

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,  
CHHATRAPATI SAMBHAJINAGAR.



NAAC- 'A +' Grade

**CIRCULAR NO.SU/ Sci./College/NEP-2020/73/2025**

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies/ Ad-hoc Boards/Committee and recommended by the Dean, Faculty of Science & Technology, the Academic Council at its meeting held on 09 May 2025 has been accepted **the following B.Sc. Course Structure & Curriculum** under the Faculty of Science & Technology as per National Education Policy – 2020 run at the Affiliated Colleges of Dr. Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1	B.Sc. PHYSICS	III RD AND IV TH SEMESTER
2	B.Sc. ELECTRONICS	III RD AND IV TH SEMESTER
3	B.Sc. MATHEMATICS	III RD AND IV TH SEMESTER
4	B.Sc. INDUSTRIAL CHEMISTRY	III RD AND IV TH SEMESTER
5	B.Sc. AGROCHEMICAL AND FERTILIZE	III RD AND IV TH SEMESTER
6	B.Sc. HORTICULTURE	III RD AND IV TH SEMESTER
7	B.Sc. BIOCHEMISTRY	III RD AND IV TH SEMESTER
8	B.Sc. BOTANY	III RD AND IV TH SEMESTER
9	B.Sc. ZOOLOGY	III RD AND IV TH SEMESTER
10	B.Sc. BIOTECHNOLOGY	III RD AND IV TH SEMESTER
11	B.Sc. MICROBIOLOGY	III RD AND IV TH SEMESTER
12	B.Sc. DIARY SCIENCE AND TECHNOLOGY	III RD AND IV TH SEMESTER
13	B.Sc. STATISTICS	III RD AND IV TH SEMESTER
14	B.Sc. COMPUTER SCIENCE	III RD AND IV TH SEMESTER
15	B.Sc. GEOLOGY	III RD AND IV TH SEMESTER
16	B.Sc. CHEMISTRY	III RD AND IV TH SEMESTER
17	B.Sc. ANALYTICAL CHEMISTRY	III RD AND IV TH SEMESTER
18	B.Sc. POLYMER CHEMISTRY	III RD AND IV TH SEMESTER
19	B.Sc. ENVIRONMENTAL SCIENCE	III RD AND IV TH SEMESTER
20.	B.Sc. FISHERIES SCIENCE	III RD AND IV TH SEMESTER

21.	B.SC. HOME SCIENCE	III RD AND IV TH SEMESTER
22.	B.SC. DATA SCIENCE	III RD AND IV TH SEMESTER
23.	B.SC. INFORMATION TECHNOLOGY	III RD AND IV TH SEMESTER
24.	B.SC. NETWORKING AND MULTIMEDIA	III RD AND IV TH SEMESTER
25.	B.SC. AUTOMOBILE TECHNOLOGY	III RD AND IV TH SEMESTER
26.	B.SC. FORENSIC SCIENCE	III RD AND IV TH SEMESTER
27.	B.SC. FORENSIC SCIENCE & CYBER SECURITY	III RD AND IV TH SEMESTER
28.	B.SC. NON-CONVENTIONAL & CONVENTIONAL ENERGY	III RD AND IV TH SEMESTER
29.	B.SC. CLINICAL LABORATORY SCIENCE	III RD AND IV TH SEMESTER
30.	BACHELOR OF COMPUTER APPLICATION	III RD AND IV TH SEMESTER

This is effective from the Academic Year 2025-26 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,  
Chhatrapati Sambhajinagar  
-431 004.  
Ref.No. SU/Sci./2025/ 827-29  
Date:- 26/05/2025

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*26/05/2025*  
**Deputy Registrar,  
Syllabus Section.**

**Copy forwarded and necessary action to :-**

- 1] **The Principal of all Affiliated Colleges,**  
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

**Copy to :-**

- 1] The Director, Board of Examinations & Evaluation, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

**Dr. Babasaheb Ambedkar Marathwada University,**

Chhatrapati Sambhajinagar- 431001



**B.Sc. Degree Programme**

(Three Year / Four Years (Hons) /Four Years (Hons with Research)

**Course Structure and syllabus for**

**B. Sc. Second Year**

**(Revised)**

**( AS PER NEP-2020)**

**Subject: B.Sc. Computer Science**

**3 / 4 Year Degree Course**

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13/6/2020

**Effective from 2025-26**

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## **General Guidelines for Course Selection**

- 1) The Major subject is the discipline or course of main focus, bachelors degree shall be awarded in that discipline / subject.
- 2) Students will have to choose any three subjects as a Major 1, Major 2, Major 3, from **Basket 1** under the Faculty of Science and Technology (based on the available options in the respective college).
- 3) Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year.
- 4) In the beginning of second year, students will have to select / declare choice of **one major subject and one minor subject** from three major options **M1, M2 and M3** (which were opted in the first year)
- 5) Once the students finalize their **Major Subject** and **Minor Subject** in the beginning of the second year of the programme, they shall pursue their further education in that particular subject as their **Major and Minor** subjects. Therefore, from second year onwards curriculum of the Major and Minor subjects shall be different.
- 6) Students are required to select **Minor subject from other discipline of the same faculty**.
- 7) Students are required to select **Generic /Open Elective** (vertical 3 in the credit framework) **compulsorily from the faculty different than that of their Major / Minor subjects**.
- 8) Vocational Skill Courses and Skill Enhancement Courses (VSC and SEC) shall be related to the Major subject.
- 9) Curriculum of Ability Enhancement Courses (AEC), Value Education Courses (VEC), Indian Knowledge System (IKS), and Co-curricular Courses (CC) will be provided by the University separately.

### **Programme Educational Objectives (PEOs) :**

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge:** Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.
2. **Interdisciplinary Proficiency:** Graduates will possess the ability to integrate knowledge



and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

**3. Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

**4. Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

**5. Global Citizenship and Cultural Sensitivity:** Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

#### **Programme Outcomes (POs) :**

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1.** To develop problem solving abilities using a computer.
- **PO2.** To prepare necessary knowledge base for research and development in Computer Science.
- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.
- **PO4. Individual and team work:** Function effectively as a leader and as well as team



member in diverse/ multidisciplinary environments.

➤ **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

➤ **PO6. Project management:** Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.

➤ **PO7. Life-long learning:** Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change

➤ **PO8.** To train students in professional skills related to Software Industry

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

#### **Programme Specific Outcomes (PSOs):**

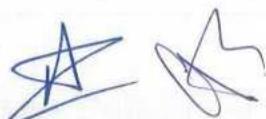
**PSO1. Domain knowledge:** Apply the knowledge of Computer Science fundamental, and advanced areas of Computer Science to provide comprehensive solution

**PSO2. Problem Analysis:** Identify Computer Science related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion

**PSO3. Design Development of solutions:** Design/ develop solutions for problems at varied complexity in various areas of Computer Science to address changing challenges put forward by market demand/ stakeholder

**PSO4. Conduct Investigation of complex problems:** Use established knowledge and methods to design of experiments, analyze resulting data and interpret the same to provide valid conclusions.

**PSO5. Modern tools:** Create, select, and apply appropriate techniques, resources, and modern electronics and relevant IT tools including prediction and modeling to complex Information Technology related activities with clear understanding of the limitations.



