BACHELOR OF COMPUTER APPLICATIONS

SYLLABUS

(Under Choice Based Credit System)
Applicable for the students admitted
from 2023 – 2024 onwards

DEPARTMENT OF COMPUTER APPLICATIONS

Bishop Heber College (Autonomous)

(Nationally Reaccredited at the A+ Level by NAAC)
(Recognized by UGC as "College with Potential for Excellence")

Tiruchirappalli-620 017

B.C.A.,

SYLLABUS

FROM THE ACADEMIC YEAR
2023 - 2024

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

Introduction

BCA (Bachelor of Computer Applications)

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the state which will help the students to ensure similar quality of education irrespective of the institute and location.

Computer Application is the study of quantity, structure, space and change, focusing on problem solving, application development with wider scope of application in science, engineering, technology, social sciences etc. throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Computer Applications is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Nowadays, practically everyone is a computer user, and many people are even computer programmers. Computer Application can be seen on a higher level, as a science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of computer Applications also has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular application domain. Computer Application has a wide range of specialties. These include Computer Architecture, Software Systems, Graphics, Artificial Intelligence, Computational Science, and Software Engineering. Drawing from a common core of computer science knowledge, each specialty area focuses on specific challenges. Computer Application is practiced by mathematicians, scientists and engineers. Mathematics, the origins of Computer Science, provides reason and logic. Science provides the methodology for learning and refinement. Engineering provides the techniques for building hardware and software.

Programme Outcome, ProgrammeSpecificOutcomeandCourseOutcome

Computer Application is the study of quantity, structure, space and change, focusing on problem solving,

application development with wider scope of application in science, engineering, technology, social sciences etc. The key core areas of study in Mathematics include Algebra, Analysis (Real & Complex), Differential Equations, Geometry and Mechanics.

The students completing this programme will be able to present Software application clearly and Precisely, make abstract ideas precise by formulating them in the Computer languages. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in software industry, banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

1. Programme Outcomes (PO)of BCA

- Scientific aptitude will be developed in Students.
- Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the Computer Science &humanities stream.
- Students will become employable; Students will be eligible for career opportunities in education field, Industry, or will be able to opt for entrepreneurship.
- Students will possess basic subject knowledge required for higher studies, professional and applied courses.
- Students will be aware of and able to develop solution-oriented approach towards various Social and Environmental issues.
- Ability to acquire in-depth knowledge of several branches of Computer Science and aligned areas. This Programme helps learners in building a solid foundation for higher studies in Computer Science and applications.
- The skills and knowledge gained leads to proficiency in analytical reasoning, which can be utilized in modelling and solving real life problems.
- Utilize computer programming skills to solve theoretical and applied problems by critical understanding, analysis and synthesis.
- Torecognizepatternsandtoidentifyessentialandrelevantaspectsofproblems.
- Abilitytoshareideasandinsightswhileseekingandbenefittingfromknowledgeandinsightofothers.

Mould the students into responsible citizens in a rapidly changing interdependent society.

Theaboveexpectationsgenerallycanbepooledinto6 broad categories and can be modified according to institutional requirements:

PO1: Knowledge

PO2:ProblemAnalysis

PO3:Design/Development of Solutions

PO4:Conduct investigations of complex problems

PO5:Modern tool usage

PO6:Applying to society

2. Programme Specific Outcomes of B.Sc. Degree Programme in Computer Science

PSO1:Think in a critical and logical based manner

PSO2:Familiarize the students with suitable software tools of computer science and industrial applications to handle issues and solve problems in mathematics or statistics and real time application related sciences.

PSO3:Know when there is a need for information, to be able to identify, locate, evaluate,andeffectivelyusethatinformationfortheissueorproblemathand.

PSO4:Understand,formulate,developprogrammingmodelwith logical approaches to address issues arising in social science, business and other contexts.

PSO5:Acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Computer science and Industrial statistics.

PO6:Provide students/learners sufficient knowledge and skills enabling them to undertake further studies in Computer Science or Applications or Information Technology and its allied a reason multiple disciplines linked with Computer Science.

PO7:Equip with Computer science technical ability, problem solving skills, creative talentandpowerofcommunicationnecessaryforvariousformsofemployment.

PO8:Develop a range of generic skills helpful in employment, internships & societal activities.

PO9:Get adequate exposure to global and local concerns that provides platform for furtherexplorationintomulti-dimensionalaspectsofcomputingsciences.

Mapping of Course Learning Outcomes (CLOs)with Programme Outcomes (POs)and Programme Specific Outcomes (PSOs)can be carried out accordingly, assigning the appropriate level in the grids: (put tick mark in each row)

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

3. Highlights of the Revamped Curriculum

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the corecomponentsandincorporatingapplicationorientedcontentwhereverrequired.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematicalmodelsandalgorithmsforprovidingsolutionstoindustry/real
- Life situations. The curriculum alsofacilitatespeerlearningwithadvancedmathematicaltopicsinthefinal semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Computer Science based problem solving skills are included as mandatory components in the Training for Competitive Examinations 'course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second-year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.

State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and interdisciplinary nature are incorporated as Elective courses, covering conventional topics to the latest – Statistics with R Programming, Data Science, Machine learning. Internet of Things and Artificial Intelligenceetc.

4. Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome/Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Mathematics and simulating mathematical Concepts to real world.	• Instil confidence among students • Create interest for the subject
I,II,III,IV	**Skill Enhancement papers** (Discipline centric/Generic/Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enablethestudentsgainknowledgeandexposureonlatestcomputationalaspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self–employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• DisciplinecentricskillwillimprovetheTechnicalknowhowofsolvingreallifeproblemsusingICT tools

III, IV,V &VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stake holders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and interdisciplinary nature • Students are exposed to Latest topics on Computer Science/IT, that require strong mathematical background • Emerging topics in higher education /industry /communication network/health sector etc. Are introduced with hands-on-training, facilitates designing of mathematical models in the respective sectors
IV	Industrial Statistics	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship /Industrial Training	• Practical training at the Industry/ Banking Sector /Private/ Public sector organizations / Educational institutions, enable the students gain professional Experience and also become responsible citizens.
V Semester	Project with Viva–voce	• Self-learning is enhanced • Applicationoftheconcepttorealsituationisconceivedresultingintangibleoutcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; Mathematics forAdvancedExplain‘componentwillcompriseofadvancedtopicsinMathematics and allied fields, for those in the peer group/aspiring researchers; • _Training for Competitive Examinations‘ –caters to the needs of the aspirants towards most sought-after services of the nation viz, UPSC, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners/Honors degree**		• To cater to the needs of peer learners/research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course –\CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective - VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic / Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic / Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement - (Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**22**	**30**		**25**	**30**		**26**	**30**		**21**	**30**
Total – 140 Credits																	

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2

	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	**30**

Third Year
Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	26
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

Illustration for B.C.A. Curriculum Design

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	CC1–Python Programming	5	5
	CC2-Practical: Python Programming Lab	5	5
	ElectiveCourse1(Generic/Discipline Specific)–EC1**Choose from Annexure–I**	3	4
	SkillEnhancementCourse-SEC-1–**Choose from Annexure-II**	2	2
Part-IV	Foundation Course FC–Structured programming in C	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	CC3–Object Oriented Programming Concepts using C++	5	5
	CC4 -Practical: C++Programming Lab	5	5
	ElectiveCourse2(Generic/Discipline Specific)–EC2 **Choose from Annexure-I**	3	4
Part-IV	Skill Enhancement Course-SEC-2-**ChoosefromAnnexure-II**	2	2
	Skill Enhancement Course–SEC-3(Discipline/Subject Specific)–**Choose from Annexure-II**	2	2
		23	**30**

Second Year

Semester-III

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	CC5-DataStructuresandAlgorithms	5	5
	CC6-Practical: Data Structures and Algorithms Lab	5	5
	Elective Course3(Generic/Discipline Specific)-EC3-**Choose From Annexure-I**	3	4
Part-IV	SkillEnhancementCourse-SEC-4(Entrepreneurial Based)– **-Choose from Annexure-II**	1	1
	SkillEnhancementCourse-SEC-5(Discipline Specific/Generic) –**Choose from Annexure-II**	2	2
	Environmental Studies	-	1
		22	**30**

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	CC7-Programming in Java	5	5
	CC8 -Practical: Programming in Java Lab	5	5
	Elective Course-EC4(Generic/Discipline Specific)– **Choose from Annexure-I**	3	3
Part-IV	Skill Enhancement Course–SEC-6-**Choose from Annexure-II**	2	2
	Skill Enhancement Course-SEC-7 -**Choose from Annexure-II**	2	2
	Environmental Studies	2	1
		25	**30**

Third Year

Semester-V

Part	List of Courses	Credit	Hoursper week(L/T/P)
Part-III	CC9–Operating Systems	4	5
	CC10-ASP.Net Programming	4	5
	CC11-Practical: ASP.Net Programming Lab	4	5
	Elective Course–EC5(Discipline Specific)– **Choose from Annexure-I**	3	4
	Elective Course–EC6(Discipline Specific)– **Choose from Annexure-I**	3	4
	CC12-Project with Viva voce (Individual)	4	5
Part-IV	Value Education	2	2
	Internship/Industrial Training (Summer vacation at the end of IV semester activity)	2	
		26	**30**

Semester-VI

Part	List of Courses	Credit	Hours per week(L/T/P)
Part-III	CC13-ComputerNetworks		6
	CC14–Data Analytics using R Programming	4	6
	CC15- Practical: R Programming Lab	4	6
	Elective Course–EC7(Discipline Specific)– **Choose from Annexure-I**	3	5
	Elective Course–EC8(Discipline Specific)**–** **Choose from Annexure-I**	3	5
Part-IV	ProfessionalCompetencySkillEnhancementCourse-SEC8	2	2
Part-V	Extension Activity	1	
		21	**30**
	Total Credits: 140		

Annexure I Suggested topics in Core component

1. Microprocessor and Microcontroller
2. Microprocessor and Microcontroller Lab
3. RDBMS with PL/SQL
4. PL/SQL Lab
5. Software Engineering
6. Machine Learning
7. Machine Learning Lab
8. Network Security
9. Data Mining and Warehousing
10. Mobile Application Development
11. Mobile Application Development Lab
12. Introduction to Data Science and more..

