AC – 27/12/2023
Item No. – 6.8 (N)

# As Per NEP 2020

# University of Mumbai

**Title of the program**

**A-** U.G. Certificate in **Computer Science**
**B-** U.G. Diploma in **Computer Science**
**C-** B.Sc. (**Computer Science**)
**D-** B.Sc. ( Hons.) in **Computer Science**
**E-** B.Sc. (Hons. with Research) in **Computer Science**

**Syllabus for**

**Semester – I & II**

**Ref: GR dated 20th April, 2023 for Credit Structure of UG**

**(With effect from the academic year 2024-25 progressively)**

# Mandatory Courses

## Name of the Course: Digital System and Architecture

| Sr. No. | Heading | Particulars |
|---|---|---|
| 1 | **Description the course:** | **Introduction:**<br><br>The Digital Systems and Architecture course serves as a foundational exploration into the fundamental principles governing digital systems and computer architecture. This course delves into the design and organization of digital circuits and systems that form the backbone of modern computing devices.<br><br>**Relevance:**<br><br>In the era of rapid technological advancement, understanding digital systems and architecture is paramount. From smartphones to supercomputers, digital systems are pervasive. This course is essential for anyone aspiring to comprehend the inner workings of these systems and contribute to their development.<br><br>**Usefulness:**<br><br>The course equips students with the knowledge and skills to design, analyze, and optimize digital systems. It serves as a gateway for students to explore various aspects of computer architecture, laying the groundwork for more advanced studies and applications in the field.<br><br>**Application:**<br><br>Knowledge gained in this course finds practical applications in diverse domains, including embedded systems, computer networks, signal processing, and beyond. Students will learn how to translate theoretical concepts into tangible solutions, bridging the gap between abstraction and real-world implementation.<br><br>**Interest:**<br><br>Digital System and Architecture is an intellectually stimulating course that captivates students with its blend of theoretical concepts and hands-on application. The allure of creating efficient and high-performing digital systems often sparks curiosity and enthusiasm among students.<br><br>**Connection with Other Courses:**<br><br>This course establishes crucial linkages with other courses in computer science. It provides a solid |

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| | | foundation for more advanced courses such as computer organization, microprocessor systems, and hardware description languages. The knowledge gained here forms a seamless continuum in the study of computer systems.<br><br>**Demand in the Industry:**<br><br>As the demand for faster, more efficient computing systems continues to rise, professionals well-versed in digital systems and architecture are highly sought after. Industries ranging from electronics and telecommunications to automotive and healthcare actively seek individuals with expertise in designing and optimizing digital systems.<br><br>**Job Prospects:**<br><br>Graduates with proficiency in digital systems and architecture find themselves well-positioned for a myriad of career opportunities. Roles may include digital design engineer, embedded systems developer, hardware architect, and systems analyst. The skills acquired in this course open doors to a wide array of industries where digital technology plays a pivotal role. |
| **2** | **Vertical:** | Major |
| **3** | **Type:** | Theory |
| **4** | **Credits:** | 2 credits |
| **5** | **Hours Allotted:** | 30 Hours |
| **6** | **Marks Allotted:** | 50 Marks |
| **7** | **Course Objectives(CO):**<br>**CO 1.** To understand fundamentals of Logic gates, Number system and Flip Flops.<br>**CO 2.** To have an understanding of Digital System and Operation of a Digital Computer.<br>**CO 3.** To Learn Different Architecture & Organization of memory system, processor organization and control unit.<br>**CO 4.** Basic understanding of 8085 microprocessor and its applications. | |
| **8** | **Course Outcomes (OC):**<br>After successful completion of this course, students would be able to -<br>**OC 1.** Learn how number system and codes are useful in computer system design.<br>**OC 2.** Learn how Flip Flops are useful in memory design and data communication through CPU and Memory and I/O devices.<br>**OC 3.** Learn about basics of instruction sets and its types.<br>**OC 4.** Learn about Processor Internal Architecture and Design. | |

