Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-IV													
23BTCSL203	Computer Architecture and Organization	PCC8	4			4	4	10	15	50			75
23BTCSL202/ 23BTCSP202	Database Management Systems	PCC5	3		2	5	4	10	15	50	25	25	125
UNXXL2XX	Multi-Disciplinary Minor:	MD M2	2			2	2	10	15	50			75
23BTCSL221	Open elective -II	OE2	2			2	2	10	15	50			75
UNXXL2XX / UNXXP2XX	Vocational and Skill Enhancement Elective -III	VSEC3	1		2	3	2	10	15		25		50
UNHUL202/ UNHUP202	Aptitude & Employability Skills	AEC2	1		2	3	2	10	15		25		50
UNHUL203	Entrepreneurship Development Practices	EEMC2	2	-	-	2	2	10	15	50	-	-	75
UNHUL204	Universal Human Values 2 : Understanding Harmony	VEC2	2			2	2	10	15	50			75
TOTAL			**17**	**-**	**6**	**23**	**20**	**80**	**120**	**300**	**75**	**25**	**600**

Title: **Computer Architecture and Organization**										
Semester	IV	Course Title: Computer Architecture and Organization								
Term	OddEven	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Course Category	PCC8	Th	Tu	Pr	Credits	TAE	CAE	ESE	Int	Ext
Course Code	23BTCSL203	4	-	-	4	10	15	50	-	-
Teaching Mode	Offline									

Course Objectives	To understand the design principles of digital computing systems
	To provide an essential understanding of different subsystems of modern computer system and design aspects of these subsystems3
	To provide an overview of performance enhancement methods in instruction Execution
Course Outcomes	CO1: To describe the basic components and design of a computer system
	CO2: To examine the issues involved in the instruction execution and various stages of instruction life stage
	CO3: To apply the concept of various memories and interfacing technologies
	CO4: To analyze the different parallel processing technique
	CO5: To design different high-performance computing architecture

Mapping of Course Outcomes with Program Outcomes and Program-Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3												3		
CO2		3											2		
CO3		3											2		
CO4			3										3		
CO5			3											3	

Course Contents:

Unit	Contents	Hours
I	Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU –registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set, Instruction set architecture CISC, RISC, Case study: Instruction sets of common CPUs	8
II	Data representation method, IEEE standard: single and double precision format and examples, Fixed point Addition, Subtraction, Multiplication, and Division. Floating Point Arithmetic, High-performance arithmetic. Booth's algorithm: Multiplication & Division	8
III	Memory hierarchy, Memory Chip Organization, Cache memory, and Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, DMA, Serial Bus Architectures, Mass storage, Input and Output Devices, Segmentation, TLB	8
IV	An Overview of Pipelining: Basic concepts of Pipelining, Pipelined Datapath, and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Arithmetic and Instruction Pipeline, throughput and speedup, pipeline hazards.	8
V	CPU control unit design: hardwired and micro-programmed design approaches, Case study: Von Neumann Architecture, Design of a simple hypothetical CPU, Multicore processors architecture, Simple MIPS Processor Components, Designing a Datapath for a Simple Processor	8

Text Books	1.	Computer Organization and Architecture by Carl Hamacher 4th Edition
	2.	Advance computer Architecture by Kai Hwang under Tata McGraw Hill Publications
	3.	Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop
EBooks	1.	Computer Architecture and Organization by William Stalling http://home.ustc.edu.cn/~leedsong/reference_books_tools/Computer%20Organization%20and%20Architecture%2010th%20-%20William%20Stallings.pdf
Reference Books	1.	Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare By PHI Publications
	2.	Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
	3	Parallel Computers – Architecture and Programming by V. Rajaraman And C. Siva Ram Murthy.
	4.	Introduction to Parallel Programming by Steven Brawer
On-line TL Material	1.	NPTL https://nptel.ac.in/courses/106/105/106105163/

Course Title: **DATABASE MANAGEMENT SYSTEM**										
Semester	IV	Teaching Scheme				Evaluation cheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC5	2 Hrs.	1 Hr.	2	4	10	15	50	25	25
Course Code	23BTCSL202									
Teaching Mode	Offline	3 Hrs			Total	75			50	
Duration of ESE	2 Hrs					12 55				