## BSc Second Year: 3<sup>rd</sup> Semester

Students will have to select / declare choice of **one major subject** and **one minor subject** from three major options M1, M2 and M3 (which were opted in the first year)

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major ( Core) Mandatory DSC	CS/DSC/T/200	Fundamentals of PHP	2		2		2+2+2+2 = 08
	CS/DSC/T/201	Data Structure		4		2	
	CS/DSC/P/ 226	Practical based on CS/DSC/T/200	2		2		
	CS/DSC/P/ 227	Practical based on CS/DSC/P/ 201		4		2	
Minor (Choose any two from pool of courses) It is from different discipline of the same faculty	CS/Mn/T/ 200	To be chosen for other discipline of same faculty	2		2		2+2 = 04
	CS/Mn/T/ 201				2		
Generic / Open Elective ( GE/OE) (Choose any one from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	CS/GE/OE/T/200	To be chosen from other faculty	2		2		02
VSC (Vocational Skill Courses) (Choose any one from CS/VSC/T/ 200 and CS/VSC/T/ 201) and corresponding Practicals	CS/VSC/T/200	A)Introduction to MySql B)Basics of Networking	1		1		02
	CS/VSC/P/201	1)Practical based on CS/VSC/T/ 200 (A) 2)Practical based on CS/VSC/T/ 200 (B)		2		1	
AEC, VEC, IKS	CS/AEC/T/200	English (Common for all the faculty)	2		2		2 + 2 = 04
	CS/VEC/T/201	Environmental Studies	2		2		
OJT/FP/CEP/CC/RP	CS/CC/P/226	Cultural Activity / NSS,NCC (Common for all the faculty)		4		2	02
			15	14	15	07	22

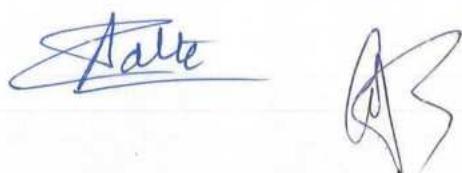
### Minor courses for other discipline

CS/Mn/T/ 200: E-Governance (It is from different discipline of the same faculty)

CS/Mn/T/ 201: Data Entry tools & Software (It is from different discipline of the same faculty)

### Generic /Open Elective Courses for other faculty

CS/GE/OE/T/200-3: E-Business (This course will be available for the students from other faculty)



## BSc Second Year: 4th Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major ( Core) Mandatory DSC	CS/DSC/T/250	Advanced PHP	2		2		2+2+2+2 = 08
	CS/DSC/T/ 251	Software Engineering		4		2	
	CS/DSC/P/ 276	Practical based on CS/DSC/T/250	2		2		
	CS/DSC/P/ 277	Practical based on CS/DSC/P/ 251		4		2	
Minor (Choose any two from pool of courses) It is from different discipline of the same faculty	CS/Mn/T/250	To be chosen for other discipline of same faculty	2		2		2+2 = 04
	CS/Mn/T/ 251		2		2		
Generic / Open Elective ( GE/OE) (Choose any one from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	CS/GE/OE/T/250	To be chosen from other faculty	2		2		02
SEC ( Skill Enhancement Courses) (Choose any one from CS/SEC/T/250 and CS/SEC/T/251) and corresponding Practicals	CS/SEC/T/250	A) Introduction to IOT B) Fundamentals of Big Data	1		1		1+1 =02
	CS/SEC/P/ 251	Practicals based on CS/SEC/T/250 Practicals based on CS/SEC/T/250(B)		2		1	
AEC, VEC, IKS	CS/AEC/T/ 250	Modern Indian Language (MIL-2) ( Choose any one from pool of language courses )	2		2		02
OJT/ FP/CEP/CC/RP	CS/FP/P/ 276	Field Project		4		2	2+2= 04
	CS/CC/P/ 277	(Fine/ Applied/ Visual/ Performing Arts) ( Common for all the faculty)		4		2	
			13	18	13	09	22

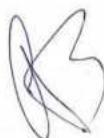
### Minor Courses for other Discipline

CS/Mn/T/ 250 : M-Governance (It is from different discipline of the same faculty)

CS/Mn/T/ 251: Smart Devices & Automation (It is from different discipline of the same faculty)

### Generic /Open Elective Courses for other faculty

CS/GE/OE/T/250: Ethical Hacking (This course will be available for the students from other faculty)




**Detailed Illustration of Courses included in 3<sup>rd</sup> and 4<sup>th</sup> semester:**

**1) Major (Core) subject are mandatory.**

CS/DSC/T/200: This is a 2 credit theory course corresponding to Major (core) subject CS/DSC/T/201: This is a 2 credit theory course corresponding to Major (core) subject CS/DSC/P/226: This is a 2 credit practical course based on CS/DSC/T/200 CS/DSC/P/227: This is a 2 credit practical course based on CS/DSC/T/201

CS/DSC/T/250: This is a 2 credit theory course corresponding to Major (core) subject CS/DSC/T/251: This is a 2 credit theory course corresponding to Major (core) subject CS/DSC/P/276: This is a 2 credit practical course based on CS/DSC/T/250 CS/DSC/P/277: This is a 2 credit practical course based on CS/DSC/T/251

**2) Minor : It is from different discipline of the same faculty**

CS/Mn/T/200 : This is a 2 credit theory from different discipline of the same faculty CS/Mn/T/201 : This is a 2 credit theory from different discipline of the same faculty

CS/Mn/T/250 : This is a 2 credit theory from different discipline of the same faculty CS/Mn/T/251 : This is a 2 credit theory from different discipline of the same faculty

**3) Generic / Open Elective ( GE/OE ) : (Needs to be chosen (any one) from pool of courses available at respective college). These courses should be chosen compulsorily from faculty other than that of Major.**

CS/GE/OE/T/200 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

CS/GE/OE/T/250: This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

**4) VSC (Vocational Skill Courses) : Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.**

CS/VSC/T/200 : This is a 1 credit theory course based Hands on Training corresponding to Major ( core) subject.

CS/VSC/T/201 : This is a 1 credit theory course based Hands on Training corresponding to Major ( core) subject.

CS/VSC/P/226 : This is a 1 credit practical course based on CS/VSC/T/200 CS/VSC/P/227 : This is a 1 credit practical course based on CS/VSC/T/201

**5) SEC (Skill Enhancement Courses) : Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.**

CS/SEC/T/250 : This is a 1 credit theory course to enhance the technical skills of the students in specific area.

CS/SEC/T/251 : This is a 1 credit theory course to enhance the technical skills of the students in specific area.

CS/SEC/P/276 : This is a 1 credit practical course based on CS/SEC/T/250 CS/SEC/P/277 : This is a 1 credit practical course based on CS/SEC/T/251



6) **AEC** (Ability Enhancement courses): The focus of these courses should be based on linguistic and communication skills.

**CS/AEC/T/200 : English**

This is a 2 credit theory course based on linguistic proficiency.

**CS/AEC/T/250 : Modern Indian Language MIL-2 (Hindi/ Marathi/ Pali & Buddhism/ Sanskrit/ Urdu)**

This is a 2 credit theory course based on linguistic proficiency. Students will have to choose one of the above mentioned languages.

**7) VEC : Environmental Studies**

**CS/VEC/T/201 : Environmental Studies**

This is 2-credit theory course based on Environmental Studies.