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| **9** | **Modules:-**<br>**Module 1 (15 hours):** |
| | **Fundamentals of Digital Logic:** Boolean algebra, Logic Gates, Simplification of Logic Circuits: Algebraic Simplification, Karnaugh Maps.<br><br>**Combinational Circuits:** Adders, Subtractors, Multiplexer, De-Multiplexer.<br><br>**Sequential Circuits:** Flip- Flops (SR, JK & D), Counters: synchronous and asynchronous Counter.<br><br>**Computer System:** Comparison of Computer Organization & Architecture, Computer Components and Functions, Interconnection Structures. Bus Interconnections, Input / Output: I/O Module Programmed I/O, Interrupt Driven I/O, Direct Memory Access. |
| | **Module 2 (15 hours):** |
| | **Memory System Organization:** Classification and design parameters, Memory Hierarchy, Internal Memory: RAM, SRAM and DRAM, Interleaved and Associative Memory. Cache Memory: Design Principles, Memory mappings, Replacement Algorithms, Cache performance, Cache Coherence. Virtual Memory, External Memory: Magnetic Discs, Optical Memory, Flash Memories, RAID Levels<br><br>**Instructions:** Instruction Formats, Instruction Sets, Addressing Modes, Addressing Modes Examples with Assembly Language [8085/8086 CPU].<br><br>**Processor Organization:** Structure and Function. Register Organization [8085/8086 CPU]. Basic Microprocessor operations: Data Transfer (Register / Memory) Operations, Arithmetic & Logical Operations.<br><br>Instruction Cycle, Instruction Pipelining. Introduction to RISC and CISC Architecture, Instruction Level Parallelism and Superscalar Processors, Design Issues. |
| **10** | **Text Books**<br>1. M. Mano, Computer System Architecture 3rd edition, Pearson<br>2. Carl Hamacher et al., Computer Organization and Embedded Systems, 6 ed., McGraw-Hill 2012<br>3. R P Jain, Modern Digital Electronics, Tata McGraw Hill Education Pvt. Ltd. , 4th Edition, 2010 |
| **11** | **Reference Books**<br>1. William Stallings (2010), Computer Organization and Architecture-designing for performance, 8th edition, Prentice Hall, New Jersy.<br>2. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, PearsonEducation Inc,<br>3. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHill<br>4. Ramesh Gaonkar (2013), Microprocessor Architecture, Programming and Application with 8085, $6^{th}$ edition, Penram. |

<table>
<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>Continuous Evaluation through:<br>Class Test on Module 1: 10 marks<br>Class Test on Module 2: 10 marks<br>Average of 2 Class Tests: 10 marks<br>Assignment on Module 1: 5 marks<br>Assignment on Module 2: 5 marks<br>Total of 2 Assignments: 10 marks<br>Total: 20 marks</td><td>Evaluation through:<br>A Semester End Theory Examination of 1 hour duration for 30 marks as per the paper pattern given below.<br>Total: 30 marks</td></tr>
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## Name of the Course: Fundamentals of Database Systems

| Sr. No. | Heading | Particulars |
|---|---|---|
| 1 | **Description the course:** | **Introduction:**<br><br>The Fundamentals of Database Systems course is a foundation in the study of information management and technology. It provides students with a comprehensive understanding of the principles, design, and implementation of databases, which are critical components in virtually every domain where data is utilized.<br><br>**Relevance:**<br><br>In today's data-driven world, the management and retrieval of information are paramount. This course is highly relevant as it addresses the core concepts essential for organizing, storing, and manipulating data efficiently.<br><br>**Usefulness:**<br><br>This course is immensely useful for individuals aspiring to work with data in various capacities. Whether designing databases, developing applications that interact with databases, or analyzing data trends, a solid understanding of database fundamentals is crucial.<br><br>**Application:**<br><br>The principles learned in this course find application across diverse sectors, including business, healthcare, finance, and technology. Students will gain the skills to model real-world scenarios, design efficient databases, and implement systems that store and retrieve information seamlessly.<br><br>**Interest:**<br><br>This course often attracts students due to its practical and tangible applications. The ability to structure and manage data effectively, ensuring its integrity and accessibility, can be intellectually stimulating and applicable to numerous real-world scenarios.<br><br>**Connection with Other Courses:**<br><br>This course forms a vital connection with various other courses in computer science and information technology. It is foundational to courses like database management, data warehousing, and data mining. Additionally, it complements courses related to software development, ensuring a holistic understanding of system architecture. |