Course Objectives	This course introduces general idea of database management system, also gives idea to design databases using data modeling and design techniques.
	It is also aimed to developing skills to implement real life applications which involve database handling.
	This course also provide carrier opportunities in subject areas of designing, storage techniques and data handling and managing techniques
Course Outcomes	**CO1**: Analyze an information storage problem and derived an information model expression in the form of Entity relation diagram and design appropriate data model for it.
	CO2: Demonstrate SQL queries to perform CRUD (Create, Retrieve, Update, Delete) operations on database and perform inferential analysis of data model
	CO3: Identify features of database management systems and Relational database and Understand functional dependencies and various normalization forms
	CO4: Perform basic transaction processing and m nagement and ensure database security, integrity and concurrency control
	CO5: Analyze the management of structured and unstructured data management with recent tools and technologies

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	--	--	3	--	3	--	--	--	--	--	--	--	2	--
CO2	--	--	3	3	--	--	--	--	--	--	--	--	3	--
CO3	--	2	3	--	--	--	--	--	--	--	--	--	--	3
CO4	--	--	3	2	--	--	--	--	--	--	--	--	2	--
CO5	--	--	2	--	3	--	--	--	--	--	--	--	2	--

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Unit	Contents	Hours
I	Introduction to DBMS - DBMS Architecture, Data Models, E-R Diagram, Relational Database design:	6
II	SQL Concepts - Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types.	8
III	Functional Dependency (FD) – Basic concepts, closure of set of FD, closure of attribute set, Decomposition, Normalization – 1NF, 2NF, 3NF, BCNF, 4NF	5
IV	Transaction control commands – Commit, Rollback, Save point. Transaction Management: Transaction concepts, properties of transactions, serializability of transactions, Two- Phase Commit protocol, Deadlock, two-phase locking protocol. Cursors, Stored Procedures, Stored Function, Database Trigger, Database recovery.	7
V	Indexing and hashing, Query processing, Query Optimization, Data Mining, Advances in databases	4

Text Books	1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002.
	2.	Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.
E-Books	1.	https://ebooks.lpude.in/computer_application/mca/term_1/DCAP204_MANAGING_DATABASE_DCAP402_DATABASE_MANAGEMENT_SYSTEMS.pdf
Reference Books	1.	G. K. Gupta :"Database Management Systems", McGraw – Hill.
	2.	Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O'Reilly Media 2017.
	3.	Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018.
	4.	RamezElmasri and ShamkantNavathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.
online TL Material	1.	https://nptel.ac.in/courses/106/105/106105175/

Course Title: **Multidisciplinary Minor II:Data Structure Using C**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MD M2 23BTCSL204	2	--		2	10	15	50		
Course Code										
Teaching Mode	Offline	2			Total	75				
Duration of ESE						75				

Course Objectives	This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
	It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
	The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.
Course Outcomes	CO1: choose appropriate data structure as applied to specified problem Definition Analyze various techniques for searching, Sorting and Hashing.
	CO2: Illustrate linear arrays and linked lists, including operations such as insertion, deletion, traversal, sorting, and searching.
	CO3: to apply concepts Analyze various techniques for searching, Sorting and Hashing
	CO4: to use linear and non-linear data structures like stacks, queues, linked list..
	CO5: Understand the basics of Graphs as non-linear data structures.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1		3	2	3									1	
CO2		2	3	3									2	
CO3		3	3	3									2	1
CO4		3	3	3									3	2
CO5		3	3	2									3	1

Course Contents:

Unit	Contents	Hours
I	Enumerated, Structure ,and Union Types– The Type Definition (typedef), Enumerated types, Structures –Declaration, initialization, accessing structures, operations on structures, Complex structures, structures and functions, Passing structures through pointers, self referential structures, unions, bit fields, C programming examples	6
II	Data Structures – Introduction to Data Structures, abstract data types. Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, circularly linked lists- Operations for Circularly linked lists, doubly linked list implementation, insertion, deletion and searching operations, applications of linked lists.	6
III	Stack ADT- definition, operations, array and linked implementations in C, applications- infix to postfix conversion, Postfix expression evaluation, recursion implementation. Queue ADT- definition and operations, array and linked Implementations in C, Circular queues Insertion and deletion operations	6
IV	Searching and Sorting – Searching-linear and binary search methods Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort comparison of sorting and searching methods.	6
V	Trees – Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, applications of trees.	6