**8) FP-1 : Field Project :**

**CS/FP/P/276** : This is a 2 credit course, should be corresponding to Major ( core) subject

**9) CC (Curricular Courses):** The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Preforming Arts.

**CS/CC/P/226 : Cultural Activity / NSS, NCC**

This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

**CS/CC/P/277 : Fine/ Applied/ Visual/ Performing Arts**

This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty



B.Sc.

Computer Science (Major)

Semester - III

**CS/DSC/T/200: Fundamentals of PHP**

**Total Credits : 02**

**Total Contact Hours : 30 Hrs.**

**Maximum Marks : 50**

**Learning Objectives of the Course:**

- i) Introduce students to the fundamental concepts of PHP.
- ii) Enable students to develop dynamic web pages and applications.

**Course Outcomes ( COs) :**

After completion of the course, students will be able to

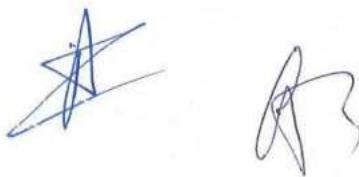
- i) Understand PHP Basics.
- ii) Implement Control Structures.
- iii) Manage Data Using Arrays and Functions.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to PHP:</b> Basics of Web Development & Role of PHP, Client-Side vs Server-Side Scripting, Installation & Configuration (XAMPP, WAMP, LAMP), Writing and Executing a Simple PHP Script, PHP Syntax, Variables, and Constants, Data Types and Type Casting.	10 Hrs.
II	<b>Operators and Control Structures:</b> Arithmetic, Logical, and Comparison Operators, Conditional Statements (if, if-else, switch-case), Looping Structures (for, while, do-while, foreach), Using Break & Continue.	10 Hrs.
III	<b>Functions and Arrays:</b> Defining & Calling Functions, Function Parameters & Return Values, Built-in Functions vs User-Defined Functions, Understanding Arrays (Indexed & Associative), Array Functions (Sorting, Merging, Searching).	10 Hrs.

**References:**

1. "PHP & MySQL: Server-side Web Development" – Jon Duckett, Wiley
2. "Learning PHP, MySQL & JavaScript" – Robin Nixon, O'Reilly Media
3. PHP Official Documentation: [www.php.net](http://www.php.net).
4. "PHP: The Complete Reference", - Steven Holzner, McGraw Hill.

<b>CS/DSC/P/226: Practical based on CS/DSC/T/200 (Fundamentals of PHP)</b>	
<b>Total Credits : 02</b>	<b>Total Contact Hours : 60 Hrs</b>
<b>Maximum Marks : 50</b>	
<b>List of experiments</b>	
<b>1</b>	Write a PHP script to calculate and display the sum, difference, product, and quotient of two given numbers.
<b>2</b>	Write a PHP program to check if two given numbers are equal. Display "Equal" if they are the same and "Not Equal" otherwise.
<b>3</b>	Create a PHP script to check if a number is <b>between 10 and 50</b> using logical operators.
<b>4</b>	Write a PHP program that checks if a user is eligible to vote (age $\geq 18$ ).
<b>5</b>	Create a PHP script that takes a day of the week (e.g., "Monday") and displays whether it's a weekday or a weekend using switch-case.
<b>6</b>	Write a PHP script that prints the multiplication table of a given number (e.g., 5) using a for loop.
<b>7</b>	Create a PHP script that asks the user for a password and keeps asking until the correct password "PHP123" is entered (using a do-while loop).
<b>8</b>	Write a PHP script that prints numbers from 1 to 20, but <b>stops</b> if it encounters the number 13 (use break).
<b>9</b>	Write a PHP script that prints numbers from 1 to 10, <b>skipping</b> even numbers (use continue).
<b>10</b>	Create a function that takes two numbers as arguments and returns their sum.
<b>11</b>	Write a function to check if a given number is <b>odd or even</b> and return "Odd" or "Even".
<b>12</b>	Write a function that takes a string and returns the reversed version of the string.
<b>13</b>	Use a built-in PHP function to find the <b>length of a string</b> and compare it with a custom function that does the same.
<b>14</b>	Create an <b>indexed array</b> of five fruits and display them using a loop.
<b>15</b>	Create an <b>associative array</b> for a student with keys: name, age, and grade. Print each key-value pair.



**CS/DSC/T/ 201: Data Structure****Total Credits : 02****Total Contact Hours : 30 Hrs.****Maximum Marks : 50****Learning Objectives of the Course:**

- i) To introduce fundamental data structures and their implementation in C.
- ii) To develop efficient problem-solving skills using various data structures.
- iii) To analyze the efficiency of algorithms

**Course Outcomes ( COs ) :**

After completion of the course, students will be able to

- i) Understand the Fundamentals of Data Structures
- ii) Implement sorting using array & String.
- iii) Develop and Apply Linked Lists, Stacks and Queues

Module No.	Topics / Actual Contents of the Syllabus	Contact Hours
I	<b>Introduction</b> , Definition, need, and classification of data structures, Abstract Data Types (ADT), Time and Space Complexity (Big O Notation) <b>Arrays and Strings</b> : One-dimensional and Multi-dimensional arrays, Array operations (insertion, deletion, searching, sorting)	10 Hrs.
II	<b>Linked Lists</b> : Concept and comparison with arrays, Singly Linked List (creation, insertion, deletion, traversal), Introduction to Doubly and Circular Linked Lists <b>Stacks and Queues</b> : Stack: Definition, operations, applications (expression evaluation, recursion), Queue: Definition, types (linear, circular), operations, Implementation using arrays and linked lists.	10 Hrs.
III	<b>Trees</b> : Definition, binary trees, binary search trees (BST), Tree traversal techniques (Inorder, Preorder, Postorder). <b>Searching and Sorting Techniques</b> : Searching: Linear search, Binary search, Sorting: Bubble sort, Selection sort, Insertion sort.	10 Hrs.

**References:**

1. "Data Structures Using C" – Yashavant Kanetkar, BPB Publication.
2. "Data Structures and Program Design in C" – Robert L. Kruse, Bruce P. Leung, Pearson Education.
3. "Data Structures Through C in Depth" – S.K. Srivastava, Deepali Srivastava, BPB Publication.
4. "C and Data Structures" – Reema Thareja, Oxford University Press.
5. "Let Us C" – Yashavant Kanetkar, BPB Publication.



CS/DSC/P/ 227: Practical based on CS/DSC/P/ 201 (based on Data Structure)

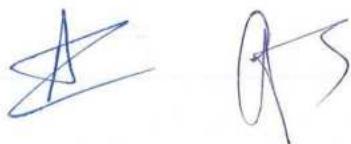
Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

**List of experiments**

1	Program to insert, delete an element into an array
2	Program to search for an element in an array (Linear Search, Binary search)
3	Program to sort an array using Bubble Sort, Selection Sort, Insertion sort
4	Program to reverse a string
5	Program to demonstrate Singly Linked List using C.
6	Program to implement a Doubly Linked List (insertion, deletion, traversal)
7	Program to implement a stack using an array
8	Program to implement a stack using a linked list
9	Program to implement a queue using an array
10	Program to implement a queue using a linked list
11	Program to create and traverse a Binary Tree (Inorder, Preorder, Postorder)
12	Program to create and traverse a Binary Tree (Inorder, Preorder, Postorder)