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| | | **Demand in the Industry:**<br>As businesses and organizations amass ever-growing volumes of data, there is an increasing demand for professionals versed in database systems. Industries such as finance, healthcare, e-commerce, and technology actively seek individuals who can design, implement, and manage robust databases.<br>**Job Prospects:**<br>Graduates proficient in the fundamentals of database systems enjoy promising job prospects. Potential roles include database administrator, data analyst, database developer, and business intelligence analyst. These professionals play a pivotal role in ensuring the efficient and secure management of an organization's data assets. |
| **2** | **Vertical:** | Major |
| **3** | **Type:** | Theory |
| **4** | **Credits:** | 2 credits (1 credit = 15 Hours for Theory) |
| **5** | **Hours Allotted:** | 30 Hours |
| **6** | **Marks Allotted:** | 50 Marks |
| **7** | **Course Objectives(CO):**<br>**CO 1.** To make students aware fundamentals of database system.<br>**CO 2.** To give idea how ERD components helpful in database design and implementation.<br>**CO 3.** To experience the students working with database using MySQL.<br>**CO 4.** To familiarize the student with normalization, database protection and different DCL Statements.<br>**CO 5.** To make students aware about importance of protecting data from unauthorized users.<br>**CO 6.** To make students aware of granting and revoking rights of data manipulation. | |
| **8** | **Course Outcomes (OC):**<br>After successful completion of this course, students would be able to -<br>**OC 1.** To appreciate the importance of database design.<br>**OC 2.** Analyze database requirements and determine the entities involved in the system and their relationship to one another.<br>**OC 3.** Write simple queries to MySQL related to String, Maths and Date Functions.<br>**OC 4.** Create tables and insert/update/delete data, and query data in a relational DBMS using MySQL commands.<br>**OC 5.** Understand the normalization and its role in the database design process.<br>**OC 6.** Handle data permissions.<br>**OC 7.** Create indexes and understands the role of Indexes in optimization search. | |

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| **9** | **Modules**<br>**Module 1 (15 hours):** |
| | **Introduction to DBMS:** Database, DBMS – Definition, Overview of DBMS, Advantages of DBMS, Levels of abstraction, Data independence, DBMS Architecture<br><br>**Data models**: Client/Server Architecture, Object Based Logical Model, Record Based Logical Model (relational, hierarchical, network<br><br>**Entity Relationship Model and ER to Table:** Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER) Entity to Table, Relationship to tables with and without key constraints.<br><br>**DDL Statements:** Creating Databases, Using Databases, datatypes, Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, Truncating Tables<br><br>**DML statements:** Viewing the structure of a table insert, update, delete, Select all columns, specific columns, unique records, conditional select, in clause, between clause, limit, aggregate functions (count, min, max, avg, sum), group by clause, having clause |
| | **Module 2 (15 hours):** |
| | **Relational data model**: Domains, attributes, Tuples and Relations, Relational Model Notation, Characteristics of Relations, Relational Constraints - primary key, referential integrity, unique constraint, Null constraint, Check constraint<br><br>**Functions:** String Functions (concat, instr, left, right, mid, length, lcase/lower, ucase/upper, replace, strcmp, trim, ltrim, rtrim), Math Functions (abs, ceil, floor, mod, pow, sqrt, round, truncate) Date Functions(adddate, datediff, day, month, year, hour, min, sec, now, reverse)<br><br>**Joining Tables and Subqueries**: inner join, outer join (left outer, right outer, full outer)<br><br>subqueries with IN, EXISTS, subqueries restrictions, Nested subqueries, ANY/ALL clause, correlated subqueries<br><br>**Normal forms:** Functional dependencies, first, second, third, and BCNF normal forms based on primary keys, lossless join decomposition.<br><br>**Database Protection:** Security Issues, Threats to Databases, Security Mechanisms, Role of DBA, Discretionary Access Control, Backing Up and Restoring databases<br><br>**Views**: Creating, altering dropping, renaming and manipulating views<br><br>**DCL Statements:** Creating/dropping users, privileges introduction, granting/revoking privileges, viewing privileges), Transaction control commands – Commit, Rollback |