Text Books	1.	AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.
	2.	THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.
	3.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.
	4.	Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan AndersonFreed, Universities Press.
E--Books	1.	https://apps2.mdp.ac.id/perpustakaan/ebook/Karya%20Umum/Dsa.pdf
Reference Books	1.	Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
	2.	Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson
	3.	MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)
	3.	Wirth, N., "Algorithms and Data Structures", Prentice-Hall of India.
On-line TL Material	1.	https://nptel.ac.in/courses/106/102/106102064/
	2.	http://cse01-iiith.vlabs.ac.in/
	3.	https://ds2-iiith.vlabs.ac.in/data-structures-2/

Course Title: **Vocational & Skill Enhancement Elective-III: Principals of Object Oriented Programming**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	1 Hrs.	-	2 Hrs.	2	10	15		25	-
Course Code	23BTCSL205									
Teaching Mode	Offline	3 Hrs.			TOTAL	25			25	
Duration of ESE	NA					50				

Course Objectives	1. This course introduces student's general idea and concepts of object-oriented programming.
	2. It is also aimed at developing skills to implement these concepts.
	3. The course provide carrier opportunities in design of some applications as object-oriented concepts plays dominant role in software development
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Articulate the principles of object-oriented programming.
	CO2: Develop the basics of C++ programming.
	CO3: Implement the object oriented programming in terms of classes and objects.
	CO4: Implement constructors, destructors and operator overloading for software Development.
	CO5: Apply Inheritance and Polymorphism for generic programming applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO3	--	--	2	2	--	--	--	--	--	--	--	--	3	--	--
CO4	--	--		2	--	--	--	--	--	--	--	--	2	--	--
CO5	--	--		2	--	--	--	--	--	--	--	--	2	--	--

Course Contents:

Unit	Contents	Hours
I	**Principles Of Object-Oriented Programming:** Principles of Object Oriented Programming (OOP), Software Evaluation, A Look at Procedure Oriented Programming, OOP Paradigm, Basic Concepts of OOP, Benefits of OPP, Application of OOP.	5
II	**Introduction to C++** What is C++, A simple C++ Program, More C++ statements, Structure of C++ Program., Tokens , Keywords, Identifiers and Constants, C++ data types, Variables: Declaration, Dynamic initialization of variables, Reference variables, Operators in C++ : Scope resolution operator, Member deferencing Operators, Memory Management Operators, Manipulators, Type cast operators, Expressions and Control Structures.	5
III	**Classes and Objects:** Introduction, Specifying a Class, Defining member Functions, C++ Program with Class, Nesting of Member functions, Private member functions, Memory Allocation for Objects, Static Data members, Static Member Functions, Arrays within a Class, Arrays of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects.	5
IV	**Constructors, Destructors and operator Overloading:** Constructors, Parameterized Constructors, Multiple Constructors in a class, Copy constructor, Destructors, Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Type Conversions.	5
V	**Inheritance and Polymorphism:** Introduction, Defining Derived Classes, Single inheritance, Multiple inheritance, Hierarchical inheritance, Multilevel inheritance, Hybrid inheritance, Virtual Base Classes, Polymorphism, static and dynamic binding, Constructor in Derived Classes, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions.	5

Text Books	1.	Object Oriented Programming in C++ -Robert Lafore, edition, Galgotia publications
	2.	The Complete Reference C++, Herbert Schildt, 4th Edition, TMH
E--Books	1.	Cryptography & network security by atul kahate https://www.pdfdrive.com/cryptography-network-security-by-atul-kahate-e124796757.html
Reference Books	1.	Let's C++ by Y. Kanetkar, BPB publications
	2	Object oriented programming with C++, E Balagurusamy, 4th edition, TMH