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<b>Minor-1 : E-Governance</b>		
<b>Total Credits : 02</b>		<b>Total Contact Hours : 30 Hrs.</b>
<b>Maximum Marks : 50</b>		
<b>Learning Objectives of the Course:</b>		
<ul style="list-style-type: none"> <li>i) To introduce students to the concepts, models, and frameworks of e-Governance.</li> <li>ii) To understand the role of ICT in governance and public service delivery.</li> <li>iii) To explore various national and international e-Governance initiatives.</li> <li>iv) To analyze the challenges, security concerns, and ethical aspects of e-Governance</li> </ul>		
<b>Course Outcomes ( COs) :</b>		
<p>After completion of the course, students will be able to</p> <ul style="list-style-type: none"> <li>i) Understand the importance of e-Governance in modern administration.</li> <li>ii) Analyze various models and frameworks of e-Governance.</li> <li>iii) Evaluate the role of ICT in public administration and citizen services.</li> </ul>		
<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to E-Governance:</b> Definition and Evolution of E-Governance, Difference Between E-Governance and Traditional Governance, Objectives and Benefits of E-Governance, Stakeholders of E-Governance (Government, Citizens, Businesses)	<b>10 Hrs.</b>
II	<b>E-Governance Infrastructure &amp; Services:</b> Role of ICT in E-Governance, National E-Governance Plan (NeGP) and Digital India Initiatives, Key E-Governance Portals (Aadhaar, DigiLocker, UMANG, e-Courts, GSTN), Smart Cities and Digital Public Infrastructure.	<b>10 Hrs.</b>
III	<b>Security, Privacy, and Legal Aspects:</b> Cyber security Challenges in E-Governance, Data Privacy Laws and Digital Identity Management, Right to Information (RTI) and E-Governance, Ethical Issues and Challenges in Implementation, Future Trends and International Best Practices in E-Governance.	<b>10 Hrs.</b>
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. "E-Governance: Concepts and Case Studies" – C.S.R. Prabhu, PHI Learning</li> <li>2. "E-Government: Principles and Practices" – Roland Traunmüller, Springer</li> <li>3. "Digital Governance: New Technologies for Public Decision Making" – Michael E. Milakovich.</li> </ol>		




<b>Minor-2 : Data Entry Tools and Software</b>		
<b>Total Credits : 02</b>		<b>Total Contact Hours : 30 Hrs.</b>
<b>Maximum Marks : 50</b>		
<b>Learning Objectives of the Course:</b>		
<ul style="list-style-type: none"> <li>i) To introduce students to essential data entry tools and techniques.</li> <li>ii) To develop proficiency in using software for efficient data entry and management.</li> <li>iii) To ensure accuracy and efficiency in data handling and processing.</li> </ul>		
<b>Course Outcomes ( COs) :</b>		
<p>After completion of the course, students will be able to</p> <ul style="list-style-type: none"> <li>i) Understand the importance of data entry in various industries.</li> <li>ii) Use common data entry tools and software effectively.</li> <li>iii) Ensure accuracy and speed in data entry operations.</li> </ul>		
Module No.	Topics / Actual Contents of the Syllabus	Contact Hours
I	<b>Introduction to Data Entry:</b> Definition and Importance of Data Entry, Types of Data (Text, Numeric, Categorical), Role of Data Entry in Business and Research, Essential Skills for Efficient Data Entry.	10 Hrs.
II	<b>Data Entry Tools and Software:</b> Overview of Data Entry Software: Microsoft Excel, Google Sheets, OpenOffice, Data Entry Forms and Templates, Introduction to Database Management Systems (MS Access).	10 Hrs.
III	<b>Data Entry Techniques and Accuracy:</b> Keyboard Shortcuts and Speed Improvement Techniques, Data Validation and Error Checking, Formatting and Organizing Data, Preventing Data Entry Errors and Common Mistakes, Role of AI and Automation in Data Entry, Introduction to Cloud-Based Data Entry Tools (Google Drive, Microsoft OneDrive).	10 Hrs.
<b>References:</b>		
<ol style="list-style-type: none"> <li>1. "Microsoft Excel Data Analysis and Business Modeling" – Wayne L. Winston, Microsoft Press.</li> <li>2. "Database Management Systems" – Raghu Ramakrishnan, McGraw-Hill Education.</li> <li>3. "The Data Warehouse Toolkit" – Ralph Kimball, John Wiley &amp; Sons.</li> </ol>		

**CS/VSC/T/ 200 (A): Introduction to MySQL**

**Total Credits : 01**

**Total Contact Hours : 15 Hrs.**

**Maximum Marks : 50**

**Learning Objectives of the Course:**

- i) Understand the need for database systems and the basic concepts of DBMS.
- ii) Learn and apply the relational data model and SQL language.
- iii) Gain practical knowledge of MySQL to manage and query databases.
- iv) Identify key elements like constraints, keys, and joins in relational databases.
- v) Apply concepts through simple real-world database design and implementation.

**Course Outcomes ( COs) :**

After completion of the course, students will be able to

- i) Explain the architecture and types of DBMS.
- ii) Design simple relational databases using appropriate keys and constraints.
- iii) Use SQL commands for database creation, data manipulation, and querying.
- iv) Implement joins and subqueries to retrieve data from multiple tables.
- v) Demonstrate proficiency in using MySQL for database operations.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to DBMS:</b> What is a DBMS?, Advantages over file systems, Types of DBMS (Hierarchical, Network, Relational), DBMS architecture (1-tier, 2-tier, 3-tier) <b>Relational Model &amp; Keys:</b> Tables, attributes, tuples, Concept of Schema, Types of Keys: Primary, Foreign, Candidate, Composite, ER to relational mapping (brief overview)	<b>05 Hrs.</b>
II	<b>SQL Basics with MySQL:</b> Introduction to MySQL, Creating databases and tables, Inserting, updating, and deleting data, SQL Data Types, Simple SELECT queries with WHERE, ORDER BY. <b>Constraints and Aggregate Functions:</b> Constraints: NOT NULL, UNIQUE, DEFAULT, CHECK, PRIMARY KEY, FOREIGN KEY, Functions: COUNT, SUM, AVG, MAX, MIN, Grouping: GROUP BY, HAVING.	<b>05 Hrs.</b>
III	<b>Joins and Subqueries:</b> Joins: INNER, LEFT, RIGHT, Subqueries: Single-row and multi-row, Real-life application example: Student/course database	<b>05 Hrs.</b>

**References:**

1. "Database System Concepts" – Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill
2. "Fundamentals of Database Systems" – Ramez Elmasri, Shamkant B. Navathe, Pearson Education.
3. "MySQL: The Complete Reference" - Vikram Vaswani, McGraw Hill.
4. "SQL, PL/SQL: The Programming Language of Oracle", - Ivan Bayross, BPB Publications.

List of experiments	
1	Install MySQL and create a user. Set up a new database named CollegeDB.
2	Create a table Students with fields: StudentID, Name, Age, Department, Email.
3	Add a PRIMARY KEY to StudentID and a UNIQUE constraint to Email.
4	Insert at least 5 records into the Students table.
5	Create a table Courses with CourseID, CourseName, Credits, and add a PRIMARY KEY to CourseID.
6	Create an Enrollments table with StudentID, CourseID, and Grade, using foreign keys appropriately.
7	Update the Age of a student whose name is "Ravi".
8	Delete the enrollment record of a student from Enrollments table based on StudentID.
9	Use SELECT to retrieve names of all students older than 20 years.
10	Display all students in alphabetical order of their names.
11	Add constraints: NOT NULL on Name, CHECK on Age > 17, and DEFAULT value 'Unknown' for Email.
12	Use aggregate functions to count the number of students in each department.
13	Find the average grade of students enrolled in each course.
14	Use INNER JOIN to display Student Name, Course Name, and Grade from related tables.
15	Write a subquery to find students who scored more than the average grade.