<table>
<tr><td>10</td><td colspan="2">Text Books<br>1. Fundamentals of Database System, ElmasriRamez, NavatheShamkant, Pearson Education, Seventh edition, 2017<br>2. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition,2014<br>3. Murach's MySQL, Joel Murach, 3rd Edition, 3rd Edition, 2019</td></tr>
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## Name of the Course: Computer Science Practical 1

| Sr. No. | Heading | Particulars |
|---|---|---|
| 1 | **Description the course:** | **Introduction:**<br><br>The Major Computer Science Practical Course, encompassing Digital Systems and Architecture as well as Database Systems, is a comprehensive and hands-on exploration into the foundational aspects of both hardware and software that underpin modern computing. This practical course is designed to provide students with a holistic understanding of digital systems, computer architecture, and the effective management of data within databases.<br><br>**Relevance:**<br><br>In an era where seamless integration of hardware and software is pivotal, the combination of Digital Systems and Architecture with Database Systems is highly relevant. This practical course addresses the symbiotic relationship between the two, offering students a holistic perspective on building robust computing solutions.<br><br>**Usefulness:**<br><br>This course is immensely useful for students aiming to bridge the gap between hardware and software. By integrating digital systems with database concepts, students gain a unique skill set that enables them to design, implement, and optimize computing systems comprehensively.<br><br>**Application:**<br><br>The skills acquired in this practical course find direct application in the development of efficient and integrated computing solutions. Students learn to design digital systems, optimize hardware performance, and seamlessly integrate these systems with databases to handle and manipulate data effectively.<br><br>**Interest:**<br><br>The Major Computer Science Practical Course is designed to spark interest by offering a hands-on approach to both hardware and software components. Students engage in practical exercises that involve designing digital circuits, implementing database solutions, and integrating these components, fostering a deeper understanding and appreciation for the intricacies of computing systems. |

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| | | **Connection with Other Courses:**<br><br>This practical course serves as a nexus, connecting various other courses in the computer science curriculum. It lays a foundation for advanced courses in computer organization, embedded systems, software engineering, and database management. The integrated approach ensures students comprehend the synergies between different aspects of computer science.<br><br>**Demand in the Industry:**<br><br>Professionals who can seamlessly navigate both digital systems and database management are in high demand. Industries ranging from electronics and telecommunications to software development and data analytics actively seek individuals proficient in both hardware and software aspects, recognizing the practical value of this dual expertise.<br><br>**Job Prospects:**<br><br>Graduates from this practical course enjoy promising job prospects in roles that require a holistic understanding of computing systems. Potential job titles include systems architect, database administrator, embedded systems developer, and hardware-software integration specialist. These professionals are well-positioned to contribute to diverse industries seeking comprehensive computing solutions. |
| **2** | **Vertical:** | Major |
| **3** | **Type:** | Practical |
| **4** | **Credits:** | 2 credits (1 credit = 30 Hours of Practical work in a semester) |
| **5** | **Hours Allotted:** | 60 hours |
| **6** | **Marks Allotted:** | 50 Marks |
| **7** | **Course Objectives(CO):**<br>**CO 1.** To verify the truth tables of various logic gates<br>**CO 2.** Develop proficiency in designing and implementing digital circuits.<br>**CO 3.** Explore various components of digital systems, including processors, memory units, and input/output interfaces.<br>**CO 4.** Develop skills in designing and creating relational databases.<br>**CO 5.** Explore the principles of database querying using SQL.<br>**CO 6.** Gain practical knowledge of transaction management and data control in database systems. | |