Suggested topics in Elective Course

Generic Specific

1. Discrete Mathematics–I
2. Discrete Mathematics-II
3. Statistical Methods and its Application-I
4. Statistical Methods and its Application-II
5. Optimization Techniques
6. Nano Technology
7. Introduction to Linear Algebra
8. Graph Theory and its Application
9. Financial Accounting
10. Cost and Management Accounting
11. Digital Logic Fundamentals
12. Numerical Methods
13. Resource Management Techniques and more.

Elective course–(EC1-EC8)-Discipline Specific

1. Software Metrics
2. Natural Language Processing
3. Analytics for Service Industry
4. Cryptography
5. Database Management System
6. Big Data Analytics
7. IOT and its Applications
8. Software Project Management
9. Image Processing
10. Information Security
11. Human Computer Interaction
12. Fuzzy Logic
13. Artificial Intelligence
14. Mobile Adhoc Network
15. Computational Intelligence
16. Grid Computing
17. Cloud Computing
18. Artificial Neural Network
19. Agile Project Management and more.

[Pl. Note: In Semester-VI-For EC7and EC8 subjects Instructional hours may be used as:5per cycle]

Annexure II

Suggested topics in Skill Enhancement (SEC1-SEC8) Course

Skill Enhancement Course

1. Fundamentals of Information Technology
2. Introduction to HTML
3. Web Designing
4. PHP Programming
5. Software Testing
6. Problem Solving Techniques
7. Understanding Internet
8. Office Automation
9. Quantitative Aptitude
10. Opensource Technologies
11. Multimedia Systems
12. Advanced Excel
13. Biometrics
14. Cyber Forensics
15. Pattern Recognition
16. Enterprise Resource Planning
17. Robotics and Applications
18. Simulation and Modelling
19. Organization Behavior and more.

PROGRAMME STRUCTURE (AS Per COE Patterns)

BCA COURSE STRUCTURE FOR 2023-2024 BATCH ONWARDS

(Syllabus for students admitted from 2023-2024 onwards)

Sem	Part	Subject Code	Course	Subject Title	Hrs/Week	Credits	Int. Mark	Ext. Mark	Total
I	I	U23TM1L1	Language I/*	பொதுத்தமிழ் I	6	3	25	75	100
	II	U23EG1L1	English I	Prose and Short Stories	6	3	25	75	100
	III	U23CA101	Core I	Python Programming	5	5	25	75	100
		U23CA1P1	Core Prac. I	Python Programming Lab	3	3	40	60	100
		U23MAZY1	Allied I	Numerical Methods	6	5	25	75	100
	IV	U23CA1E1	NMEC I	Introduction to HTML	2	2	25	75	100
		U23CAIN1	Foundation Course	Structured Programming Language in C	2	2	100	--	100
II	I	U23TM2L1	Language II/*	பொதுத்தமிழ் II	6	3	25	75	100
	II	U23EG2L2	English II	Poetry and Shakespeare	6	3	25	75	100
	III	U23CA202	Core II	Object Oriented Programming Concepts using C++	5	5	25	75	100
		U23CA2P2	Core Prac. II	Object Oriented Programming Concepts using C++ Lab	3	3	40	60	100
		U23MAZY2	Allied II	Operations Research	6	5	25	75	100
	IV	U23CA2E2	NMEC II	Web Designing	2	2	25	75	100
		U23CA2S3	SBEC I	IOT and its Applications	2	2	25	75	100
III	I	U23TM3L3	Language III/*	பொதுத்தமிழ் III	6	3	25	75	100
	II	U23EG3L3	English III	One Act Plays and Abridged Novel	6	3	25	75	100
	III	U23CA303	Core III	Data Structures and Algorithms	5	5	25	75	100
		U23CA3P3	Core Prac. III	Data Structures and Algorithms Lab using C++	4	3	40	60	100
		U23CA3Y3	Allied III	Digital Logic Fundamentals	5	5	25	75	100
	IV	U23CA3S4	Entrepreneurial Skill	Enterprise Resource Planning	1	1	100	--	100
		U23CA3S5	SBEC II	Artificial Intelligence	2	2	25	75	100
		U23EST41	EVS	Environmental Studies	1	-	-	-	-
IV	I	U23TM4L4	Language IV/*	பொதுத்தமிழ் IV	6	3	25	75	100
	II	U23EG4L4	English IV	English through Literature	6	3	25	75	100
	III	U23CA404	Core IV	Programming in JAVA	5	5	25	75	100
		U23CA4P4	Core Prac. IV	Programming in JAVA Lab	4	3	40	60	100
		U23CA4Y4	Allied IV	Nano Technology	4	5	25	75	100
	IV	U23CA4S6	Life Skills	Life Skills	2	2	100	--	100
		U23CA4S7	Service Learning	Smart Application Development for Rural Community	2	2	100	--	100
		U23EST41	EVS	Environmental Studies	1	2	25	75	100
V	III	U23CA505	Core V	Operating Systems	5	4	25	75	100
		U23CA506	Core VI	ASP.Net Programming	5	4	25	75	100
		U23CA5P5	Core Prac. V	ASP.Net Programming Lab	6	4	40	60	100
		U23CA5PJ	Core Project with Viva Voce	Project	4	4	20	80	100
		U23CA5D1	Elective-I	Database Management System	4	3	25	75	100
		U23CA5D2	Elective-II	Artificial Neural Networks	4	3	25	75	100
	IV	U23VLO51 U23VLO52	VLO	Abundant Life Human Values	2	2	100	-	100
		U23CA5I1	Core Internship	Internship/Industrial Training(Summer)	-	2	100	-	100
VI	III	U23CA607	Core VII	Computer Networks	6	4	25	75	100
		U23CA608	Core VIII	Data Analytics using R Programming	6	4	25	75	100
		U23CA6P6	Core Prac. VI	R Programming Lab	6	4	40	60	100
		U23CA6D1	Elective-III	Cryptography	5	3	25	75	100
		U23CA6D2	Elective-IV	Software Engineering	5	3	25	75	100
	IV	U23CA6N2	Professional Competency Skill	Quantitative Aptitude	2	2	100	-	100
		U23ETA61	Extension Activity	Extension Activity	-	1	-	-	-
Total					**30**	**21**	**240**	**360**	**600**
Total					**180**	**140**	**1685**	**2615**	**4300**

CORE PAPER
FIRST YEAR

SEMESTER - I

Subject Code U23CA101	Subject Name	C a	L	T	P	S	C r	Marks		
	PYTHON PROGRAMMING		5	-	-	-	5	25	75	100

Learning Objectives	
LO1	To make students understand the concepts of Python programming.
LO2	To apply the OOPs concept in PYTHON programming.
LO3	To impart knowledge on demand and supply concepts
LO4	To make the students learn best practices in PYTHON programming
LO5	To know the costs and profit maximization

UNIT	Contents	No. of Hours
I	**Basics of Python Programming:** History of Python-Features of Python-Literal-Constants-Variables - Identifiers–Keywords-Built-in Data Types-Output Statements – Input Statements-Comments – Indentation- Operators-Expressions-Type conversions. **Python Arrays:** Defining and Processing Arrays – Array methods.	**15**
II	**Control Statements:** Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. **Jump Statements:** break, continue and pass statements**.**	**15**
III	**Functions:** Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. **Function Arguments**: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments- Recursion. **Python Strings:** String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison. **Modules**: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules.	**15**
IV	**Lists:** Creating a list -Access values in List-Updating values in Lists-Nested lists -Basic list operations-List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples– Difference between lists and tuples. **Dictionaries:** Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries.	**15**
V	**Python File Handling:** Types of files in Python - Opening and Closing files-Reading and Writing files: write() and writelines() methods- append() method – read() and readlines() methods – with keyword – Splitting words – File methods - File Positions-Renaming and deleting files.	**15**
	SSS HOURS	**75**

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Learn the basics of python, Do simple programs on python, Learn how to use an array.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Develop program using selection statement, Work with Looping and jump statements, Do programs on Loops and jump statements.	PO1, PO2, PO3, PO4, PO5, PO6

CO3	Concept of function, function arguments, Implementing the concept strings in various application, Significance of Modules, Work with functions, Strings and modules.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Work with List, tuples and dictionary, Write program using list, tuples and dictionary.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Reema Thareja, "Python Programming using problem solving approach", First Edition, 2017, Oxford University Press.	
2	Dr. R. Nageswara Rao, "Core Python Programming", First Edition, 2017, Dream tech Publishers.	
Reference Books		
1.	Vamsi Kurama, "Python Programming: A Modern Approach", Pearson Education.	
2.	Mark Lutz, "Learning Python", Orielly.	
3.	Adam Stewarts, "Python Programming", Online.	
4.	Fabio Nelli, "Python Data Analytics", APress.	
5.	Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication.	
Web Resources		
1.	https://www.programiz.com/python-programming	
2.	https://www.guru99.com/python-tutorials.html	
3.	https://www.w3schools.com/python/python_intro.asp	
4.	https://www.geeksforgeeks.org/python-programming-language/	
5.	https://en.wikipedia.org/wiki/Python_(programming_language)	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**2**	**3**	**3**	**3**
CO 2	**3**	**2**	**2**	**3**	**2**	**3**
CO 3	**3**	**2**	**2**	**3**	**2**	**2**
CO 4	**3**	**2**	**2**	**3**	**2**	**3**
CO 5	**3**	**2**	**2**	**3**	**3**	**3**
Weightage of course contributed to each PSO	15	10	10	15	13	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Date	L	T	P	S	Cr	Marks

Core Prac. I U23CA1P1	PYTHON PROGRAMMING LAB		-	-	4	-	3	40	60	100

Course Objectives:

1. Be able to design and program Python applications.
2. Be able to create loops and decision statements in Python.
3. Be able to work with functions and pass arguments in Python.
4. Be able to build and package Python modules for reusability.
5. Be able to read and write files in Python.