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**CS/VSC/T/ 200 (B): Basics of Networking**

**Total Credits : 01**

**Total Contact Hours : 15 Hrs.**

**Maximum Marks : 50**

**Learning Objectives of the Course:**

- i) To introduce the fundamentals of communication systems.
- ii) To provide an overview of networking basics.
- iii) To introduce students to the fundamental concepts of computer networks.

**Course Outcomes ( COs ) :**

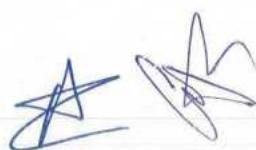
After completion of the course, students will be able to

- i) Understand Fundamental Networking Concepts.
- ii) Analyze Various Modulation Techniques.
- iii) Explore Wireless Communication and Emerging Technologies.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to Communication Systems:</b> Definition and Need for Communication, Elements of a Communication System, Types of Communication: Wired & Wireless, Analog and Digital Communication Basics, Noise and its Effects in Communication.	05 Hrs.
II	<b>Analog and Digital Communication:</b> Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM), Pulse Modulation Techniques: PAM, PWM, PPM, Basics of Digital Communication, Advantages of Digital Communication over Analog, Introduction to Multiplexing (TDM & FDM).	05 Hrs.
III	<b>Basics of Networking:</b> Definition and Importance of Networking, Types of Networks: LAN, MAN, WAN, Network Topologies (Bus, Star, Ring, Mesh, Hybrid), Transmission Media: Wired (Twisted Pair, Coaxial, Optical Fiber) and Wireless, Network Devices: Hub, Switch, Router, Modem, Repeater.	05 Hrs.

**References:**

1. "Computer Networks" – Andrew S. Tanenbaum, Pearson
2. "Data Communications and Networking" – Behrouz A. Forouzan, McGraw-Hill.
3. "Networking Essentials" – Cisco Networking Academy, Cisco Press
4. Online Resources: Cisco Packet Tracer, W3Schools, GeeksforGeeks, Coursera.



<b>CS/VSC/P/201 (B): Practical based on CS/VSC/T/ 200 (Basics of Networking)</b>	
<b>Total Credits : 01</b>	<b>Total Contact Hours : 30 Hrs</b>
<b>Maximum Marks : 50</b>	
<b>List of experiments</b>	
1	Set up and analyze a simple Local Area Network (LAN) with multiple nodes
2	Demonstrate the difference between various network topologies by connecting devices in Bus, Star, and Ring configurations.
3	Study the characteristics of different transmission media (Twisted Pair, Coaxial, Optical Fiber) by measuring signal attenuation.
4	Configure and test a network using basic networking devices such as a Hub, Switch, and Router.
5	Demonstrate the working of a Modem by transmitting and receiving digital data over an analog channel.
6	Use a Repeater to extend network coverage and measure signal strength
7	<b>Case Study on Communication Evolution:</b> Analyze the evolution of communication systems from wired telephony to modern wireless networks
8	<b>Analog vs. Digital Communication:</b> Compare a historical analog communication system (e.g., early telephone networks) with a modern digital system (e.g., VoIP). What are the key improvements?
9	<b>Case Study on Network Topologies:</b> Compare different network topologies in real-world implementations, such as data centers, corporate offices, and ISP networks.
10	<b>Wired vs. Wireless Transmission Media:</b> Investigate a case where the transition from wired (fiber optics) to wireless (5G) communication improved efficiency.



**CS/GE/OE/T/200-3: E-Business****Total Credits : 02****Total Contact Hours : 30 Hrs.****Maximum Marks : 50****Learning Objectives of the Course:**

- i) Understand the core concepts and scope of E-Business.
- ii) Differentiate between various E-Business models and their applications.
- iii) Learn the fundamentals of online transactions and payment systems.
- iv) Understand cybersecurity, ethical, and legal considerations in E-Business.

**Course Outcomes ( COs) :**

After completion of the course, students will be able to

- i) Understand Core E-Business Concepts.
- ii) Differentiate E-Business Models.
- iii) Analyze Online Transactions & Payment Systems.
- iv) Evaluate Security & Legal Issues in E-Business.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to E-Business:</b> Definition, evolution, and importance of E-Business, Difference between E-Business and E-Commerce, Key benefits and challenges of E-Business. <b>E-Business Models &amp; Strategies:</b> Types of E-Business models: B2B, B2C, C2C, C2B, G2C, Revenue models in E-Business.	10 Hrs.
II	<b>Online Transactions &amp; Payment Systems:</b> Online payment methods (credit/debit cards, UPI, digital wallets), Role of payment gateways (PayPal, Razorpay, Stripe, etc.), Introduction to blockchain and cryptocurrencies in payments.	10 Hrs.
III	<b>Security &amp; Legal Aspects of E-Business:</b> Cybersecurity threats and solutions in online business, Data privacy laws and regulations (GDPR, IT Act, etc.), Ethical considerations in E-Business.	10 Hrs.

**References:**

1. "E-Business and E-Commerce Management" – Dave Chaffey, Pearson
2. "Fundamentals of E-Commerce" – P.T. Joseph, Prentice Hall
3. "Digital Marketing Essentials" – Jeff Larson & Stuart Draper, Stukent

Three handwritten signatures in blue ink are arranged horizontally. The first signature on the left is a stylized 'Z'. The second signature in the middle is a stylized 'A'. The third signature on the right is a stylized 'D'.



B. Sc.

## Computer Science (Major)

## Semester – IV

**CS/DSC/T/250: Advanced PHP**

**Total Credits : 02**

**Total Contact Hours : 30 Hrs.**

**Maximum Marks : 50**

**Learning Objectives of the Course:**

- i) Understand advanced features and syntax of PHP.
- ii) Develop web applications using object-oriented PHP programming.
- iii) Integrate MySQL with PHP for dynamic content generation.
- iv) Manage sessions, cookies, and user authentication securely.
- v) Implement error handling, file operations, and form validation.
- vi) Understand the basics of PHP frameworks and RESTful API development.

**Course Outcomes ( COs) :**

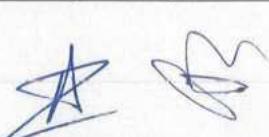
After completion of the course, students will be able to

- i) Apply advanced PHP programming concepts including OOP and file handling.
- ii) Create secure, database-driven web applications using PHP and MySQL.
- iii) Implement session management, cookies, and authentication in web apps.
- iv) Use PHP to validate forms and handle user input securely.
- v) Build simple APIs and understand PHP MVC framework structure.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Advanced PHP Syntax &amp; Concepts:</b> PHP configuration and error reporting, Include, require, include_once, Data types, arrays (indexed, associative, multidimensional), Superglobals: \$_GET, \$_POST, \$_REQUEST, \$_SERVER, \$_SESSION, \$_COOKIE. <b>Object-Oriented PHP:</b> Classes and Objects, Inheritance, interfaces, and traits, Constructors and destructors, Visibility: public, private, protected, Autoloading classes.	10 Hrs.
II	<b>Working with Forms and Files:</b> Form handling with validation, Sanitization and security (XSS, SQL Injection prevention), File uploading and downloading, Reading and writing to files. <b>PHP &amp; MySQL Integration:</b> Connecting to MySQL using MySQLi and PDO, CRUD operations using PHP and MySQL, Prepared statements and error handling, Displaying dynamic data with HTML/PHP integration.	10 Hrs.
III	<b>Sessions, Cookies &amp; Basic Security:</b> Setting and retrieving cookies, Starting and managing sessions, User login and logout functionality, Hashing passwords using password_hash() and password_verify(). <b>Introduction to PHP Frameworks and APIs:</b> Concept of MVC architecture, Overview of popular PHP frameworks (Laravel, CodeIgniter – brief), Introduction to building RESTful APIs in PHP.	10 Hrs.