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| **8** | **Course Outcomes (OC):**<br>After successful completion of this course, students would be able to -<br>**OC 1.** Verify truth tables of various logic gates<br>**OC 2.** Simplify given Boolean expressions and implement them using Logisim.<br>**OC 3.** Design and validate the operation of various combinational circuits using Logisim.<br>**OC 4.** Understand the behavior and applications of flip-flops in digital systems.<br>**OC 5.** Design and implement expressions using multiplexers/demultiplexers in Logisim.<br>**OC 6.** Create and maintain relational databases, applying normalization principles.<br>**OC 7.** Write simple queries to MySQL related to String, Maths and Date Functions.<br>**OC 8.** Create tables and insert/update/delete data, and query data in a relational DBMS using MySQL commands.<br>**OC 9.** Handle data permissions. |
| **9** | **Modules:-**<br>**Module 1 (30 hours):** |
| | **Digital Systems & Architecture – Practical**<br><br>**Logic Gates Truth Table Verification:**<br><br>Study and verify the truth table of various logic gates (NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR) using Logisim.<br><br>**Boolean Expression Simplification:**<br><br>Simplify given Boolean expressions and realize them using Logisim.<br><br>**Half/Full Adder Design:**<br><br>Design and verify the operation of a half/full adder using Logisim.<br><br>**Half/Full Subtractor Design:**<br><br>Design and verify the operation of a half/full subtractor using Logisim.<br><br>**4-Bit Magnitude Comparator:**<br><br>Design a 4-bit magnitude comparator using combinational circuits in Logisim.<br><br>**Flip-Flop Implementation:**<br><br>Verify the operation of flip-flops (e.g., D, JK) using logic gates in Logisim.<br><br>**Counter Operation Verification:**<br><br>Verify the operation of a counter using Logisim.<br><br>**4-Bit Shift Register Operation:**<br><br>Verify the operation of a 4-bit shift register using Logisim.<br><br>**Multiplexer/Demultiplexer Design:**<br><br>Design and implement expressions using multiplexers/demultiplexers in Logisim. |

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| | **3-Bit Binary Ripple Counter:**<br>Design and implement a 3-bit binary ripple counter using JK flip-flops in Logisim.<br>The above practical can be performed using any open source simulator (like Logisim) (Download it from https://sourceforge.net/projects/circuit/) |
| | **Module 2 (30 hours):** |
| | **Fundamentals of Database Systems – Practical**<br>**Conceptual Design Using ER Diagrams:**<br>Identify entities, attributes, keys, and relationships. Apply generalization and specialization.<br>**Database Management Operations:**<br>View all databases, create a database, view all tables in a database, create tables with and without constraints, perform CRUD operations.<br>**Table Management Operations:**<br>Alter a table, drop/truncate/rename tables, perform backup/restore operations on a database.<br>**Basic Queries and Aggregate Functions:**<br>Execute simple queries and utilize aggregate functions (e.g., COUNT, SUM, AVG).<br>**Advanced Query Functions:**<br>Utilize date, string, and math functions in queries.<br>**Join Queries:**<br>Execute inner and outer join queries.<br>**Subqueries:**<br>Apply subqueries with IN and EXISTS clauses.<br>**ER Model to Relational Model Conversion and Normalization:**<br>Convert ER model to a relational model and apply normalization up to 3rd Normal Form.<br>**Views:**<br>Create views with and without check options, drop views, select data from views.<br>**Data Control Language (DCL) Statements:**<br>Implement DCL statements for granting and revoking permissions. Demonstrate COMMIT and ROLLBACK statements.<br>These experiments can be implemented using a database management system like MySQL. |

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<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of 20 marks.<br>Total: 20 marks</td><td>A Semester End Practical Examination of 2 hours duration for 30 marks as per the paper pattern given below.<br><br>Certified Journal is compulsory for appearing at the time of Practical Exam<br>Total: 30 Marks</td></tr>
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