LAB EXERCISES	**Required Hours**
1. Program using variables, constants, I/O statements in Python. 2. Program using Operators in Python. 3. Program using Conditional Statements. 4. Program using Loops. 5. Program using Jump Statements. 6. Program using Functions. 7. Program using Recursion. 8. Program using Arrays. 9. Program using Strings. 10. Program using Modules. 11. Program using Lists. 12. Program using Tuples. 13. Program using Dictionaries. 14. Program for File Handling.	**60**

Course Outcomes

On completion of this course, students will

CO1	Demonstrate the understanding of syntax and semantics of
CO2	Identify the problem and solve using PYTHON programming techniques.
CO3	Identify suitable programming constructs for problem solving.
CO4	Analyze various concepts of PYTHON language to solve the problem in an efficient way.
CO5	Develop a PYTHON program for a given problem and test for its correctness.

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	**2**	**2**	**2**	**2**	**3**	**2**
CO 2	**2**	**1**	**3**	**2**	**-**	**2**
CO 3	**3**	**3**	**1**	**1**	**1**	**2**
CO 4	**2**	**3**	**3**	**1**	**-**	**1**
CO 5	**3**	**2**	**3**	**1**	**1**	**-**
Weightage of course contributed to each PSO	12	11	12	7	5	7

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credit	Marks		
U23CA1E1	INTRODUCTION TO HTML	SEC-I	2	-	-		2	25	75	100

Learning Objectives	
LO1	Insert a graphic within a web page.
LO2	Create a link within a web page.
LO3	Create a table within a web page.
LO4	Insert heading levels within a web page.
LO5	Insert ordered and unordered lists within a web page. Create a web page.

UNIT	Contents	No. of Hours
I	Introduction: Web Basics: What is Internet–Web browsers–What is Webpage –HTML Basics: Understanding tags.	6
II	Tags for Document structure (HTML, Head, Body Tag). Block level text elements: Headings paragraph(<p> tag)–Font style elements:(bold, italic, font, small, strong, strike, bigtags)	6
III	Lists: Types of lists: Ordered, Unordered– Nesting Lists–Other tags: Marquee, HR, BR-Using Images –Creating Hyperlinks.	6
IV	Tables: Creating basic Table, Table elements, Caption–Table and cell alignment– Rowspan, Colspan–Cellpadding.	6
V	Frames: Frameset–Targeted Links–No frame–Forms: Input, Textarea, Select, Option.	6
	TOTAL HOURS	**30**

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Knows the basic concept in HTML Concept of resources in HTML	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Knows Design concept. Concept of Meta Data Understand the concept of save the files.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understand the page formatting. Concept of list	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Creating Links. Know the concept of creating link to email address	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Concept of adding images Understand the table creation.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1. "Mastering HTML5 and CSS3 Made Easy", TeachUComp Inc., 2014.
2. Thomas Michaud, "Foundations of Web Design: Introduction to HTML & CSS"

Web Resources

1. https://www.teachucomp.com/samples/html/5/manuals/Mastering-HTML5-CSS3.pdf
2. https://www.w3schools.com/html/default.asp

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	2	3	3	3
CO 3	2	3	3	3	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	2	3	3
Weightage of course contributed to each PSO	14	15	14	14	15	15

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	Ext	Total
U23CAIN1	STRUCTURED PROGRAMMING LANGUAGE IN C	**Foundation Course**	Y	-	-	-	2	2	100	--	100

Course Objective	
LO1	To familiarize the students with the Programming basics and the fundamentals of C, Datatypes in C, Mathematical and logical operations.
LO2	To understand the concept using if statements and loops
LO3	This unit covers the concept of Arrays
LO4	This unit covers the concept of Functions
LO5	To understand the concept of implementing pointers.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	**Overview of C**: Importance of C, sample C program, C program structure, executing C program. Constants, Variables, and Data Types: Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, Assigning values to variables--- Assignment statement, declaring a variable as constant, as volatile. Operators and Expression.	6	CO1
II	**Decision Making and Branching**: Decision making with If, simple IF, IF ELSE, nested IF ELSE , ELSE IF ladder, switch, GOTO statement.**Decision Making and Looping**: While, Do-While, For, Jumps in loops.	6	CO2
III	**Arrays**: Declaration and accessing of one & two-dimensional arrays, initializing two-dimensional arrays, multidimensional arrays.	6	CO3
IV	**Functions**: The form of C functions, Return values and types, calling a function, categories of functions, Nested functions, Recursion, functions with arrays, call by value, call by reference, storage classes-character arrays and string functions	6	CO4
V	**Pointers:** definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor, pointers and arrays, pointers and functions, pointers and structures.	6	CO5
	Total	**30**	

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Remember the program structure of C with its syntax and semantics	PO1,PO3,PO5
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2,PO3,PO6,PO7
3	Apply the programming principles learnt in real-time problems	PO3,PO4,PO7

4	Analyze the various methods of solving a problem and choose the best method	PO4,PO5,PO6
5	Code, debug and test the programs with appropriate test cases	PO7,PO8
Text Book		
1	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010.	
Reference Books		
1.	Byron Gottfried, Schaum's Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.	
2.	Kernighan and Ritchie, The C Programming Language, Second Edition, Prentice Hall, 1998	
3.	Yashavant Kanetkar, Let Us C, Eighteenth Edition, BPB Publications,2021	
Web Resources		
1.	https://codeforwin.org/	
2.	https://www.geeksforgeeks.org/c-programming-language/	
3.	http://en.cppreference.com/w/c	
4.	http://learn-c.org/	
5.	https://www.cprogramming.com/	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**1**	**2**	**2**	**2**	**2**	**-**
CO 2	**2**	**2**	**2**	**2**	**-**	**2**
CO 3	**3**	**2**	**2**	**1**	**1**	**-**
CO 4	**3**	**2**	**2**	**1**	**-**	**1**
CO 5	**1**	**2**	**2**	**2**	**2**	**3**
Weightage of course contributed to each PSO	7	10	10	18	15	6

S-Strong-3 M-Medium-2 L-Low-1

SEMESTER II

Title of the Course/ Paper	Subject Name	Category	L	T	P	S	Credit	Inst. Hr.	Marks		
									CIA	Exter	Total
U23CA202	OBJECT ORIENTED PROGRAMMING CONCEPTS USING C++	**Core II**	Y	-	-	-	4	5	25	75	100

Course Objective	
LO1	Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects
LO2	Understand dynamic memory management techniques using pointers, constructors, destructors, etc
LO3	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism
LO4	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
LO5	Demonstrate the use of various OOPs concepts with the help of programs

UNIT	**Details**	**No. of Hours**
I	Introduction to C++ - key concepts of Object-Oriented Programming – Advantages – Object Oriented Languages – I/O in C++ - C++ Declarations. Control Structures: - Decision Making and Statements: If ..else, jump, goto, break, continue, Switch case statements - Loops in C++ :for, while, do - functions in C++ - inline functions – Function Overloading.	15
II	Classes and Objects: Declaring Objects – Defining Member Functions – Static Member variables and functions – array of objects –friend functions – Overloading member functions – Bit fields and classes – Constructor and destructor with static members.	15
III	Operator Overloading: Overloading unary, binary operators – Overloading Friend functions –type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes.	15
IV	Pointers – Declaration – Pointer to Class, Object – this pointer – Pointers to derived classes and Base classes – Arrays – Characteristics – array of classes – Memory models – new and delete operators – dynamic object – Binding, Polymorphism and Virtual Functions.	15
V	Files – File stream classes – file modes – Sequential Read / Write operations – Binary and ASCII Files – Random Access Operation – Templates – Exception Handling - String – Declaring and Initializing string objects – String Attributes – Miscellaneous functions.	15
	Total	**75**

Course Outcomes		**Programme Outcome**
CO	Upon completion of the course the students would be able to:	
1	Remember the program structure of C with its syntax and semantics	PO1,PO6

2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2
3	Apply the programming principles learnt in real-time problems	PO4 ,PO7
4	Analyze the various methods of solving a problem and choose the best method	PO6
5	Code, debug and test the programs with appropriate test cases	PO7,PO8
Text Book		
1	E. Balagurusamy, "Object-Oriented Programming with C++", TMH 2013, 7th Edition.	
Reference Books		
1.	Ashok N Kamthane, "Object-Oriented Programming with ANSI and Turbo C++", Pearson Education 2003.	
2.	Maria Litvin& Gray Litvin, "C++ for you", Vikas publication 2002.	
Web Resources		
1.	https://alison.com/course/introduction-to-c-plus-plus-programming	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**1**	**-**	**-**	**1**
CO 2	**2**	**2**	**2**	**1**	**-**	**-**
CO 3	**3**	**1**	**1**	**-**	**1**	**-**
CO 4	**1**	**2**	**1**	**2**	**2**	**1**
CO 5	**3**	**2**	**1**	**2**	**3**	**2**
Weightage of course contributed to each PSO	12	9	6	5	6	4

S-Strong-3 M-Medium-2 L-Low-1

Title of the Course/ Paper	Subject Name	Category	L	T	P	S	Credit	Inst. Hr	Marks		
									CIA	Extr	Total
U23CA2P2	OBJECT ORIENTED PROGRAMMING CONCEPTS USING C++ LAB	**Core Prac. II**	-	-	Y	-	4	5	40	60	100

Course Objective	
LO1	Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects
LO2	Understand dynamic memory management techniques using pointers, constructors, destructors, etc
LO3	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism
LO4	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
LO5	Demonstrate the use of various OOPs concepts with the help of programs

S. No	Details	No. of Hours
1	Write a C++ program to demonstrate function overloading, Default Arguments and Inline function.	
2	Write a C++ program to demonstrate Class and Objects	
3	Write a C++ program to demonstrate the concept of Passing Objects to Functions	
4	Write a C++ program to demonstrate the Friend Functions.	
5	Write a C++ program to demonstrate the concept of Passing Objects to Functions	
6	Write a C++ program to demonstrate Constructor and Destructor	
7	Write a C++ program to demonstrate Unary Operator Overloading	
8	Write a C++ program to demonstrate Binary Operator Overloading	
9	Write a C++ program to demonstrate: • Single Inheritance • Multilevel Inheritance • Multiple Inheritance • Hierarchical Inheritance • Hybrid Inheritance	
10	Write a C++ program to demonstrate Virtual Functions.	
11	Write a C++ program to manipulate a Text File.	
12	Write a C++ program to perform Sequential I/O Operations on a file.	
13	Write a C++ program to find the Biggest Number using Command Line Arguments	
14	Write a C++ program to demonstrate Class Template	
15	Write a C++ program to demonstrate Function Template.	
16	Write a C++ program to demonstrate Exception Handling.	

Course Outcomes		**Programme Outcome**
CO	Upon completion of the course the students would be able to:	
1	Remember the program structure of C with its syntax and semantics	PO1,PO6
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2

3	Apply the programming principles learnt in real-time problems	PO4 ,PO7
4	Analyze the various methods of solving a problem and choose the best method	PO6
5	Code, debug and test the programs with appropriate test cases	PO7,PO8
Text Book		
1	E. Balagurusamy, "Object-Oriented Programming with C++", TMH 2013, 7th Edition.	
Reference Books		
1.	Ashok N Kamthane, "Object-Oriented Programming with ANSI and Turbo C++", Pearson Education 2003.	
2.	Maria Litvin& Gray Litvin, "C++ for you", Vikas publication 2002.	
Web Resources		
1.	https://alison.com/course/introduction-to-c-plus-plus-programming	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**3**	**3**	**1**	**2**
CO 2	**2**	**3**	**3**	**3**	**1**	**2**
CO 3	**2**	**3**	**3**	**3**	**1**	**2**
CO 4	**2**	**3**	**3**	**3**	**1**	**2**
CO 5	**2**	**3**	**3**	**3**	**1**	**2**
Weightage of course contributed to each PSO	11	15	15	15	5	10

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Date	L	T	P	S	C	I	Marks		
U23CA2E2	WEB DESIGNING	SEC-II	Y	-	-	-	2	2	25	75	100

Course Objective	
LO1	Understand the basics of HTML and its components
LO2	To study about the Graphics in HTML
LO3	Understand and apply the concepts of XML and DHTML
LO4	Understand the concept of JavaScript
LO5	To identify and understand the goals and objectives of the Ajax

UNIT	Details	No. of Hours	Course Objective
I	HTML: HTML-Introduction-tag basics- page structure-adding comments working with texts, paragraphs and line break. Emphasizing test-heading and horizontal rules-list-font size, face and color-alignment links-tables-frames.	6	C1
II	Forms & Images Using Html: Graphics: Introduction-How to work efficiently with images in web pages, image maps, GIF animation, adding multimedia, data collection with html forms textbox, password, list box, combo box, text area, tools for building web page front page.	6	C2
III	XML & DHTML: Cascading style sheet (CSS)-what is CSS-Why we use CSS-adding CSS to your web pages-Grouping styles-extensible markup language (XML).	6	C3
IV	Dynamic HTML: Document object model (DCOM)-Accessing HTML & CSS through DCOM Dynamic content styles & positioning-Event bubbling-data binding. JavaScript: Client-side scripting, What is JavaScript, How to develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition,	6	C4
V	Advance script, JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations.	6	C5
	Total	**60**	

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Develop working knowledge of HTML	PO1, PO3, PO6, PO8
2	Ability to Develop and publish Web pages using Hypertext Markup Language (HTML).	PO1,PO2,PO3,PO6
3	Ability to optimize page styles and layout with Cascading Style Sheets (CSS).	PO3, PO5
4	Ability to develop a java script	PO1, PO2, PO3, PO7
5	An ability to develop web application using Ajax.	P02, PO6, PO7

Text Book	
1	Pankaj Sharma, “Web Technology”, SkKataria& Sons Bangalore 2011.
2	Mike Mcgrath, “Java Script”, Dream Tech Press 2006, 1st Edition.

3	Achyut S Godbole&AtulKahate, "Web Technologies", 2002, 2nd Edition.
Reference Books	
1.	Laura Lemay, RafeColburn , Jennifer Kyrnin, "Mastering HTML, CSS &Javascript Web Publishing", 2016.
2.	DT Editorial Services (Author), "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)", Paperback 2016, 2nd Edition.
Web Resources	
1.	NPTEL & MOOC courses titled Web Design and Development.
2.	https://www.geeksforgeeks.org

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**-**	**2**	**1**	**1**
CO 2	**3**	**3**	**-**	**2**	**-**	**1**
CO 3	**3**	**3**	**-**	**2**	**2**	**1**
CO 4	**3**	**3**	**-**	**2**	**-**	**1**
CO 5	**3**	**3**	**3**	**2**	**-**	**1**
Weightage of course contributed to each PSO	15	15	3	10	3	4

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	C	I	Marks		
U23CA2S3	IoT and its Applications	SEC-III	Y	-	-	-	2	5	25	75	100

Course Objective	
LO1	Use of Devices, Gateways and Data Management in IoT.
LO2	Design IoT applications in different domain and be able to analyze their performance
LO3	Implement basic IoT applications on embedded platform
LO4	To gain knowledge on Industry Internet of Things
LO5	To Learn about the privacy and Security issues in IoT

UNIT	Details	No. of Hours	Course Objective
I	IoT & Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	15	C1
II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	15	C2
III	IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	15	C3
IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management	15	C4
V	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform,	15	C5

	Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.		
	Total	**75**	

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Work with big data tools and its analysis techniques.	PO1
2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO2
3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO4, PO6
4	Perform analytics on data streams.	PO4, PO5, PO6
5	Learn NoSQL databases and management.	PO3, PO8

Text Book	
1	Vijay Madisetti and Arshdeep Bahga, "Internet of Things: (A Hands-on Approach)", Universities Press (INDIA) Private Limited 2014, 1st Edition.
Reference Books	
1.	Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", kindle version.
2.	Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications 2013, 1st Edition,.
3	WaltenegusDargie, ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice" 4..CunoPfister, "Getting Started with the Internet of Things", O"Reilly Media 2011
Web Resources	
1.	https://www.simplilearn.com
2.	https://www.javatpoint.com
3.	https://www.w3schools.com

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	**2**	**-**	**-**	**2**	**-**	**2**
CO 2	**2**	**1**	**-**	**1**	**3**	**1**
CO 3	**3**	**-**	**1**	**1**	**-**	**1**
CO 4	**2**	**-**	**-**	**2**	**1**	**2**
CO 5	**2**	**-**	**-**	**2**	**-**	2
Weightage of course contributed to each PSO	11	1	1	8	4	8

S-Strong-3 M-Medium-2 L-Low-1

SECOND YEAR

Semester III

Title of the Course/ Paper	Subject Name	Category	L	T	P	S	Credi	Inst.	CIA	Exte rnal	Total
Core III U23CA303	**DATA STRUCTURES AND ALGORITHMS**	Core	Y	-	-	-	5	5	25	75	100

Course Objective	
LO1	To understand the concepts of ADTs
LO2	To learn linear data structures-lists, stacks, queues
LO3	To learn Tree structures and application of trees
LO4	To learn graph structures and application of graphs
LO5	To understand various sorting and searching

UNIT	**Details**	**No. of Hours**
I	Abstract Data Types (ADTs)- List ADT-array-based implementation-linked list implementation singly linked lists-circular linked lists-doubly-linked lists-applications of lists-Polynomial Manipulation- All Operations-Insertion-Deletion-Merge-Traversal	15
II	Stack ADT-Operations- Applications- Evaluating arithmetic expressions – Conversion of infix to postfix expression-Queue ADT-Operations-Circular Queue- Priority Queue- deQueue applications of queues.	15
III	Tree ADT-tree traversals-Binary Tree ADT-expression trees-applications of trees-binary search tree ADT- Threaded Binary Trees-AVL Trees- B-Tree- B+ Tree – Heap-Applications of heap.	15
IV	Definition- Representation of Graph- Types of graph-Breadth first traversal – Depth first traversal-Topological sort- Bi-connectivity – Cut vertex- Euler Circuits-Applications of graphs.	15
V	Searching- Linear Search-Binary Search-Sorting-Bubble sort-Selection sort-Insertion sort-Shell sort-Radix sort-Hashing-Hash functions-Separate chaining- Open Addressing-Rehashing Extendible Hashing	15
	Total	**75**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Understand the concept of Dynamic memory management, data types, algorithms, Big O notation	PO1,PO6
2	Understand basic data structures such as arrays, linked lists, stacks and queues	PO2
3	Describe the hash function and concepts of collision and its resolution methods	PO2,PO4
4	Solve problem involving graphs, trees and heaps	PO6,PO8
5	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data	PO7

Text Book	
1	1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson

	Education 2014, 4th Edition.
2	Reema Thareja, "Data Structures Using C", Oxford Universities Press 2014, 2nd Edition
Reference Books	
1.	Thomas H.Cormen, Chales E.Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", McGraw Hill 2009, 3rd Edition.
2.	Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education 2003
Web Resources	
1.	NPTEL & MOOC courses titled Data Structures
2.	https://nptel.ac.in/courses/106106127/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**3**	**-**	**1**	**-**
CO 2	**1**	**2**	**1**	**-**	**-**	**-**
CO 3	**3**	**1**	**2**	**1**	**-**	**-**
CO 4	**2**	**2**	**1**	**-**	**-**	**1**
CO 5	**3**	**1**	**1**	**-**	**-**	**-**
Weightage of course contributed to each PSO	12	9	8	1	1	1

S-Strong-3 M-Medium-2 L-Low-1

Title of the Course/ Paper	Subject Name	Category	L	T	P	S			CIA	External	Total
Core Prac. III U23CA3P3	**DATA STRUCTURES AND ALGORITHMS LAB USING C++ LAB**	Core	-	-	Y	-	3	4	40	60	100

Course Objective	
LO1	To understand the concepts of ADTs
LO2	To learn linear data structures-lists, stacks, queues
LO3	To learn Tree structures and application of trees
LO4	To learn graph strutures and and application of graphs
LO5	To understand various sorting and searching

Sl. No	**Details**	**No. of Hours**
1.	Write a program to implement the List ADT using arrays and linked lists.	
2.	Write a programs to implement the following using a singly linked list. • Stack ADT • Queue ADT	
3.	Write a program that reads an infix expression, converts the expression to postfix form and then evaluates the postfix expression (use stack ADT).	
4.	Write a program to implement priority queue ADT.	
5.	Write a program to perform the following operations: • Insert an element into a binary search tree. • Delete an element from a binary search tree. • Search for a key element in a binary search tree.	
6.	Write a program to perform the following operations • Insertion into an AVL-tree • Deletion from an AVL-tree	
7.	Write a programs for the implementation of BFS and DFS for a given graph.	
8	Write a programs for implementing the following searching methods: • Linear search • Binary search.	
9.	Write a programs for implementing the following sorting methods: • Bubble sort • Selection sort • Insertion sort • Radix sort.	
	Total	

Course Outcomes		**Programmem Outcome**
CO	On completion of this course, students will	
1	Understand the concept of Dynamic memory management, data types, algorithms, Big O notation	PO1,PO4,PO5

2	Understand basic data structures such as arrays, linked lists, stacks and queues	PO1, PO4,PO8
3	Describe the hash function and concepts of collision and its resolution methods	PO1,PO3,PO6
4	Solve problem involving graphs, trees and heaps	PO3,PO4
5	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data	PO1,PO5,PO6
Text Book		
1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education 2014, 4th Edition.	
2	Reema Thareja, "Data Structures Using C", Oxford Universities Press 2014, 2nd Edition	
Reference Books		
1	Thomas H.Cormen,Chales E.Leiserson,Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", McGraw Hill 2009, 3rd Edition	
2.	Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education 2003	
Web Resources		
1.	NPTEL & MOOC courses titled Data Structures	
2.	https://nptel.ac.in/courses/106106127/	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**3**	**2**	**1**	**-**
CO 2	**1**	**2**	**1**	**-**	**-**	**2**
CO 3	**3**	**1**	**2**	**1**	**-**	**-**
CO 4	**2**	**2**	**1**	**2**	**3**	**1**
CO 5	**3**	**2**	**1**	**-**	**-**	**-**
Weightage of course contributed to each PSO	12	10	8	5	4	4

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	C	I	Marks		
U23CA3Y3	DIGITAL LOGIC FUNDAMENTALS	Allied III	-	Y	-	-	5	5	25	75	100

Course Objective	
LO1	To learn various number systems.
LO2	To learn various concepts of Boolean algebra.
LO3	To learn about arithmetic and combinational circuits.
LO4	To learn about registers and flip flops.
LO5	To learn about analog and digital conversion.

UNIT	Details	No. of Hours
I	**Number Systems:** Decimal Number System – Binary Number System – Hexadecimal Number System – Octal Number System. Conversions: Binary to Decimal Conversion – Decimal to Binary Conversion – Hexadecimal to Decimal Conversion – Decimal to Hexadecimal Conversion – Binary to Hexadecimal Conversion – Octal to Decimal Conversion – Decimal to Octal Conversion – Octal to Binary Conversion – Binary to Octal Conversion - **Binary Arithmetic**: Binary Addition - Binary Subtraction - Binary Multiplication - Binary Division - 1's and 2's complements - 9's Compliment - 10's Compliment – **Binary Codes:** BCD Codes - 8421 Code - 2421 and 4221 Codes - Excess-3 Code - Gray Code - ASCII Code - EBCDIC Code.	15
II	**Boolean Algebra**: Laws of Boolean Algebra – De Morgan's Laws - **Logic Gates and Logic Circuits:** Basic logic gates – AND, OR, NOT – Combinational Gates - NAND, NOR, XOR, XNOR - Universal Gates – NAND, NOR - Logic circuits and Logic Expressions - Sum of Products (SOP) - Product of Sum (POS) – Karnaugh Map: Minterms and Maxterms – Relationship between K Map and Truth Table – 2-Variable K Map Using Minterms - 3-Variable K Map Using Minterms - 4-Variable K Map Using Minterms – Don't Care Conditions - 5-Variable K Map Using Minterms – K Maps Using Maxterms.	15
III	**Arithmetic Circuits:** Half Adder and Full Adder - Four-bit Binary Adder - Half Subtractor and Full Subtractor - Four Bit Adder/Subtractor Circuit - **Combination Circuit Applications:** Multiplexer, De-multiplexer, Encoder and Decoder - **Flip-Flops:** NAND Latch – SR Flip-Flop, D Flip-Flop, JK Flip-Flop, T Flip-Flop & Master Slave flops.	15
IV	**Registers** – Shift Registers – Shift Left Register – Shift Right Register – Bi-directional Shift Register - **Counters** - Ring Counter - Shift Counter/Johnson's Counter - Asynchronous Counters/Ripple Counter - Mod-2 Counter, Mod-4 Counter, Mod-8 Counter, Mod-16 Counter - Synchronous Counters - Mod-3 Counter, Mod-5 Counter, BCD Counter.	15
V	**D/A Conversion and A/D Conversion:** Variable Resistor Networks – Binary Ladder - D/A Converters - A/D Converter-Simultaneous Conversion – A/D Converter-Counter Method – Continuous A/D Conversion – Dual Slope A/D Conversion.	15
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	

1	Translate number conversions from one number system to another.	PO1
2	Examine logical expressions, basic gates and universal gates.	PO1, PO2
3	Construct adder, subtracter, multiplexer and flip-flops.	PO4, PO6
4	Design arithmetic circuits, combinational circuits and flip-flops.	PO4, PO5, PO6
5	Differentiate various types of registers, counters and memories.	PO3, PO8
Text Book		
1	V. Vijayendran, "Digital Fundamentals", S. Viswanathan (Printers & Publishers) Pvt Ltd, 1st Edition, Reprint, 2015. (UNIT I - IV)	
2	Donald P. Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles and Application", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 7th Edition, 2011. (UNIT - V)	
Reference Books		
1.	M. Morris Mano and Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL, VHDL, and SystemVerilog", Pearson Education, 6th Edition, 2018.	
2.	Donald P. Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles and Application", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 8th Edition, 2014.	
3.	Thomas C. Bartee, "Digital Computer Fundamentals", 6th Edition, Tata Mcgraw Hill, 2011.	
Web Resources		
1.	www.tutorialspoint.com	
2.	https://nptel.ac.in/courses/106106140/	
3.	https://nptel.ac.in/courses/106106126/	

Subject Code	Subject Name	Category	L	T	P	S	C	I	Marks		
U23CA3S4	ENTERPRISE RSOURCE PLANNING	SEC IV	-	Y	-	-	1	1	100	--	100

Course Objective	
LO1	To learn the need for ERP
LO2	To learn various benefits and risks of ERP
LO3	To learn the technologies associated with ERP
LO4	To learn about Markov Decision Process.
LO5	To learn the success and failure in implementation.

