symposium on security and Privacy, 2015.
4. https://www.blockchainexpert.uk/book/blockchain-book.pdf

Suggestive digital platform web links:

1. https://ethereum.org
2. https://bitcoin.org
3. https://soliditylang.org
4. https://hyperledger.org
5. Blockchain demo simulator: https://andersbrownworth.com/blockchain

Suggestive equivalent online courses:

www.coursera.org

1. Blockchain and cryptocurrency explained
2. Blockchain revolution
3. Bitcoin and Cryptocurrency technologies
4. Blockchain basics
5. Introduction to Blockchain
6. Introduction to Blockchain technologies
7. Blockchain foundations and use cases

www.udemy.com

1. Build a blockchain and cryptocurrency from scratch
2. The Basics of Blockchain
3. Blockchain advanced level

PART D : Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation**(CCE)**: **40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/Quiz/Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions:

PARTA: Introduction

Program: 1-Year PG Diploma	Class: PG Diploma (CS)	Semester: II	Session:2025-26

Subject: Computer Science

1.	Course Code	PC-22	
2.	Course Title	Database Management System	
3.	Course Type(Core Course/Practical Course)	Practical Course	
4.	Pre-Requisite(if any)	Knowledge of SQL and relational algebra	
5.	Course Learning Outcomes(CLO)	**On completion of this course, learners will be able to:** 1. Model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model. 2. Write SQL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS. 3. Learn to optimize SQL queries using query processing and optimization. 4. Understand detailed architecture, define objects, load data, query data, and performance tune SQL databases. 5. Handle large volumes of structured, semi-structured, and unstructured data using database technologies.	
6.	Credit Value	**Theory**—4 Credits	
7.	Total Marks	Max. Marks: 100	Min. Passing Marks: 40

PARTB: Content of the Course

No. of Labs(in hours per week):8Hrs.per week

Total No. of Labs : 120Hrs.

Module	Reference/Suggestive List of Practical Faculty is free to introduce innovative assignments as per student level The following theory is suggested for implementation of practical. The classes for the theory can be conducted during the practical sessions.	No. of Labs
	Digitization of Archival Records :Background, Image Capturing (Scanning), Image processing and cleaning (Image Enhancement), Optical Character Recognition/ Handwriting Recognition, Translation into English and AI based auto tagging, Conversion to PDF, Subject Metadata and Captioning Unique record identifiers, Quality control checklist, Access to digitized files/records, Long Term Storage, Modalities of digitization, Digitization of Ancient Scriptures and Manuscripts Introduction: Advantages of DBMS approach, Various views of data, data independence, schema & sub-schema, primary concept of data models, database languages, transaction management, database administrator &user, data dictionary, database architectures. ER model: Basic concept, design issues, mapping constraint, keys, ER diagram, weak & strong entity-sets, specialization & generalization, aggregation, inheritance, design of ER schema, Reduction of ER Schema to tables. Domains, relation, kind of relation, Relational databases, Various types of keys: candidate, primary, alternate & foreign keys. Relational Algebra and SQL: The structure, relational algebra with extended	

	operations, modification of database, Idea of relational calculus. Relational Database: Basic structure of SQL, Set operation, Aggregate functions, Null values, Nested Sub queries, derived relations, views, Modification of database, join relation, Domain, relation & keys, DDL in SQL. Programming concepts of PL/SQL, Stored procedure, Database connectivity with ODBC/JDBC Functional dependencies: Basic definitions, Trivial & non trivial dependencies, closure set of dependencies & of attributes, Irreducible set of dependencies, FD diagram. Normalization: Introduction to normalization, non-loss decomposition, First, second and third normal forms, dependency preservation, BCNF, multivalue dependencies and fourth normal form, join dependencies and fifth normal form. Database Integrity: general idea, integrity rules, Domain rules, Attributes rules, assertion, triggers, integrity & SQL Transaction Management: basic concept, ACID properties, transaction state, Implementation of atomicity & durability, Concurrent execution, Basic idea of serializability. Concurrency & Recovery: Basic idea of concurrency control, basic idea of deadlock, Failure Classification, storage structure-types, stable storage implementation, data access, recovery & Atomicity: log based recovery, deferred database modification, immediate database modification, checkpoints. MongoDB : Introduction, SQL Database, Advantage over RDBMS, Data Types, Data Modeling, MongoDB Operators: Query, Projection, Update Operator Database Commands : Aggregation, Geospatial, Query and Write Operation, Query Plan Cache, Authentication, User Management Role Management, Replication, Shadings, SessionDatabase and Collection : Create, Drop CRUD : Documents (Inset, Update, Delete, Query) SQL to MongoDB Mapping, MongoDB text search	
I	Digitization of Archival Records :Background, Image Capturing (Scanning), Image processing and cleaning (Image Enhancement), Optical Character Recognition/ Handwriting Recognition, Translation into English and AI based auto tagging, Conversion to PDF, Subject Metadata and Captioning Unique record identifiers, Quality control checklist, Access to digitized files/records, Long Term Storage, Modalities of digitization, Digitization of Ancient Scriptures and Manuscripts Prepare the case study on ER diagram and normalized database design based on FD's e.g. Retail Banking, Technical Training Institute, Internet Book Shop, Customer Order Warehouse	24
II	Design a Database and create required tables. For e.g. Bank, College Database Apply the constraints like Primary Key , Foreign key, NOT NULL to the tables.	24
III	SQL statement for implementing ALTER,UPDATE and DELETE Queries to implement the joins Query for implementing the following functions: MAX(),IN(),AVG(),COUNT()	24
IV	Query to implement the concept of Intergrity constrains Query to create the views, Queries for triggers Perform the following operation for demonstrating the insertion, updation and Deletion using the referential integrity constraints Query for creating the users and their role	24

V	**PL/SQL** Computation, Functions, Procedure, Cursor, Trigger. Where Clause, AND, OR operations in MongoDB. Commands and Operations of MongoDB in: Insert, Query, Update, Delete and Projection. (Note: use any collection)	24

Keywords/ Tags:

PART C: Learning Resources

Textbooks, Reference Books, Other Resources

Suggested Readings:

- "Database System Concepts", Abraham Silberschatz, Henry Korth, S. Sudarshan, McGraw Hill
- "Database management system", Bipin C. Desai,Galgotia Publications, New Delhi.
- "SQL, PL/SQL The programming language of Oracle- Ivan BayrossBPB Publications, New Dwlhi.

Suggestive digital platform web links:

- http://www.mysqltutorial.org/mysql-stored-procedure-tutorial.aspx
- https://www.w3schools.com/sql/
- https://www.nationalarchives.nic.in/sites/default/files/2024-08/Final%20SOPs%20for%20Digitization.pdf
- https://www.managedoutsource.com/blog/digitization-of-ancient-scriptures-and-manuscripts/

Suggestive equivalent online courses:

- https://klic.mkcl.org/klic-courses/database-management-system
- https://www.simplilearn.com/tutorials/dbms-tutorial
- https://www.scaler.com/topics/course/dbms/
- https://www.mygreatlearning.com/database-management-system/free-courses

Suggested online SQL compiler

- https://sqlfiddle.com/
- https://onecompiler.com/mysql/3xttmasjt

PARTD : Assessment and Evaluation

Internal Assessment : Continuous Comprehensive Evaluation **(CCE): 40 Marks**		End Term Examination(s) :**60 Marks** Time : 03:00 Hours	
Class Test	Marks		
Presentation/Assignment/ Quiz/ Group Discussion	Marks		
Appropriate weightage of attendance in the class	Marks		
Total	40 Marks	Total	60 Marks

Any Remarks/ Suggestions: