VANITA VISHRAM WOMEN'S UNIVERSITY

(Managed By: Vanita Vishram, Surat)

1st Women's University of Gujarat

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

5 YEARS INTEGRATED M.SC. (IT)

SYLLABUS

AS PER NEP-2020

W.E.F 2023-24

INDEX

1 PREAMBLE – VVWU

Vanita Vishram Women's University (VVWU) is the First-ever Women's University of Gujarat approved by the Government of Gujarat under the provisions of the Gujarat Private Universities Act, 2009. It is a university committed to achieve Women's Empowerment through Quality Education, Skill Development, and by providing employment opportunities to its girl students through its model curriculum, integration of technology in pedagogy and best-in-class infrastructure. The focus is on prioritizing practical component and experiential learning supported through academia-industry linkages, functional MoUs, skill development training, internships etc. It aims at providing opportunities to the girl students for holistic development and self-reliance.

VISION

Empowerment of women through quality education and skill development, so as to make them strong pillars of stability in the society.

MISSION

To provide Education & Professional Training to all women for their all-round development, so as to enable them to become economically independent and socially empowered citizens.

2 SALIENT FEATURES

- Based on NEP-2020 & CBCS
- Interdisciplinary as well as multidisciplinary.
- Practical-oriented, skill-based & vocation-based.
- Based on experiential learning.
- Greater exposure to internship, hands-on training, project work, field work, presentation etc.
- Mode of teaching shall be Offline)
- Qualified & Competent Faculty Members for effective teaching-learning
- Employment-Generating

3 INTRODUCTION OF THE PROGRAM

Master of Science in Information Technology is an integrated program offered by VVWU, Surat in Academic Year 2023.This program has a five-years duration with two semesters per year. The program is designed to meet the growing demand for IT professionals who can effectively navigate and contribute to the rapidly evolving technological landscape.

4 OBJECTIVE OF THE PROGRAM

The objective of the program is to provide necessary knowledge skills and foundation for acquiring a wide range of career in to the rapidly expanding world of Information Technology. To make the students industry ready in reputed IT Companies.

5 PROGRAM OUTCOME (POs)

PO 1. **Enhancement of Fundamental Knowledge**

Program enables students to enhance the knowledge in the domains of core computer science and Information Technology (IT). It also makes students capable of using core concepts in the conceptualization of domain specific application development.

PO 2. **Development of Critical Thinking**

The program develops the skills of critical thinking, problem solving, evaluative learning of various techniques, and understanding the essence of the problem.

PO 3. **Advanced Emerging Technology and Industrial Awareness**

The program trains students with the latest technologies that is being used in the industry. The continuous syllabus review adds value to the program for the outgoing students and make them ready to face challenging demands of the industry.

PO 4. **Utilization of Advanced Tools**

The students are able to apply the knowledge of advanced tools to solve the real world problems.

PO 5. **Project Planning and Management Capabilities**

The program enables students for designing and conceptualizing the software architecture, planning and managing the product development process of complex and live software projects. It also makes students understand the decision making for selection of an appropriate project management capabilities.

PO 6. **Real World Problem / Project Development**

Real world project provides the candidates exposure to work in the challenging

and demanding environment training makes students employable and industry ready.

PO 7. **Team Work and Leadership Development**

Enables the students to work in a team and also to take leadership of the project management team.

6 PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon completion of the Integrated M.Sc. IT program, the students would:

PSO 1. Students will learn to develop and strengthen the fundamental concepts that are required to solve complex programming problems.

PSO 2. Students can enable analyze identify and prepare physical solutions for the given challenges.

PSO 3. Students will be able to apply the concept of project management to solve a real-world problem using software engineering.

PSO 4. Students will be able to learn emerging technologies and apply them for the development of Web applications, Mobile application, etc.

PSO 5. Students will develop necessary Entrepreneur and Technical skills to start their own startup programs in the field of IT.

7 PROGRAM HIGHLIGHTS:

Program Level	Integrated					
Program	Master in Science Information Technology					
Duration	5 years (10 semesters)					
Examination Type	Semester system (1-10 semesters)					
Intake	200					
Eligibility	10 + 2 in Science stream with A, B or AB group or Commerce					
Mapping between POs and PSOs		PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
	PO 1.					
	PO 2.					
	PO 3.					
	PO 4.					
	PO 5.					
	PO 6.					
	PO 7.					
Job Positions	Project Manager, IT Manager, System Analyst, Technical Leaders, Software Consultant, Database Designer, Database Administrator, Application Programmer, Network Planning Manager, etc.					

8 SCHEME OF ASSESSMENT

Following is the scheme of assessment followed by the university –

Weightage (%)	Credit	Continuous Comprehensive Evaluation (CCE) (50%)	Semester End Evaluation (SEE) (50%)
100%	4	[Internal Exam] **(20)** + [1. Assignments/2. Project Work/ 3. Field Work/4. QUIZ / 5. group discussion/6. Role Play/ 7. (Lab Record/Lab Performance/Lab Work)/ 8. (Seminar/Class Performance/Poster Presentation) / 9. Viva-Voice/ 10. Book Review or Article Review/ 11. Case Studies/ 12. Class Test/ 13. Report Writing/ 14. Any other as per the requirement of the subject] (Any Two) (Thread-01 + Thread-02) **(10 + 10)** + [Attendance] **(10)**	Semester End Evaluation (SEE) Theory Exams Whole Syllabus
100%	2	[Internal Exam] **(20 - Converted into 10 at the time of marks entry)** + [1. Assignments/2. Project Work/ 3. Field Work/4. QUIZ / 5. group discussion/6. Role Play/ 7. (Lab Record/Lab Performance/Lab Work)/ 8. (Seminar/Class Performance/Poster Presentation) / 9. Viva-Voice/ 10. Book Review or Article Review/ 11. Case Studies/ 12. Class Test/ 13. Report Writing/ 14. Any other as per the requirement of the subject] (Any One) (Thread-01) **(10)** + [Attendance] **(5)**	Semester End Evaluation (SEE) Theory Exams Whole Syllabus

9 CREDIT STRUCTURE

5 Years Integrated M.Sc. IT Credit structure for 2023 - 24									
According to Curriculum and Credit Framework for Integrated Programs									
Semester	**Discipline Specific Course (Major)**	**Discipline Specific Elective (Minor)**	**Multi-Disciplinary**	**Ability Enhancement Course (AEC)**	**Skill Enhancement Course (SEC)**	**Value Added Courses (VAC)/IKS**	**Summer Internship/ Project/ Online Course**	**Dissertation**	**Total**
1	8	4	4	2	2	2	0	0	22
2	8	4	4	2	2	2	0	0	22
3	12	0	4	2	2	2	0	0	22
4	12	4	0	0	2	2	0	0	22
5	12	8	0	2	2	0	0	0	22
6	12	4	0	0	4	0	0	0	22
Total	**64**	**24**	**12**	**10**	**14**	**8**	**0**	**0**	**132**
7	18	0	0	0	0	0	4	0	22
8	18	0	0	0	0	0	4	0	22
9	18	0	0	0	0	0	4	0	22
10	22	0	0	0	0	0	0	0	22
Total	**76**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**88**
Grand Total	**140**	**24**	**12**	**10**	**14**	**8**	**12**	**0**	**220**
* If anyone wants to exit after 2nd/ 4th Sem and wants a certificate/Diploma respectively, should complete an internship of 4 credits (60 hrs.)									

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SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

INTEGRATED M.SC. (IT)

SEMESTER 2

SYLLABUS

AS PER NEP-2020

W.E.F 2023-24

10 COURSE STRUCTURE – PAPER TITLES SEMESTER 1

Integrated Course structure for year – 2023								
Sem	**Discipline Specific Course (Major)**	**Discipline Specific Elective (Minor)**	**Multi-Disciplinary**	**Ability Enhancement Compulsory (AEC)**	**Skill Enhancement Courses (SEC)**	**Value Added Courses (VAC) / IKS**	**Summer Internship/ Project/ Online Course**	**Dissertation**
1	Advanced C Programming (Theory) Advanced C Programming (Practical) Operating System with UNIX (Theory) Operating System with UNIX (Practical)	Advanced Database Management System (Theory) Advanced Database Management System (Practical)	Foundation of Discrete Mathematics	Functional English-II	Microprocessor and Embedded System	Environmental Studies	-	-

11 TEACHING AND EVALUATION SCHEME FOR INTEGRATED M.SC. (IT) ACADEMIC YEAR 2023-24

Semester	Course Code	Course Category	Course Title	Offering Department	Teaching Scheme				Examination Scheme													
					Contact Hour			Total Credit	Theory						Practical						Total Marks	Total Credits
										CCE		SEE				CCE		SEE				
					Theory	Practical	Total		Credit	Max.	Passing	Max.	Passing	CCE+SEE Passing	Credit	Max.	Passing	Max.	Passing	CCE+SEE Passing		
2	ITM203-1C	Discipline Specific Course (Major)	**Advanced C Programming (Theory)**	Computer Science	2	0	2	4	2	25	9	25	9	18	0	0	0	0	0	0	50	4
		Discipline Specific Course (Major) - Practical	**Advanced C Programming (Practical)**	Computer Science	0	4	4		0	0	0	0	0	0	2	25	9	25	9	18	50	
	ITM204-1C	Discipline Specific Course (Major)	**Operating System with UNIX (Theory)**	Computer Science	2	0	2	4	2	25	9	25	9	18	0	0	0	0	0	0	50	4
		Discipline Specific Course (Major) - Practical	**Operating System with UNIX (Practical)**	Computer Science	0	4	4		0	0	0	0	0	0	2	25	9	25	9	18	50	
	ITE202-1C	Discipline Specific Elective (Minor)	**Advanced Database Management System (Theory)**	Computer Science	2	0	2	4	2	25	9	25	9	18	0	0	0	0	0	0	50	4

		Discipline Specific Elective (Minor) - Practical	**Advanced Database Management System (Practical)**	Computer Science	0	4	4		0	0	0	0	0	0	2	25	9	25	9	18	50	
	MDC202-1C	Multi-Disciplinary	**Foundation of Discrete Mathematics**	Computer Science	4	0	4	4	4	50	18	50	18	36	0	0	0	0	0	0	100	4
	AEC202-1C	Ability Enhancement Course (AEC)	**Functional English-II**	Computer Science	2	0	2	2	2	25	9	25	9	18	0	0	0	0	0	0	50	2
	SEC202-1C	Skill Enhancement Courses (SEC)	**Microprocessor and Embedded System**	Computer Science	2	0	2	2	2	25	9	25	9	18	0	0	0	0	0	0	50	2
	VAC201-1C	Value Added Courses (VAC) / IKS	**Environmental Studies**	Computer Science	2	0	2	2	2	25	9	25	9	18	0	0	0	0	0	0	50	2
				TOTAL	-	-	-	22	16	-	-	-	-	-	6	-	-	-	-	-	550	22

12 SYLLABUS: SEMESTER 2

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
ITM203-1C: Advanced C Programming (Theory)

Credit 4 **Contact Hours per week 2**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Discipline Specific Course (Major)
Purpose of Course	To study advance concepts about computer programming to explore and develop detail skills of programming.
Course Objective	Enable students to understand ● Introduce students to the essentials of computer Programming and programming methodology using structure, Union, Pointers, User Defined Functions and File management of C language. ● Apply various advanced programming constructs. ● Understand library and user defined functions.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	NIL
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. Introduction of Functions** 1.1 User Defined Functions 1.2 Structure of UDF 1.3 Function Prototype 1.4 Types of UDF 1.5 Recursive Function, Call by Reference & Call by Value 1.6 Variable Scope, Visibility and lifetime in function, Storage Classes 1.7 Command Line arguments	30%	10
2	**Unit 2. Structure & Union** 2.1 Defining Structure 2.2 Accessing a structure variable 2.3 Array of Structure and Array within structure 2.4 Defining Union 2.5 Comparison between Structure and Union.	25%	08
3	**Unit 3. Pointers** 3.1 Introduction to Pointers 3.2 Declaration and initialization 3.3 Pointer Arithmetic, Null pointers 3.4 Array and String using pointers. 3.5 Memory Allocation Function : malloc(), calloc(), recalloc(), Free()	25%	08
4	**Unit 4. File Management** 4.1 Defining and opening a file, Closing Files, Input/output Operations on Files. 4.2 Random Access and Sequential access to Files	20%	04

REFERENCE

Core references:

1. Programming in C, Balaguruswami – TMH
2. Let us C - 17th Edition, Yashavant Kanetkar, BPB Publication, Noida
3. C Language Programming – Byron Gottfried – TMH
4. The C Programming Language, Brian Kernigham & Dennis Ritchie, Prentice Hall Publications
5. C: The Complete Reference, Herbert Schildt, McGraw Hill Publications, Noida

Reference books:

1. C Programming Language, Kernigham& Ritchie – TMH
2. Programming in C, Stephan Kochan – CBS
3. Mastering Turbo C, Kelly & Bootle – BPB
4. Problem Solving with C, Somashekara – PHI

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	On completion of this course, student will understand the advanced concepts of C programming such as pointer, structure, union, UDF to design programs.
CO 2.	Ability to design and develop Computer programs, related to file management in C programs.
CO 3.	Interprets the concept of pointers, declarations, initialization, operations on pointers
CO 4.	Solve computational problems and file handling using C program using basic C language Constructs.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1.	CO 2.	CO 3.	CO 4.
1	Introduction of Functions				
2	Structure & Union				
3	Pointers				
4	File Management				

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					
CO 4.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
Advanced C Programming (Practical)
Contact Hours per week 4

Outline of the Course:

Course type	Practical
Level of the Course	200-299 Intermediate-level
Course Category	Discipline Specific Course (Major) - Practical
Purpose of Course	**ITM203-1C: Advanced C Programming** ● Practical implementation of program covered as part of syllabus using required software and learning programming areas. ● Understanding and learning User defined Function, Structure, Union, Pointer and File Management.
Course Objective	**ITM203-1C: Advanced C Programming** ● Introduce students to the essentials of computer Programming and modular programming methodology using C language. ● Analyze C language code that uses pointer, File Handling. ● Apply various programming constructs. ● Understand library and user defined functions.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Basic of Programming, Spreadsheet and Database
Teaching Methodology	Lab work
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	On completion of this course, student will understand the advanced concepts of C programming such as pointer, structure, union, UDF to design programs.
CO 2.	Ability to design and develop Computer programs, related to file management in C programs.
CO 3.	Interprets the concept of pointers, declarations, initialization, operations on pointers
CO 4.	Solve computational problems and file handling using C program using basic C language Constructs.

COURSE ARTICULATION MATRIX

	PSO 1.	**PSO 2.**	**PSO 3.**	**PSO 4.**	**PSO 5.**
CO 1.					
CO 2.					
CO 3.					
CO 4.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
ITM204-1C: Operating System with UNIX (Theory)

Credit 4 **Contact Hours per week 2**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Discipline Specific Course (Major)
Purpose of Course	To studying basic about Operating System to explore concepts and develop basic skills of operating System and Unix operating System.
Course Objective	Enable students to understand ● To understand functionality of Operating System. ● To make students aware with basic concepts of Unix OS.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Basic Computer Fundamental
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. OS Introduction & Memory Management** 1.1 History Operating, Need of an Operating System, 1.2 Types & Function of Operating System, 1.3 Memory Management: Memory Allocation Techniques, 1.4 virtual Memory, Page replacement, 1.5 Thrashing.	30%	08
2	**Unit 2. Process & File Management** 2.1 Process Concept, process state diagram, PCB, 2.2 CPU Scheduling Algorithm, IPC, 2.3 Deadlocks: Prevention, Avoidance, Detection, Recovery, 2.4 File System: File Concept, Operations on File, File Access Methods, 2.5 Introduction of Directory Structure organization.	20%	07
3	**Unit 3. Introduction to UNIX Basics** 3.1 Overview of UNIX Architecture, 3.2 Directory Structure of UNIX, 3.3 Role & Function of Kernel and Shell, System Calls, 3.4 Basic UNIX commands, 3.5 Filters and Advanced filters commands	30%	08
4	**Unit 4. UNIX file system and Shell Programming** 4.1 Inode and File Structure, 4.2 File System Structure and Features, 4.3 File Access Permissions (chmod), 4.4 Display Beginning and End of files, Translating Characters, 4.5 Basic Shell Scripting.	20%	07

REFERENCE

Core references:

1. Modern Operating System 3rd Edition, 2008- Andrew Tanenbaum-PHI
2. Operating System Concepts, 6rd Edition, James Peterson Wesley Abraham Silberschatz- JOHN WILEY & SONS. INC
3. Operating System Concepts: – James Peterson: – McGraw Hill
4. Operating System: – Stallings – PHI
5. Operating System Principles: – Silberschatz, Galvin, Gagne - Willey, India

Reference books:

1. Operating Systems – A. S. Godbole – Tata McGraw Hill
2. Linux – The Complete Reference – Richard Petersen – Tata McGraw Hill
3. Linux –Application and administration, 2009 Edition, Ashok Kumar Harnal, TMH
4. Unix Concepts and Application- Sumitabha Das-MGH
5. Operating systems- Dhamdhere-MGH

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Learn the concepts of Operating System and its need for computer System. Students will know how the computer system internally work. Learn the concepts of Memory and its significance in computer System.
CO 2.	Students can Learn the multiple Process runs under the Computer System and how it executed. They work with OS File System and Directory Structure.
CO 3.	Learn the Unix OS and its interfaces and basic utilities.
CO 4.	Students are able to run the Unix and its various commands in Practical approach.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1	CO 2	CO 3	CO 4
1	OS Introduction & Memory Management				
2	Process & File Management				
3	Introduction to UNIX Basics				
4	UNIX file system and Shell Programming				

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					
CO 4.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
Operating System with UNIX (Practical)
Contact Hours per week 4

Outline of the Course:

Course type	Practical
Level of the Course	200-299 Intermediate-level
Course Category	Discipline Specific Course (Major) – Practical
Purpose of Course	**ITM204-1C: Operating System with UNIX** ● Practical implementation of program covered as part of syllabus using required software and learning Operating System areas. ● Understanding and learning basic concepts of UNIX operating System, commands, shell programming basics.
Course Objective	**ITM204-1C: Operating System with UNIX** ● To understand functionality of Operating System using UNIX. ● To make students aware with basic concepts of UNIX OS. ● Apply various programming constructs by shell scripts. ● Understand commands for filters and advanced filters.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Basic knowledge of Computer System
Teaching Methodology	Lab work
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Learn the Unix Operating System environment and work on it.
CO 2.	Students can Learn the various commands and basic scripting practically to operate the system and application programs.

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester I
ITE202-1C: Advanced Database Management System (Theory)

Credit 4 **Contact Hours per week 2**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Discipline Specific Elective (Minor)
Purpose of Course	• This course imparts the knowledge of Advanced Database Management System, specifically database normalization. Understanding of PL/SQL block structure. • To teach the emerging trends in NoSQL databases MongoDB course will helps to understand & learn the leading document-oriented NoSQL database, Schema Design, Data Modelling, and Indexing.
Course Objective	• To impart knowledge of NoSQL Databases With the large volume of unstructured data on various platforms, it is becoming difficult to manage voluminous unstructured data. • Existing Relational Database Management Systems are expensive and not in a position to support these unstructured data. • NoSQL database technology is now getting popularity to manage these voluminous unstructured data. • The objective of this course is to make candidates familiarize with NoSQL database Technology and give some hands-on on one of the most popular NoSQL database MongoDB.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Fundamentals of DBMS
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. Database Design and Advanced SQL** 1.1 Database design and Extended ER Model: 1.1.1 Extended E-R features, Generalization, Specialization 1.1.2 Normalization: 1NF, 2NF, 3NF 1.2 Introduction to UML 1.3 Join Queries: 1.3.1 Inner Join, Outer Join (Left, Right, Full), self-Join 1.3.2 Subqueries 1.3.3 Correlated subqueries 1.4 Introduction to Transactions Management 1.4.1 Commit, Rollback, Savepoint 1.4.2 GRANT and REVOKE OPTION	20%	06
2	**Unit 2. The PL/SQL Block** 1.1 PL/SQL Block structure 1.2 Cursors 2.2.1 Types of Cursors - Explicit & Implicit Cursors 2.2.2 Cursor for loops 1.3 Sub Program 2.3.1 Procedures and Functions 1.4 Triggers, Packages	20%	06
3	**Unit 3. NoSQL Database-MongoDB** 3.1 Concepts and Characteristics of NoSQL databases 3.2 Overview of non-relational databases 3.3 Types: document-oriented, key-value, column-family, graph databases 3.4 Introduction to MongoDB 3.4.1 Features and Scope of MongoDB 3.4.2 The Document Data Model 3.4.3 Documents and Collections 3.4.4 Mongo Shell 3.4.5 Installation and Configuration of MongoDB	30%	09
4	**Unit 4. MongoDB Databases** 4.1 Working Database – create, drop 4.2 Working with collections – create, drop 4.3 Working with Document – 4.4.1 Adding batch of document, find document, 4.4.2 Modify document, find selected fields, removing document 4.4 Indexing 4.5 Writing to Shards 4.6 MongoDB as a File System	30%	09

REFERENCE

Core references:

1. Henry Kroth & Silbershats, Database System Concept.
2. C.J. Date, Introduction to Database Design, Addition Wesley, Nasora.
3. MongoDB: The Definitive Guide - Powerful and Scalable Data Storage, Shroff/O'Reilly; Third edition
4. Chodorow, K. (2013). MongoDB: The Definitive Guide (2nd ed.). Upper Saddle River, NJ: Pearson Education, Inc. ISBN-13: 978-1449344689 ISBN-10: 1449344682.
5. Shashank Tiwari, Professional NoSQL, Sierra Nevada Books, ISBN13: 978-0470942246
6. Amol Nayak, Instant MongoDB, Packt Publishing Limited, 2013, ISBN13: 978-1782169703

Reference books:

1. Martin Gruber, Understanding SQL, BPB Pub., New Delhi. 4. Ivan Baross, SQL, PL/SQL The Programming Language of ORACLE, BPB Pub., New Delhi.
2. James Martin, Computer Database Organization, PHI, New Delhi.
3. Kristina Chodorow, MongoDB Definitive Guide 2e, O'Reilly, 2013, ISBN-13: 978-1449344689
4. MongoDB Fundamentals: A Hands-on Guide to Using MongoDB and Atlas in the Real World - by Amit Phaltankar, Juned Ahsan, and Micha
5. MongoDB: The Definitive Guide: Powerful and Scalable Data Storage 3rd Edition, O'Reilly Media, Inc. 9781491954461
6. MongoDB and Python, by Niall O'Higgins, Released September 2011, Publisher(s): O'Reilly Media, Inc., ISBN: 9781449310370

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Students will gain proficiency in designing efficient and normalized databases, and develop advanced SQL skills for complex data manipulation and retrieval.
CO 2.	The PL/SQL Block course outcomes include proficiency in writing and executing blocks of procedural SQL code for Oracle databases.
CO 3.	Proficiency in designing and implementing MongoDB databases for efficient data storage, retrieval, and management in NoSQL environments.
CO 4.	Develop proficiency in designing and managing MongoDB databases for efficient and scalable NoSQL data storage solutions

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1.	CO 2.	CO 3.	CO 4.
1	Database Design and Advanced SQL				
2	The PL/SQL Block				
3	NoSQL Database-MongoDB				
4	MongoDB Databases				

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					
CO 4.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
Advanced Database Management System (Practical)
Contact Hours per week 4

Outline of the Course:

Course type	Practical
Level of the Course	200-299 Intermediate-level
Course Category	Discipline Specific Course (Major) - Practical
Purpose of Course	**ITE202-1C: Advanced Database Management System** • To provide students with hands-on experience and practical skills in designing, implementing, and managing complex database systems. • Emphasizes real-world application and problem-solving.
Course Objective	**ITE202-1C: Advanced Database Management System** • The course aims to equip students with the practical skills and theoretical knowledge needed to excel in the field of advanced database management, preparing them for roles where they may be responsible for designing, implementing, and maintaining complex database systems. • Explore non-relational (NoSQL) database systems and understand their strengths and weaknesses compared to traditional relational databases.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Basic Database Concepts and SQL Proficiency
Teaching Methodology	Lab work
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Students will learn the DBMS practical with normalization and PL/SQL concept.
CO 2.	Students will learns NoSQL Database with MongoDB.

COURSE ARTICULATION MATRIX

	PSO 1.	**PSO 2.**	**PSO 3.**	**PSO 4.**	**PSO 5.**
CO 1.					
CO 2.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
MDC202-1C: Foundation of Discrete Mathematics

Credit 4 **Contact Hours per week 4**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Multidisciplinary
Purpose of Course	This course in discrete mathematics covers foundational concepts such as divisibility theory in integers, functions, counting, and probability, as well as graph theory. Students will gain a deep understanding of number theory, function properties, combinatorics, and graph representations. The course aims to develop problem-solving skills applicable in computer science, mathematics, and related fields, emphasizing practical applications of mathematical concepts.
Course Objective	• Develop a solid understanding of divisibility theory in integers, including the division algorithm, greatest common divisors, and the Euclidean algorithm. • Explore the theory of functions, covering one-to-one functions, onto functions, and inverse functions, with a focus on their applications. • Acquire proficiency in counting methods, probability calculations, and combinatorial concepts, such as possibility trees and the pigeonhole principle. • Gain familiarity with graph theory, including graph definitions, representations, and applications in problem-solving, networks, and the World Wide Web. • Enhance problem-solving skills and apply mathematical concepts to real-world scenarios in computer science, mathematics, and related disciplines.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Fundamental knowledge of mathematics.
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. Divisibility Theory in the Integers** 1.1 Early Number Theory 1.2 The Division Algorithm 1.3 The Greatest Common Divisor 1.4 The Euclidean Algorithm 1.5 The Diophantine Equation Ax + By = C	25%	15
2	**Unit 2. Functions** 2.1 Functions Defined on General Sets 2.2 Hamming distance and Boolean functions 2.3 One-to-One Functions 2.4 One-to-One Functions on Infinite Sets 2.5 Onto Functions 2.6 Onto Functions on Infinite Sets 2.7 Relations between Exponential and Logarithmic functions 2.8 One-to-One Correspondences 2.9 Inverse Functions	27%	16
3	**Unit 3. Counting and Probability** 3.1 Introduction 3.2 Probabilities: Deck of Cards, Pair of Dice, The Monty Hall Problem 3.3 Possibility Trees and the Multiplication Rule 3.4 Counting Elements of Disjoint Sets: The Addition Rule 3.5 The Pigeonhole Principle 3.6 Counting Subsets of a set: Combinations	31%	19
4	**Unit 4. Graphs and Trees** 4.1 Definitions 4.2 Terminology 4.3 Drawing more than one picture for a graph 4.4 Labeling Drawings to Show They Represent the Same Graph 4.5 Using a Graph to Represent a Network 4.6 Using a Graph to Represent the World Wide Web 4.8 Special Graphs	17%	10

REFERENCE

Core references:

1. Elementary Number Theory By David M. Burton,7th Ed., McGraw Hill (2011).
2. Discrete Mathematics with Applications By Susanna S. Epp, 4th Ed., Brooks Cole Cengage Learning (2010).

Reference books:

1. Discrete Mathematics for Computer Science By Gary Haggard, John Schlipf and Sue Whitesides, Thomson Brooks Cole (2006).
2. Discrete Mathematics, Schaum's Outlines Series By Seymour Lipschutz, Marc Lipson, Tata MCGraw Hill (2007).
3. Discrete Mathematics and its Applications By Kenneth H. Rosen, Tata MCGraw Hill.
4. Discrete mathematical structures By B Kolman RC Busby, S Ross, PHI
5. Discrete structures By Liu, Tata MCGraw Hill

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Demonstrate a mastery of divisibility theory in integers, showcasing proficiency in applying the division algorithm, determining greatest common divisors, and utilizing the Euclidean algorithm.
CO 2.	Apply advanced concepts of functions, including one-to-one functions, onto functions, and inverse functions, to solve mathematical problems and analyze real-world scenarios.
CO 3.	Exhibit a comprehensive understanding of counting techniques, probability principles, and combinatorial concepts, enabling effective problem-solving and decision-making.
CO 4.	Display proficiency in graph theory by effectively defining, representing, and applying graphs to solve complex problems, with an understanding of their practical applications in various fields.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1.	CO 2.	CO 3.	CO 4.
1	Divisibility Theory in the Integers				
2	Functions				
3	Counting and Probability				
4	Graphs and Trees				

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					
CO 4.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
AEC202-1C: Functional English-II

Credit 2 **Contact Hours per week 2**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Ability Enhancement Course (AEC)
Purpose of Course	To equip individuals with the necessary language skills and confidence to communicate effectively in English, enabling them to succeed academically, professionally, and in various social settings
Course Objective	● Utilize their knowledge of functional English effectively for communicative purposes. ● Learn language in authentic contexts. ● Use English efficiently for routine. ● Sharpen Writing and Speaking skills for better expression by providing authentic resources. Make students understand how the development of these skills will lead to their holistic development.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Elementary knowledge of English Language.
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. Functional Grammar (Practical)** 1.1 The concept of mood in English grammar (indicative, imperative, subjunctive) 1.2 Time and tense relationships in complex sentences 1.3 Active and passive voice and their functions 1.4 Information structure (focus, topic, comment) in English	34%	10
2	**Unit 2. Introduction to Productive Skills** 2.1 Concept and Characteristics of Speaking 2.2 Qualities of a Good Public Speaker 2.3 Introduction to the Writing Skills 2.4 Concept and Characteristics of Writing	33%	10
3	**Unit 3. Productive Skills (Practical)** 3.1 Speaking in Public/ Group Discussion/ Debate 3.2 Dialogue Writing/ Speech Writing for various occasions 3.3 Paragraph/ Essay/ Report Writing	33%	10

REFERENCE

Core references:

1. "An Introduction to Functional Grammar" by M. A. K. Halliday and Christian M. I. M. Matthiessen
2. "Functional English Grammar: An Introduction for Second Language Teachers" by Michael A. K. Halliday and Ruqaiya Hasan
3. Gupta, S.C. English Grammar & Composition. Arihant Publication. 2022.
4. Mitra, Barun K. Personality Development and Soft Skills. Oxford University Press, 2015.
5. Urmila Rai and S.M. Rai. Business Communication. 1st Edition, Mumbai: Himalaya Publishing House.
6. Krishna Mohan and Meera Banerji. Developing Communication Skills. New Delhi: Macmillan India Private Ltd.
7. Wren and martin. English Grammar. MB publication, 2022.
8. Ur, Penny. Teaching Listening Comprehension. Cambridge University Press
9. Teaching Listening and Speaking : From Theory to Practice https://www.professorjackrichards.com/wp-content/uploads/teaching-listening-and-speaking-from-theory-to-practice.pdf

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Enable themselves to comprehend ideas clearly and accurately with listening and reading skills.
CO 2.	Gain confidence in an academic and professional context.
CO 3.	Analyze and improve language skills. Prepare themselves better for placements and beyond.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes		
		CO 1.	CO 2.	CO 3.
1	Functional Grammar (Practical)			
2	Introduction to Productive Skills			
3	Productive Skills (Practical)			

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
SEC202-1C: Microprocessor and Embedded System

Credit 2 **Contact Hours per week 2**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Skill Enhancement Course (SEC)
Purpose of Course	To studying basic about computer programming to explore concepts and develop basic skills of programming.
Course Objective	• To apply knowledge of computing and/or mathematics appropriate to the discipline. • To understand the Intel 8086 Processor Family Instruction set and its basic architecture. • To understand the Assembly Language Fundamentals.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	Knowledge about Computer Devices, Number System and Logic Circuits
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Medium of Instruction	English
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. Introduction to 8086 Microprocessor** 1.1 Microprocessor Structure 1.2 Structure of 8086 CPU 1.3 Register set of 8086 1.4 Instruction set architecture 1.5 Addressing modes	30%	06
2	**Unit 2. Microcomputer Programming - Assembly Language** 2.1 Need and Use of Assembly Language 2.2 Assembly Program Execution 2.3 Assembly Program Components 2.4 Types of Assembly Programs 2.5 Input / Output in Assembly Language	35%	12
3	**Unit 3. Introduction to Embedded Systems** 3.1 Application domain of embedded systems 3.2 Features and characteristics 3.3 System Model 3.4 Microprocessor Vs Microcontroller 3.5 Current trends and Challenges 3.6 Hard and Soft real time systems	35%	12

REFERENCE

Core references:

1. Ramesh Gaonkar, Microprocessor, Architecture, Programming and Applications, Penram International Publishing; Sixth edition, 2014.
2. Mathur A., Introduction to Microprocessors, Tata McGraw Hill, New Delhi, 1992.

Reference books:

1. Rafiquzzaman, Microprocessor Theory and Application, PHI Learning, First Edition.
2. Ray Ajoy and Burchandi, Advanced Microprocessor & Peripherals, Tata McGraw Hill, Education, New Delhi, Second Edition.
3. Douglas V. Hall, Microprocessors and Interfacing, Tata McGraw Hill, Education, New Delhi, Third Edition

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Perform effectively as entry level Embedded Systems professionals.
CO 2.	Understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.
CO 3.	Understand the concept of embedded system, microcontroller, different components of microcontroller and their interactions.

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes		
		CO 1.	CO 2.	CO 3.
1	Introduction to 8086 Microprocessor			
2	Microcomputer Programming - Assembly Language			
3	Introduction to Embedded Systems			

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					

VANITA VISHRAM WOMEN'S UNIVERSITY, SURAT
SCHOOL OF SCIENCE AND TECHNOLOGY
Department of Computer Science
M.Sc. IT Program
FY M.Sc. IT
Semester II
VAC201-1C: Environmental Studies

Credit 2 **Contact Hours per week 2**

Outline of the Course:

Course type	Theory
Level of the Course	200-299 Intermediate-level
Course Category	Value Added Courses
Purpose of Course	The students need to learn basic concepts of environment. How environment impact our life on earth and which activities are harmful to our environment and how we can contribute to wellbeing of our earth and environment.
Course Objective	• To develop the understanding basics concept of our environment and its sustainable development. • Demonstrate knowledge and understanding different component of environment. • Demonstrate knowledge and understanding of the ecosystem and its • functioning and impact on survival of organism on earth. To develop the ability to think critically about sustainable • development of our earth environment.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Last Review / Revision	November 2023
Pre-requisite	10+2
Teaching Methodology	Class Room Teaching, Discussion and Assignment
Evaluation Method	50% Continuous Comprehensive Evaluation (CCE) 50% Semester End Evaluation (SEE)

Course Content:

Units	Particulars	% Weightage of Unit	Minimum Nos. of Hours
1	**Unit 1. Introduction of Environment** 1.1 Definition and multidisciplinary nature of environmental studies. 1.2 Concept and Components of environment (Atmosphere, Lithosphere and Hydrosphere) 1.3 Bio-geochemical cycles 1.4 Concept, structure and function of an ecosystem. 1.5 Food chains, food webs and Energy flow in an ecosystem 1.6 Terrestrial ecosystem: Forest ecosystem and Grassland ecosystem 1.7 Aquatic ecosystems: Pond and ocean ecosystem	25%	08
2	**Unit 2. Natural Resources: Renewable and Non-renewable Resources** 2.1 Land as a resource, soil erosion and land degradation, landslides, and desertification 2.2 Forests: Use and over-exploitation, deforestation, 2.3 Impacts of deforestation on biodiversity and tribal populations. 2.4 Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs	25%	08
3	**Unit 3. Biodiversity and its Conservation** 3.1 Introduction — Definition, ecosystem diversity, Value of biodiversity, 3.2 India as a mega-biodiversity nation; 3.3 Threats to biodiversity: Habitat loss, poaching of wildlife, man- wildlife conflicts. 3.4 Endangered and endemic species of India. Common plant and animal species. 3.5 Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	25%	07
4	**Unit 4. Environmental pollution** 4.1 Definition Causes, effects and control measures of: 4.4.1 Air pollution 4.4.2 Water pollution 4.4.3 Soil pollution 4.4.4 Marine 4.4.5 Noise pollution 4.4.6 Thermal pollution 4.4.7 Nuclear hazards	25%	07

REFERENCE

Reference books:

1. Bharucha, E. (2013). Textbook of Environmental Studies for Undergraduate Courses. Universities Press.
2. Asthana, D. K. (2006).Text Book of Environmental Studies. S. Chand Publishing.
3. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India
4. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications.
5. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
6. Tiwari, G.N. & Ghosal. M. K. 2005. Renewable Energy Resources: Basic Principles and Application. Narosa Publishing House.
7. R. K. Khitoliya., 2012. Environmental Pollution 2nd edition.S. Chand Publishing
8. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. Environmental and Pollution Science. Elsevier Academic Press.
9. Purohit, S.S. & Ranjan, R. 2007. Ecology, Environment & Pollution. Agrobios Publications.

COURSE OUTCOMES:

Upon successful completion of the course,

CO 1.	Students will gain knowledge about Earth structure and its environment and ecology and biodiversity and its role in human welfare and its conservation
CO 2.	Students will develop the understanding about various natural resources and their management.
CO 3.	Students will be able to critically examine all sides of environmental issues and apply understanding from various disciplines such as psychology, law, literature, politics, sociology, philosophy, and religion to create opinions about how to interact with the environment on both a personal and a social level.
CO 4.	Students will understand the global character of environmental problems and ways of addressing them, including interactions across local to global scales

COURSE OUTCOMES MAPPING

Unit No.	Title of the Unit	Course Outcomes			
		CO 1.	CO 2.	CO 3.	CO 4.
1	Introduction of Environment				
2	Natural Resources: Renewable and Non-renewable Resources				
3	Biodiversity and Conservation				
4	Environmental pollution				

COURSE ARTICULATION MATRIX

	PSO 1.	PSO 2.	PSO 3.	PSO 4.	PSO 5.
CO 1.					
CO 2.					
CO 3.					
CO 4.					

13 TEACHING METHODOLOGY

A teaching method comprises the principles and methods used by teachers to enable student learning. In order to achieve its objective of focused process- based learning and holistic development, the teacher/faculty may use a variety of knowledge delivery methods:

13.1 LECTURES/CLASS WORKS:

Lectures should be designed to provide the learners with interesting and fresh perspectives on the subject matter. Lectures should be interactive in a way that students work with their teachers to get new insights in the subject area, on which they can build their own bridges to higher learning. Classwork has the ability to enhance relationships between teachers and students. Create goal- oriented tasks for students to prepare and enable self-learning.

13.2 DISCUSSIONS/ SEMINARS/PRESENTATION:

Discussions / seminars / presentation are critical components of learning and can be used as a platform for students to be creative and critical with old and new ideas. Besides developing critiquing skills, arriving at consensus on various real-life issues and discussion groups lead to innovative problem-solving and ultimately to success.

13.3 CASE STUDIES/ SELF-STUDY:

Real case studies, wherever possible, should be encouraged in order to challenge students to find creative solutions to complex problems of individual, community, society and various aspects of knowledge domain concerned. Technology is transforming higher Education learning and teaching though various case studies to improve overall standards.

13.4 PRACTICAL/PROBLEM SHEET:

Practical ability is the essential requirement for computer science undergraduates' ability structure, and it emphasizes that computer science undergraduates should have a good grasp of theory from practice and then apply the theory to practice, improving them own software developing skills and employ ability.

13.5 ASSIGNMENTS:

Computer science assignments not only help students overcome their fear and stress but also help them learn more interesting facts about the subjects of computer science which are part of their syllabus and also out of curriculum.

13.6 INDUSTRIAL TOURS:

Computer Science students have to know the things practically through interaction, working methods and employment practices. Moreover, it gives exposure from academic point of view. Main aim industrial visit is to provide an exposure to students about practical working environment.

13.7 TEAM WORK:

Teamwork based projects challenge the student to apply the technical knowledge they gain in college to solve meaningful and complex problems. Positive collaboration in the form of team work is critical in the classroom environment, for which it is necessary to transcend one’s prejudices and predilections so as to achieve the desired outcomes. In the process of team work, learners will acquire the skills of managing knowledge acquisition and other collaborative learners, thereby understanding how to incorporate and balance personalities.

14 KEYWORDS

- Master of Science in Information Technology
- Basics of Computers
- Office Automation
- Operating System
- Web Development
- Programming Concept
- Database-backend tool
- Web Designing
- Statistical analysis
- Internet
- Algorithms
- Software analysis, coding, design, testing
- Mobile Computing
- Cyber Security
- IT Projects
- Network fundamentals
- Framework
- Frontend tools
- Animation
- Graphics fundamentals
- Full Stack Development
- Digital Electronics
- Troubleshooting