**References:**

1. "PHP and MySQL Web Development" – Luke Welling, Laura Thomson, Pearson.
2. "PHP and MySQL for Beginners" – S. R. Rajeev, BPB Publications
3. "Advanced PHP Programming" – George Schlossnagle, Wiley India.
4. "PHP 7 Programming", Nitin Upadhyaya, Packt Publishing.




<b>CS/DSC/P/ 276: Practical based on CS/DSC/T/250 (Advanced PHP)</b>	
<b>Total Credits : 02</b>	<b>Total Contact Hours : 60 Hrs</b>
<b>Maximum Marks : 50</b>	
<b>List of experiments</b>	
1	Install PHP, MySQL, and configure XAMPP/WAMP for PHP development.
2	Write PHP scripts demonstrating variable declaration, data types, and basic arithmetic operations.
3	Create indexed, associative, and multidimensional arrays. Demonstrate various array functions.
4	Create a simple contact form using <code>\$_GET</code> and <code>\$_POST</code> to collect and process user data.
5	Use <code>\$_GET</code> , <code>\$_POST</code> , <code>\$_SERVER</code> , <code>\$_SESSION</code> , <code>\$_COOKIE</code> , and <code>\$_REQUEST</code> in various examples.
6	Demonstrate the usage of <code>include</code> , <code>require</code> , <code>include_once</code> , and create an example of autoloading.
7	Create a simple PHP class with properties and methods. Instantiate objects and demonstrate access control.
8	Implement a class that uses inheritance and interfaces. Demonstrate method overriding and polymorphism.
9	Write a PHP script to upload files, read from files, and write data to a file.
10	Build a form with validation for user input (like email and password), and sanitize input for security.
11	Create a login system using PHP sessions and cookies to maintain user login state across pages.
12	Connect to a MySQL database using <code>MySQLi</code> or <code>PDO</code> , and perform CRUD operations.
13	Demonstrate the use of prepared statements in <code>MySQLi</code> for preventing SQL injection and handling errors.
14	Fetch data from a MySQL database and display it dynamically using PHP in HTML tables.
15	Create a simple RESTful API in PHP to handle GET and POST requests, and return JSON responses.




**CS/DSC/T/ 251: Software Engineering****Total Credits : 02****Total Contact Hours : 30 Hrs.****Maximum Marks : 50****Learning Objectives of the Course:**

- i) Understand the fundamental principles and lifecycle of software development.
- ii) Explore various software development process models.
- iii) Learn the techniques involved in requirement analysis, design, coding, testing, and maintenance.
- iv) Understand project management concepts including cost estimation, risk analysis, and quality assurance.

**Course Outcomes ( COs ) :**

After completion of the course, students will be able to

- i) Identify and apply suitable software development models based on project requirements.
- ii) Analyze and specify software requirements and transform them into appropriate design models.
- iii) Apply software testing methods and tools for quality assurance.
- iv) Recognize the importance of software process standards and documentation.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to Software Engineering:</b> Nature and goals of software engineering, Characteristics of good software, Software development lifecycle (SDLC), Software myths and process maturity. <b>Software Development Models:</b> Waterfall model, Incremental model, Spiral model, V-Model, Agile development and Scrum overview.	10 Hrs.
II	<b>Software Requirements and Analysis:</b> Requirement types: functional and non-functional, Requirement engineering process, SRS (Software Requirement Specification), Use cases and requirement validation <b>Software Design and Coding:</b> Design concepts and principles, Design diagrams: DFDs, ER diagrams, UML basics, Coding standards and documentation, Structured programming and modular design.	10 Hrs.
III	<b>Software Testing:</b> Testing principles and types: unit, integration, system, acceptance, Black-box and white-box testing, Test case design and defect tracking, Basics of automation testing. <b>Software Project Management &amp; Quality Assurance:</b> Project scheduling and estimation (LOC, FP, COCOMO), Risk management, Configuration management, Software quality, ISO and CMMI models, Ethics in software engineering.	10 Hrs.

**References:**

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



<b>CS/DSC/P/ 277: Practical based on CS/DSC/P/ 251 (Software Engineering)</b>	
<b>Total Credits : 02</b>	<b>Total Contact Hours : 60 Hrs</b>
<b>Maximum Marks : 50</b>	
<b>List of experiments</b>	
1	<b>Create CASE STUDY on Library Management System</b> Apply SDLC phases to analyze and design a library system: <ul style="list-style-type: none"> <li>✓ Functional &amp; non-functional requirements</li> <li>✓ Use case, DFD, ER diagrams</li> <li>✓ Black-box test cases</li> </ul>
2	<b>Create CASE STUDY on Online Student Registration Portal</b> Model an online student admission/registration system: <ul style="list-style-type: none"> <li>✓ Agile development overview</li> <li>✓ UML diagrams</li> <li>✓ SRS and estimation using COCOMO</li> </ul>
3	<b>Create CASE STUDY on Online Food Ordering System</b> Develop a food delivery platform: <ul style="list-style-type: none"> <li>✓ Compare Waterfall and Agile models</li> <li>✓ Design UI wireframes and use case diagrams</li> <li>✓ Create unit/integration test cases</li> </ul>
4	<b>Create CASE STUDY on Hospital Management System</b> End-to-end case study with SDLC: <ul style="list-style-type: none"> <li>✓ Requirement gathering and SRS</li> <li>✓ Structured coding standards</li> <li>✓ Test plan and quality assurance process</li> </ul>
5	<b>Create CASE STUDY on E-Commerce Shopping Cart System</b> Explore design and architecture: <ul style="list-style-type: none"> <li>✓ DFD, ER and UML diagrams</li> <li>✓ Apply object-oriented principles</li> <li>✓ Security testing &amp; ethics in data handling</li> </ul>