UNIT	Details	No. of Hours
I	ERP-Introduction; Advantages- ERP and Business – value creation; Integrated Information Management-Enterprise and ERP, Business modelling-Integrated data model.	4
II	To ERP or not to ERP – Strategic Options-Benefits of ERP: Quantifiable, Intangible-P&G- Risks: People, process, Technology, Implementation, Operational and Managerial risks.	4
III	Introduction to ERP related technologies-Functional modules of ERP software-Implementation of ERP: Life cycle;	4
IV	Implementation methodologies, transition strategies; People involved in implementation.	4
V	Success and failure in implementation – factors. Operation and Maintenance of an ERP system.	4
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Understand the importance of ERP.	PO1
2	Understand various benefits of ERP.	PO1, PO2
3	Understand the technologies involved in ERP.	PO4, PO6
4	Understand the people involved in ERP.	PO4, PO5, PO6
5	Understand the success and failures in ERP.	PO3, PO8

Text Book	
1	Alexis Leon, “Enterprise Resource Planning”, Second Edition, TMH Publishers.

Reference Books	
1.	Vaman, “ERP in practice”, TMH, Publishers.
2.	Daniel E.O’Leary, “Enterprise Resource Planning Systems”, Cambridge University Press,2002.
3.	Ellen Monk, Bret Wagner, “Concepts in Enterprise resource planning”, Cengage learning, Third edition, 2009.

Web Resources	
1.	https://www.oracle.com/in/erp/what-is-erp/
2.	https://www.geeksforgeeks.org/introduction-to-erp/
3.	https://www.javatpoint.com/erp-full-form

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**2**	**3**	**2**	**3**	**2**	**-**
CO 2	**2**	**-**	**2**	**3**	**3**	**2**
CO 3	**1**	**2**	**-**	**-**	**2**	**3**
CO 4	**3**	**1**	**2**	**2**	**2**	**1**
CO 5	**2**	**1**	**3**	**1**	**2**	**2**
Weightage of course contributed to each PSO	10	7	9	9	11	8

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	C	I	Marks		
U23CA3S5	Artificial Intelligence	SEC V	-	Y	-	-	2	5	25	75	100

Course Objective	
LO1	To learn various concepts of AI Techniques.
LO2	To learn various Search Algorithms in AI.
LO3	To learn probabilistic reasoning and models in AI.
LO4	To learn about Markov Decision Process.
LO5	To learn various type of Reinforcement learning.

UNIT	Details	No. of Hours
I	Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree	15
II	Search Algorithms : Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search	15
III	Probabilistic Reasoning : Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.	15
IV	Markov Decision process : MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.	15
V	Reinforcement Learning : Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning	15
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Understand the various concepts of AI Techniques.	PO1
2	Understand various Search Algorithm in AI.	PO1, PO2
3	Understand probabilistic reasoning and models in AI.	PO4, PO6
4	Understand Markov Decision Process.	PO4, PO5, PO6
5	Understand various type of Reinforcement learning Techniques.	PO3, PO8

Text Book	
1	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall.
	Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill

Reference Books	
1.	Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.
2.	Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011
3.	David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010

Web Resources	
1.	NPTEL&MOOCcoursestitledArtificialIntelligenceandExpertSystems
2.	https://nptel.ac.in/courses/106106140/
3.	https://nptel.ac.in/courses/106106126/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**2**	**3**	**2**	**3**	**2**	**-**
CO 2	**2**	**-**	**2**	**3**	**3**	**2**
CO 3	**1**	**2**	**-**	**-**	**2**	**3**
CO 4	**3**	**1**	**2**	**2**	**2**	**1**
CO 5	**2**	**1**	**3**	**1**	**2**	**2**
Weightage of course contributed to each PSO	10	7	9	9	11	8

S-Strong-3 M-Medium-2 L-Low-1

SEMESTER IV

Subject Code	Subject Name	Category	L	T	P	S	Credit	Hours	Marks		
U23CA404	PROGRAMMING IN JAVA	Core IV	Y	-	-	-	5	5	25	75	100

Course Objectives	
LO1	To provide fundamental knowledge of object-oriented programming
LO2	To equip the student with programming knowledge in Core Java from the basics up.
LO3	To enable the students to use AWT controls, Event Handling and Swing for GUI.
LO4	To provide fundamental knowledge of object-oriented programming.
LO5	To equip the student with programming knowledge in Core Java from the basics up.

UNIT	Details	No. of Hours	Course Objectives
I	**Introduction:** Review of Object Oriented concepts – History of Java – Java buzzwords – JVM architecture – Data types - Variables - Scope and life time of variables - arrays - operators – control statements - type conversion and casting - simple java program - constructors - methods - Static block - Static Data – Static Method String and String Buffer Classes.	15	CO1
II	**Inheritance**: Basic concepts - Types of inheritance - Member access rules - Usage of this and Super key word - Method Overloading - Method overriding - Abstract classes - Dynamic method dispatch - Usage of final keyword. **Packages**: Definition- Access Protection –Importing Packages. **Interfaces**: Definition–Implementation–Extending Interfaces. **Exception Handling**: try – catch - throw - throws – finally – Built-in exceptions - Creating own Exception classes.	15	CO2
III	**Multithreaded Programming**: Thread Class - Runnable interface –Synchronization–Using synchronized methods– Using synchronized statement- Interthread Communication –Deadlock. **I/O Streams:** Concepts of streams - Stream classes- Byte and Character stream - Reading console Input and Writing Console output - File Handling.	15	CO3
IV	**AWT Controls:** The AWT class hierarchy - user interface components- Labels - Button - Text Components - Check Box - Check Box Group - Choice - List Box - Panels – Scroll Pane - Menu - Scroll Bar. Working with Frame class - Colour - Fonts and layout managers. **Event Handling:** Events - Event sources - Event Listeners - Event Delegation Model (EDM) - Handling Mouse and Keyboard Events - Adapter classes - Inner classes	15	CO4
V	**Swing:** Introduction to Swing - Hierarchy of swing components. Containers - Top level containers - JFrame -	15	CO5

	JWindow - JDialog - JPanel - JButton - JToggleButton - JCheckBox - JRadioButton - JLabel,JTextField - JTextArea - JList - JComboBox - JScrollPane.		
	Total	**75**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Understand the basic Object-oriented concepts. Implement the basic constructs of Core Java.	PO1, PO2, PO6	
CO2	Implement inheritance, packages, interfaces and exception handling of Core Java.	PO2, PO3, PO8	
CO3	Implement multi-threading and I/O Streams of Core Java	PO1, PO3, PO7	
CO4	Implement AWT and Event handling.	PO2, PO6	
CO5	Use Swing to create GUI.	PO1, PO3, PO8	
Text Books:			
1.	Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010		
2.	Gary Cornell, Core Java 2 Volume I – Fundamentals, Addison Wesley, 1999		
References:			
1.	Head First Java, O'Rielly Publications,		
2.	Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson Education India, 2010		
Web Resources			
1.	https://javabeginnerstutorial.com/core-java-tutorial		
2.	http://docs.oracle.com/javase/tutorial/		
3.	https://www.coursera.org/		

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**-**	**2**	**2**	**2**
CO 2	**3**	**1**	**2**	**1**	**2**	**2**
CO 3	**1**	**-**	**2**	**2**	**2**	**2**
CO 4	**2**	**2**	**2**	**2**	**2**	**2**
CO 5	**1**	**2**	**-**	**2**	**2**	**2**
Weightage of course contributed to each PSO	10	7	6	9	10	10

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	ESE	Total
U23CA4P4	PROGRAMMING IN JAVA LAB	Core Prac. IV	-	-	y	-	3	4	40	60	100
Course Objective											
LO1	To provide fundamental knowledge of object-oriented programming.										
LO2	To equip the student with programming knowledge in Core Java from the basics up.										
LO3	To enable the students to know about Event Handling.										
LO4	To enable the students to use String Concepts.										
LO5	To equip the student with programming knowledge in to create GUI using AWT controls.										
UNIT	**Details**										
1	Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that Integer										
2	Write a Java program to multiply two given matrices.										
3	Write a Java program that displays the number of characters, lines and words in a text										
4	Generate random numbers between two given limits using Random class and print messages according to the range of the value generated.										
5	Write a program to do String Manipulation using Character Array and perform the following string operations: a. String length b. Finding a character at a particular position c. Concatenating two strings										
6	Write a program to perform the following string operations using String class: a. String Concatenation b. Search a substring c. To extract substring from given string										
7	Write a program to perform string operations using String Buffer class: a. Length of a string b. Reverse a string c. Delete a substring from the given string										
8	Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.										
9	Write a threading program which uses the same method asynchronously to print the numbers 1to10 using Thread1 and to print 90 to100 using Thread2.										
10	Write a program to demonstrate the use of following exceptions. a. Arithmetic Exception b. Number Format Exception c. ArrayIndexOutofBoundException d. NegativeArraySizeException										
11	Write a Java program that reads on file name from the user, then										

	displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes	
12	Write a program to accept a text and change its size and font. Include bold italic options. Use frames and controls.	
13	Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired. (Use adapter classes).	
14	Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.	
15	Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with "stop" or "ready" or "go" should appear above the buttons in a selected color. Initially there is no message shown.	
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Understand the basic Object-oriented concepts.Implement the basic constructs of Core Java.	PO1
2	Implement inheritance, packages, interfaces and exception handling of Core Java.	PO1, PO2
3	Implement multi-threading and I/O Streams of Core Java	PO4, PO6
4	Implement AWT and Event handling.	PO4, PO5, PO6
5	Use Swing to create GUI.	PO3, PO8