<b>Minor-3 : M-Governance</b>		
<b>Total Credits : 02</b>		<b>Total Contact Hours : 30 Hrs.</b>
<b>Maximum Marks : 50</b>		
<p><b>Learning Objectives of the Course:</b></p> <ul style="list-style-type: none"> <li>i) To introduce the concept of Mobile (M-Governance) and its role.</li> <li>ii) To explore the impact of mobile technology, applications, and digital inclusion in governance.</li> <li>iii) To analyze various M-Governance initiatives, frameworks at national and global levels.</li> </ul>		
<p><b>Course Outcomes ( COs) :</b></p> <p>After completion of the course, students will be able to</p> <ul style="list-style-type: none"> <li>i) Understand the significance of M-Governance in public administration and citizen engagement.</li> <li>ii) Analyze various M-Governance models, services, and applications.</li> <li>iii) Evaluate the role of mobile apps, SMS, and digital payment systems in government services.</li> </ul>		
<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to M-Governance:</b> Definition and Scope of M-Governance, Evolution from E-Governance to M-Governance, Advantages of Mobile Technologies in Governance, Role of Smartphones, SMS, USSD, Mobile Apps, and Cloud Computing, Mobile-Based Services: m-Health, m-Education, m-Finance, m-Agriculture.	10 Hrs.
II	<b>Infrastructure &amp; Digital Inclusion:</b> Mobile Networks (4G, 5G) and Internet Penetration in Governance, Mobile Payment Systems (UPI, Aadhaar Pay, Mobile Wallets), Digital Literacy and Accessibility Challenges, Government Policies and Regulatory Frameworks for M-Governance.	10 Hrs.
III	<b>Security, Privacy, and Challenges:</b> Cybersecurity and Data Privacy Issues in M-Governance, Mobile App Security and Authentication Mechanisms (OTP, Biometrics), Digital Divide and Infrastructure Challenges in Rural Areas, Ethical and Legal Issues in Mobile Governance Implementation.	10 Hrs.
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. "Government Online: Opportunities and Challenges"- M.P. Gupta, Tata McGraw-Hill.</li> <li>2. "Towards E-Government: Management Challenges"-M.P. Gupta, Tata McGraw-Hill.</li> <li>3. "Digital Governance: Leveraging Technology for Public Service" – H. Chen-</li> <li>4. Online Resources: Digital India Portal, UN E-Government Reports, NITI Aayog Reports.</li> </ol>		




**Minor-4 : Smart Devices & Automation****Total Credits : 02****Total Contact Hours : 30 Hrs.****Maximum Marks : 50****Learning Objectives of the Course:**

- i) To introduce the concepts of smart devices and automation.
- ii) To understand the technologies behind smart homes, IoT, and industrial automation.
- iii) To explore real-world applications of automation in various domains.

**Course Outcomes ( COs ) :**

After completion of the course, students will be able to

- i) Understand the fundamentals of smart devices and automation.
- ii) Identify different components used in smart automation systems.
- iii) Work with IoT-based smart devices for home and industrial applications.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to Smart Devices &amp; Automation:</b> Definition and Importance of Smart Devices, Evolution of Automation: From Traditional to Smart Systems, Applications of Smart Devices in Home, Industry, and Healthcare, Basic Concepts of IoT (Internet of Things).	10 Hrs.
II	<b>Sensors and Actuators in Smart Devices:</b> Communication Protocols: Wi-Fi, Bluetooth, Zigbee, LoRa, Cloud Platforms for Smart Automation (AWS IoT, Google IoT, Microsoft Azure), Smart Assistants: Alexa, Google Assistant.	10 Hrs.
III	<b>Home and Industrial Automation:</b> Introduction to Home Automation Systems, Smart Lighting, Security, and Energy Management, Industrial Automation: SCADA, PLC, Robotics, Smart Cities and Smart Transportation Systems.	10 Hrs.

**References:**

1. "Smart Home Automation with IoT"- Dipankar Saha, BPB Publications.
2. "Internet of Things"- Raj Kamal- McGraw Hill India.
3. "Building the Internet of Things"- Maciej Kranz, Wiley, 2016.
4. "Smart Home Automation with IoT"- Pradeeka Seneviratne, BPB Publications, 2023.

**CS/SEC/T/250: Introduction to IoT**

**Total Credits : 01**

**Total Contact Hours : 15 Hrs.**

**Maximum Marks : 50**

**Prerequisites:** Basic knowledge of Digital Electronics and Microprocessor (Suggest to selected Computer System Architecture as minor in the III Semester)

**Learning Objectives of the Course:**

- i) To introduce the basic concepts and applications of the Internet of Things.
- ii) To familiarize students with the components and architecture of IoT systems.
- iii) To provide an overview of IoT communication protocols and technologies.
- iv) To encourage students to explore simple IoT-based projects or case studies.
- v) To develop a foundational understanding of how IoT impacts real-world domains.

**Course Outcomes ( COs ) :**

After completion of the course, students will be able to

- i) Understand the fundamental concepts and terminology of IoT.
- ii) Identify the key components and architecture of IoT systems.
- iii) Recognize various sensors, actuators, and communication protocols used in IoT.
- iv) Appreciate the scope and applications of IoT across industries.
- v) Demonstrate basic knowledge through a simple hands-on activity or mini-project.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to IoT:</b> Definition, history, and evolution of IoT, Characteristics of IoT, IoT vs. traditional internet <b>IoT Architecture:</b> Four-layer architecture: Perception, Network, Processing, and Application layers, Devices, sensors, and actuators, Microcontrollers (basic overview: Arduino, ESP8266, Raspberry Pi).	05 Hrs.
II	<b>Communication Technologies:</b> Wired and wireless communication, Bluetooth, Wi-Fi, Zigbee, LoRa, and MQTT overview, Cloud platforms for IoT (intro to platforms like ThingSpeak or Blynk).	05 Hrs.
III	<b>Applications of IoT:</b> Smart homes, smart cities, healthcare, agriculture, environment, and industry, Case studies and real-world examples.	05 Hrs.

**References:**

1. "Internet of Things: A Hands-On Approach" – Arshdeep Bahga, Vijay Madisetti, Universities Press.
2. "Designing the Internet of Things" – Adrian McEwen, Hakim Cassimally, Wiley.
3. "Internet of Things: Architecture and Design Principles", Raj Kamal, McGraw Hill.
4. "Internet of Things: Principles and Applications"- Jivan S. Parab, Rajendra S. Gad, Chapman and Hall/CRC.



<b>CS/SEC/P/ 251 (A): Practical based on CS/SEC/T/ 250 (Introduction to IoT)</b> <b>Total Credits : 01</b> <b>Total Contact Hours : 30 Hrs</b> <b>Maximum Marks : 50</b>	
<b>List of experiments</b>	
1      Create CASE STUDY on Smart Home: IoT-based Automatic Light Control <ul style="list-style-type: none"> <li>• Objective: Turn lights on/off based on room occupancy.</li> <li>• IoT Components: PIR motion sensor, microcontroller, relay, Blynk app.</li> <li>• Outcome: Energy savings and automation of household utilities.</li> </ul>	
2      Create CASE STUDY on Health Monitoring System <ul style="list-style-type: none"> <li>• Objective: Real-time tracking of heart rate and temperature.</li> <li>• IoT Components: Pulse sensor, temperature sensor, ESP8266, cloud dashboard.</li> <li>• Outcome: Remote health monitoring for elderly or patients.</li> </ul>	
3      Create CASE STUDY on Smart City: Air Quality Monitoring <ul style="list-style-type: none"> <li>• Objective: Monitor air quality in urban areas.</li> <li>• IoT Components: MQ135 gas sensor, NodeMCU, cloud platform (ThingSpeak).</li> <li>• Outcome: Detect pollution levels and support environment-related decisions.</li> </ul>	
4      Create CASE STUDY on Home Security System <ul style="list-style-type: none"> <li>• Objective: Alert the user about unauthorized entry or door movement.</li> <li>• IoT Components: Door sensor, buzzer, Wi-Fi module, mobile alert via Blynk.</li> <li>• Outcome: Affordable and effective home security.</li> </ul>	
5      Create CASE STUDY on Smart Waste Management <ul style="list-style-type: none"> <li>• Objective: Detect the fill level of waste bins and notify for collection.</li> <li>• IoT Components: Ultrasonic sensor, GSM/Wi-Fi module, cloud system.</li> <li>• Outcome: Cleaner environment and efficient waste management.</li> </ul>	
6      Create CASE STUDY on Smart Water Quality System <ul style="list-style-type: none"> <li>• Objective: Measure pH and turbidity of water for safety.</li> <li>• IoT Components: pH sensor, turbidity sensor, ESP8266, cloud data logging.</li> <li>• Outcome: Real-time monitoring of water quality for health.</li> </ul>	

**CS/SEC/P/ 251 (B): Practical Based on CS/SEC/T/ 250 (Fundamentals of Big Data)****Total Credits : 01****Total Contact Hours : 15 Hrs.****Maximum Marks : 50****Learning Objectives of the Course:**

- i) To introduce the basic concepts and characteristics of Big Data.
- ii) To familiarize students with Big Data tools and technologies.
- iii) To highlight the significance of Big Data in various application domains.
- iv) To provide hands-on exposure to Big Data processing using open-source platforms.
- v) To encourage analytical thinking and data-driven problem solving.

**Course Outcomes ( COs ) :**

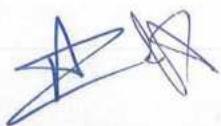
After completion of the course, students will be able to

- i) Understand the definition, scope, and importance of Big Data.
- ii) Identify the characteristics and challenges associated with Big Data.
- iii) Describe major Big Data frameworks and technologies.
- iv) Recognize real-world applications and implications of Big Data analytics.
- v) Demonstrate basic usage of tools like Hadoop or Spark through lab sessions or demonstrations.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to Big Data:</b> Definition and evolution of Big Data, Types of data: Structured, Semi-structured, Unstructured, The 5 V's of Big Data: Volume, Velocity, Variety, Veracity, and Value. <b>Big Data Technologies and Tools:</b> Traditional vs. Big Data systems, Introduction to Hadoop ecosystem (HDFS, MapReduce), Overview of Apache Spark, Basics of NoSQL (MongoDB, Cassandra overview).	05 Hrs.
II	<b>Big Data Lifecycle and Architecture:</b> Data collection and ingestion, Data storage and processing, Data analysis and visualization, Data security and governance (brief overview).	05 Hrs.
III	<b>Applications of Big Data:</b> Use cases in business, healthcare, science, social media, and IoT, Case studies and success stories, Ethical considerations and data privacy.	05 Hrs.

**References:**

1. "Big Data: Principles and Paradigms" – Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Morgan Kaufmann.
2. "Big Data Fundamentals: Concepts, Drivers & Techniques" – Thomas Erl, Wajid Khattak, Paul Buhler, Pearson Education.
3. "Big Data"- Dr. G.K. Awasthi, Dr. B.P. Gaikwad, Dr. A. Mn. Siddiqui, Dr. Sk. Faheem, PKS Publication.
4. "Big Data and Hadoop"- V. K. Jain, Khanna Publishing House.



List of experiments	
1	Create CASE STUDY on Big Data in Retail: Walmart's Inventory Management <ul style="list-style-type: none"> <li>• Objective: Analyze how Walmart uses Big Data to optimize inventory and enhance customer experience.</li> <li>• Focus Areas: Data collection, real-time processing, demand forecasting.</li> </ul>
2	Create CASE STUDY on Big Data in Healthcare: Predictive Analytics for Patient Monitoring <ul style="list-style-type: none"> <li>• Objective: Use historical and sensor data to predict patient health conditions.</li> <li>• Focus Areas: Structured/unstructured data, data ingestion, and privacy concerns.</li> </ul>
3	Create CASE STUDY on Social Media Analytics: Twitter Sentiment Analysis <ul style="list-style-type: none"> <li>• Objective: Analyze tweet sentiments during major events (elections, product launches).</li> <li>• Focus Areas: Data variety, high velocity, and real-time analytics.</li> </ul>
4	Create CASE STUDY on Big Data in Science: Climate Data Analysis <ul style="list-style-type: none"> <li>• Objective: Process and analyze large-scale climate datasets to detect patterns.</li> <li>• Focus Areas: Volume and variety of data, ethical data usage.</li> </ul>
5	Create CASE STUDY on IoT and Big Data: Smart Agriculture <ul style="list-style-type: none"> <li>• Objective: Analyze data from IoT sensors (moisture, temperature) in smart farming.</li> <li>• Focus Areas: Data ingestion from sensors, NoSQL databases, cloud storage.</li> </ul>
6	Create CASE STUDY on Big Data in Banking: Fraud Detection Systems <ul style="list-style-type: none"> <li>• Objective: Use historical transaction data to identify suspicious patterns.</li> <li>• Focus Areas: Data veracity, real-time data processing.</li> </ul>
7	Create CASE STUDY on Big Data and Public Health: COVID-19 Tracking <ul style="list-style-type: none"> <li>• Objective: Study how Big Data was used to monitor and model pandemic spread.</li> <li>• Focus Areas: Semi-structured data, global data collaboration, ethical concerns.</li> </ul>
8	Create CASE STUDY on Recommendation Engines: Netflix or Amazon <ul style="list-style-type: none"> <li>• Objective: Understand how user behavior and preferences are analyzed for content recommendations.</li> <li>• Focus Areas: Structured/unstructured data, value generation from Big Data.</li> </ul>

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**CS/GE/OE/T/250 : Ethical Hacking**

**Total Credits : 02**

**Total Contact Hours : 30 Hrs.**

**Maximum Marks : 50**

**Learning Objectives of the Course:**

- i) To introduce students to ethical hacking concepts and their importance in cyber security.
- ii) To familiarize students for techniques and security vulnerabilities.
- iii) To understand the legal and ethical considerations in hacking.

**Course Outcomes ( COs) :**

After completion of the course, students will be able to

- i) Understand the role of ethical hacking in cyber security.
- ii) Identify security vulnerabilities in systems and networks.
- iii) Understand legal and ethical aspects of hacking.

<b>Module No.</b>	<b>Topics / Actual Contents of the Syllabus</b>	<b>Contact Hours</b>
I	<b>Introduction to Ethical Hacking:</b> Definition and Importance of Ethical Hacking, Types of Hackers: White Hat, Black Hat, Grey Hat, Ethical Hacking vs. Malicious Hacking, Phases of Ethical Hacking.	10 Hrs.
II	<b>Footprinting and Exploration:</b> Information Gathering Techniques, Google Hacking & Open-Source Intelligence (OSINT), WHOIS Lookup and Social Engineering Basics, Scanning Networks (Nmap, Netstat).	10 Hrs.
III	<b>System and Network Hacking:</b> Understanding Network Security Threats, System Hacking Techniques (Password Cracking, Privilege Escalation), Wireless Network Hacking (Wi-Fi Security & Attacks), Malware Analysis (Viruses, Trojans, Keyloggers).	10 Hrs.

**References:**

1. "The Unofficial Guide to Ethical Hacking" - Ankit Fadia, Amazon.
2. "The Basics of Hacking and Penetration Testing" - Patrick Engebretson.
3. "Ethical Hacking and Penetration Testing Guide" - Rafay Baloch.