Text Book	
1	Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010.
2.	Gary Cornell, Core Java 2 Volume I – Fundamentals, Addison Wesley, 1999.
Reference Books	
1.	Head First Java, O'Rielly Publications,
2.	Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson Education India, 2010.
Web Resources	
1.	https://www.w3schools.com/java/
2.	http://java.sun.com
3.	http://www.afu.com/javafaq.html

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**1**	**3**	**2**	**3**
CO 2	**3**	**2**	**1**	**3**	**1**	**3**
CO 3	**3**	**2**	**1**	**3**	**2**	**3**
CO 4	**3**	**2**	**1**	**3**	**2**	**3**
CO 5	**3**	**2**	**1**	**3**	**2**	**3**
Weightage of course contributed to each PSO	15	10	5	15	9	15

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext	Total
U23CA4Y4	Robotics and its Applications	Allied IV	2	-	-	-	5	4	25	75	100

Course Objective	
LO1	To understand the robotics fundamentals
LO2	Understand the sensors and matrix methods
LO3	Understand the Localization:Self-localizations and mapping
LO4	To study about the concept of Path Planning, Vision system
LO5	To learn about the concept of robot artificial intelligence

UNIT	Details	No. of Hours
I	Introduction: Introduction, brief history, components of robotics, classification, workspace, work-envelop, motion of robotic arm, end-effectors and its types, service robot and its application, Artificial Intelligence in Robotics.	6
II	Actuators and sensors: Types of actuators-purpose of sensor-internal and external sensor-common sensors-encoders tachometers-strain gauge based force torque sensor-proximity and distance measuring sensors. Kinematics of robots: Representation of joints and frames, frames transformation, homogeneous matrix, D-Hmatrix, Mobile robot Kinematics: Differential wheel mobile robot.	6
III	Localization: Self-localizations and mapping - Challenges inlocalizations–IRbasedlocalizations–visionbasedlocalizations–Ultrasonicbasedlocalizations-GPSlocalizationsystems.	6
IV	Path Planning: Introduction, path planning-overview-road map path planning-cell decomposition path planning	6
	potential field path planning-obstacle avoidance-case studies Vision system: Robotic vision systems-image representation-object recognition-and categorization-depth measurement-image data compression-visual inspection-software considerations.	
V	Application: Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian-and military applications-nuclear applications-space Applications-Industrial robots-artificial intelligence in robots-	6

	application of robots in material handling-continuous arc welding-spot welding-spray painting-assembly operation-cleaning-etc.	
	Total	30
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Describe the different physical forms of robot architectures.	PO1
2	Kinematically model simple manipulator and mobile robots.	PO1, PO2
3	Mathematically describe a kinematic robot system	PO4, PO6
4	Analyze manipulation and navigation problems using knowledge of coordinate frames, kinematics, optimization, control, and uncertainty.	PO4, PO5, PO6
5	Program robotics algorithms related to kinematics, control, optimization and uncertainty.	PO3,PO8
Text Book		
1	Richared D. Klafter. Thomas Achmielewskiand Mickael Negin, Robotic Engineering and Integrated Approach, Prentice Hall India-Newdelhi-2001	
2	SaeedB. Nikku, Introduction to robotics, analysis, control and applications, Wiley-India,2 nd edition2011	
Reference Books		
1.	Industrial robotic technology-programming and application by M.P.Groover et.al, McGrawhill2008	
2.	Robotics technology and flexible automation by S.R.Deb,THH-2009	
Web Resources		
1.	https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_robotics.htm	
2.	https://www.geeksforgeeks.org/robotics-introduction/	

Mapping with Programme Outcomes:

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**2**	**2**	**2**	**1**	**3**	**-**
CO2	**2**	**2**	**2**	**3**	**1**	**3**
CO3	**3**	**2**	**3**	**2**	**1**	**3**
CO4	**3**	**3**	**2**	**2**	**2**	**1**
CO5	**3**	**2**	**1**	**3**	**3**	**3**
Weightage of course contributed to each PSO	13	11	10	11	10	10

S-Strong-3 M-Medium-2L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	C	I	Marks		
U23CA4S7	SMART APPLICATION DEVELOPMENT FOR RURAL COMMUNITY	SEC VII	-	Y	-	-	2	5	100	--	100
Course Objective											
LO1	Describe basic concepts of service learning										
LO2	Design and conclude on a software model										
LO3	Compare the various design notations										
LO4	Analyze the issues in the environment										
LO5	Describe the testing and maintenance activities to be carried out										

UNIT	Details	No. of Hours
I	**SERVICE-LEARNING:** Service-Learning – Definition, Difference between community service and service-learning, Principles; Whole Person Education. Identifying Community Needs, Community Partners, Reflection, Reciprocity. Public Dissemination; Understanding of community dynamics. Project Planning Stages and report preparation **Classroom Activity:** i. Group discussion about Civic/Social responsibility (Display of Video/Documentary film (Through this activity Students should recognize civic responsibility of the society) ii. Conduct a role play/games/drawing to provide problem solving skill and ignites critical thinking. iii. Group activity to frame questionnaire for identify community needs iv. Reflection on identify the need of the community (Students go to the community for identify the community needs and reflect their experience)	15
II	**SOFTWARE PROCESS MODELS** Software Process Models – Choice of process model - Managing interactive processes – Basics of Software estimation techniques. Classroom Activity: i. Group discussion about Software Models (Display of Video/Documentary film (Through this activity Students should recognize the fundamentals of Software Process Models) ii. Conduct a demo on software development process and software estimation will assist the students for preparing the application. iii. Group activity to frame questionnaire for managing application interactive processes.	15
III	**SOFTWARE PLANNING & TESTING**	15

	Design Notations – Design Techniques – Detailed Design Considerations – Design Guidelines -Design Thinking tools- Real Time and Distributed Systems – Test Plans – Milestones, Walkthroughs and Inspections. Classroom Activity: i. Group discussion about Design Techniques (Display of Video/Documentary film (Through this activity Students should recognize the Design Notations) ii. Conduct a game/ Prepare Design to provide Real Time and Distributed Systems. iii. Group activity to frame questionnaire for identifying Test Plans (Students will test the developed applications with the planned Milestones, Walkthroughs and Inspections)	
IV	**SMART APPLICATION DEVELOPMENT** Issues Identification - Data collection – User Interface techniques - Developing Smart Applications – Storing and retrieving Data. Field Activity: i. Students will go to the field for Issues Identification and Data collection. ii Interaction with community and Students identify the appropriate User Interfaces for application. iii Group discussion for Involving in Developing Smart Applications.	15
V	**LAUNCHING AND MAINTENANCE** Testing - Alpha and Beta Testing – Risk factors – Hosting - Support and Maintenance. Field Activity i. Group discussion for the Issues found during the Alpha and Beta Testing. ii Interaction with community and Students identify the Risk factors for the application. iii Group discussion for Involving in Hosting the application, Support and Maintenance.	15
	Total	**75**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	To comprehend the key concepts of S-L and differentiate the community service and Service-Learning	PO1
2	Discuss the software engineering principles collaboratively with the community.	PO1, PO2
3	Construct a Plan for community development through e-content launches and smart application creation.	PO4, PO5
4	Develop a prototype or model for the smart application that meet the community needs.	PO4, PO5, PO6

5	Formulate support and maintenance of the system for the developed applications.	PO3, PO4
Text Book		
1	Roger S. Pressman, "Software Engineering: A practitioners approach" , Mc Grew Hill Publishers, Seventh Edition, 2010. (Unit 2 & 3)	
2	Barry Burd, "Android application development for Dummies", Wiley Publishers, 2014.	
Reference Books		
1.	Arsdheep Bhaga, Vijay Midisetti "Internet of things – A Hands on approach ", Universities Press, First Edition, 2015.	
2.	Chandramouli Subramanian, Saikat Dutt, B.G. Geetha, "Software Engineering", Pearson India Education, 2015.	
Web Resources		
1.	https://www.suffolk.edu/student-life/student-involvement/community-public-service/service-learning/what-is-service-learning	
2.	https://www.edutopia.org/blog/what-heck-service-learning-heather-wolpert-gawron	
3.	https://serc.carleton.edu/sp/library/service/index.html	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**1**	**3**	**-**	**3**
CO 2	**-**	**-**	**1**	**-**	**2**	**-**
CO 3	**3**	**2**	**1**	**3**	**-**	**3**
CO 4	**3**	**-**	**1**	**-**	**2**	**3**
CO 5	**3**	**2**	**1**	**3**	**2**	**3**
Weightage of course contributed to each PSO	12	6	5	9	6	12

S-Strong-3 M-Medium-2 L-Low-1

THIRD YEAR

SEMESTER V

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	Ext	Total
U23CA505	OPERATING SYSTEMS	Core V	Y	-	-	-	4	5	25	75	100

Course Objective	
LO1	Understanding the design of the Operating Systems
LO2	Imparting knowledge on CPU scheduling, Process and Memory Management.
LO3	To code specialized programs for managing overall resources and operations of the computer.
LO4	To study about the concept of Job and processor scheduling
LO5	To learn about the concept of memory organization and multiprogramming

UNIT	Details	No. of Hours	Course Objective
I	**Introduction**: operating system, history (1990s to 2000 and beyond), distributed computing, parallel computation. **Process concepts:** definition of process, process states-Life cycle of a process, process management- process state transitions, process control block(PCB), process operations , suspend and resume, context switching, Interrupts -Interrupt processing, interrupt classes, Inter process communication-signals, message passing.	15	CO1
II	**Asynchronous concurrent processes:** mutual exclusion-critical section, mutual exclusion primitives, implementing mutual exclusion primitives, Peterson's algorithm,software solutions to the mutual Exclusion Problem-, n-thread mutual exclusion- Lamports Bakery Algorithm. Semaphores – Mutual exclusion with Semaphores, thread synchronization with semaphores, counting semaphores, implementing semaphores. **Concurrent programming:** monitors, message passing	15	CO2
III	**Deadlock and indefinite postponement:** Resource concepts, four necessary conditions for deadlock, deadlock prevention, deadlock avoidance and Dijkstra's Banker's algorithm, deadlock detection, deadlock recovery.	15	CO3
IV	**Job and processor scheduling:** scheduling levels, scheduling objectives, scheduling criteria, preemptive vs non-preemptive scheduling, interval timer or interrupting clock, priorities, scheduling algorithms- FIFO scheduling, RR scheduling, quantum size, SJF scheduling, SRT scheduling, HRN scheduling, multilevel feedback queues, Fair share scheduling.	15	CO4
V	**Real Memory organization and Management**:**:** Memory organization, Memory management, Memory hierarchy, Memory management strategies, contiguous vs non-contiguous memory allocation, single user contiguous memory allocation, fixed partition multiprogramming, variable partition multiprogramming, Memory swapping **Virtual Memory organization:** virtual memory basic concepts, multilevel storage organization,	15	CO5

	block mapping, paging basic concepts, segmentation, paging/segmentation systems. **Virtual Memory Management:** Demand Paging, Page replacement strategies		
	Total	**75**	

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Define the fundamentals of OS and identify the concepts relevant to process , process life cycle, Scheduling Algorithms, Deadlock and Memory management	PO1
2	know the critical analysis of process involving various algorithms, an exposure to threads and semaphores	PO1, PO2
3	Have a complete study about Deadlock and its impact over OS. Knowledge of handling Deadlock with respective algorithms and measures to retrieve from deadlock. .	PO4, PO6
4	Have complete knowledge of Scheduling Algorithms and its types.	PO4, PO5, PO6
5	Understand memory organization and management	PO3, PO8
Text Book		
1	H.M. Deitel, Operating Systems, Third Edition, Pearson Education Asia, 2011	
Reference Books		
1.	William Stallings, Operating System: Internals and Design Principles, Seventh Edition, Prentice-Hall of India, 2012.	
2.	A. Silberschatz, and P.B. Galvin., Operating Systems Concepts, Nineth Edition, John Wiley &Sons(ASIA) Pte Ltd.,2012	
Web Resources		
1.	https://www.geeksforgeeks.org/what-is-an-operating-system/	
2.	https://www.tutorialspoint.com/operating_system/os_overview.htm	

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	**3**	**-**	**1**	**2**	**-**	**1**
CO 2	**2**	**3**	**1**	**2**	**-**	**1**
CO 3	**3**	**2**	**-**	**3**	**-**	**1**
CO 4	**1**	**3**	**1**	**1**	**3**	**2**
CO 5	**3**	**-**	**1**	**3**	**2**	**1**
Weightage of course contributed to each PSO	12	8	4	11	5	6

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	ESE	Total
U23CA506	ASP .Net Programming	Core VI	Y	-	-	-	4	5	25	75	100

Course Objective	
LO1	To identify and understand the goals and objectives of the .NET framework and ASP.NET with C# language.
LO2	To develop ASP.NET Web application using standardcontrols.
LO3	To implement file handling operations.
LO4	To handles SQL Server Database using ADO.NET.
LO5	Understand the Grid view control and XML classes.

UNIT	Details	No. of Hours	Course Objective
I	Overview of .NET framework: Common Language Runtime (CLR), Framework Class Library- C# Fundamentals: Primitive types and Variables – Operators - Conditional statements -Looping statements – Creating and using Objects – Arrays – String operations.	15	C1
II	Introduction to ASP.NET - IDE-Languages supported Components -Working with Web Forms – Web form standard controls: Properties and its events – HTML controls -List Controls: Properties and its events.	15	C2
III	Rich Controls: Properties and its events –validation controls: Properties and its events– File Stream classes - File Modes – File Share – Reading and Writing to files –Creating, Moving, Copying and Deleting files – File uploading.	15	C3
IV	ADO.NET Overview – Database Connections – Commands – Data Reader - Data Adapter - Data Sets - Data Controls and its Properties – Data Binding	15	C4
V	Grid View control: Deleting, editing, Sorting and Paging. XML classes – Web form to manipulate XML files - Website Security - Authentication - Authorization – Creating a Web application.	15	C5
	Total	**60**	

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Develop working knowledge of C# programming constructs and the .NET Framework	PO1, PO2, PO6
2	To develop a software to solve real-world problems using ASP.NET	PO2, PO3, PO8
3	To Work On Various Controls Files	PO1, PO3, PO7
4	To create a web application using MicrosoftADO.NET.	PO2, PO6
5	To develop web applications using XML	PO1, PO3, PO8

Text Book	
1	SvetlinNakov, VeselinKolev & Co, “Fundamentals of Computer Programming with C#”, Faber publication,2019.

2	Mathew, Mac Donald, "The Complete Reference ASP.NET", Tata McGraw-Hill,2015.
Reference Books	
1.	Herbert Schildt, "The Complete Reference C#.NET", TataMcGraw-Hill,2017.
2.	Kogent Learning Solutions, "C# 2012 Programming Covers .NET 4.5 Black Book", Dreamtech press, 2013.
3.	Anne Boehm, Joel Murach, " Murach's C# 2015", Mike Murach & Associates Inc.2016.
4.	Denielle Otey, Michael Otey, "ADO.NET: The Complete reference", McGrawHill,2008.
5.	Matthew MacDonald, "Beginning ASP.NET 4 in C# 2010", APRESS, 2010.
Web Resources	
1.	https://www.geeksforgeeks.org/introduction-to-net-framework/
2.	https://www.javatpoint.com/net-framework

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**1**	**2**	**2**	**1**	3
CO 2	**3**	**2**	**2**	**2**	**2**	3
CO 3	**3**	**3**	**2**	**2**	**3**	3
CO 4	**3**	**1**	**2**	**2**	**1**	3
CO 5	**3**	**1**	**2**	**2**	**1**	2
Weightage of course contributed to each PSO	15	8	10	10	8	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	Ext	Tot
U23CA5P5	ASP.NET PROGRAMMING LAB	Core Prac. V	-	-	Y	-	4	6	40	60	100

Course Objective	
LO1	To develop ASP.NET Web application using standard controls.
LO2	To create rich database applications usingADO.NET.
LO3	To implement file handling operations.
LO4	To implement XML classes.
LO5	To utilize ASP.NET security features for authenticating the website

Sl. No	Programs		Course Objectives
1.	Create an exposure of Web applications and tools		C1
2.	Implement the Html Controls		
3.	Implement the Server Controls		
4.	Web application using Web controls.		
5.	Web application using List controls.		
6.	Web Page design using Rich control. Validate user input using Validation controls. Working with File concepts.		C2
7.	Web application using Data Controls.		
8.	Data binding with Web controls		
9.	Data binding with Data Controls.		
10.	Database application to perform insert, update and delete operations.		C3
11.	Database application using Data Controls to perform insert, delete, edit, paging and sorting operation.		
12.	Implement the Xml classes.		C4
13.	Implement Authentication – Authorization.		C5
14.	Ticket reservation using ASP.NET controls.		
15.	Online examination using ASP.NET controls		
	Total		

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	To create web applications and implement various controls	PO1, PO2, PO6
2	Create a web pages in Rich control.	PO3, PO8
3	Develop knowledge about file handling operations	PO1, PO4, PO8
4	An ability to design XML classes	PO2, PO6, PO7
5	To develop a software to solve real-world problems using ASP.NET	PO1,PO3, PO5, PO8

Text Book	
1	Svetlin Nakov,Veselin Kolev & Co, “Fundamentals of Computer Programming with C#”, Faber publication,2019.
2	Mathew, Mac Donald, “The Complete Reference ASP.NET”, Tata McGraw-Hill,2015.

Reference Books	
1.	Herbert Schildt, “The Complete Reference C#.NET”, TataMcGraw-Hill,2017.
2.	Kogent Learning Solutions, “C# 2012 Programming Covers .NET 4.5 Black Book”, Dream Tech Press,2013.
3.	Anne Boehm, Joel Murach, “Murach’s C# 2015”, Mike Murach & Associates Inc.2016.
4.	Denielle Otey, Michael Otey, “ADO.NET: The Complete Reference”, McGraw Hill,2008.
5.	Matthew MacDonald, “Beginning ASP.NET 4 in C# 2010”, APRESS,2010.
Web Resources	
1.	https://www.geeksforgeeks.org/introduction-to-net-framework/
2.	https://www.javatpoint.com/net-framework

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**2**	**2**	**1**	1
CO 2	**3**	**2**	**3**	**2**	**2**	2
CO 3	**3**	**3**	**2**	**2**	**1**	1
CO 4	**3**	**2**	**3**	**2**	**1**	1
CO 5	**3**	**2**	**2**	**2**	**1**	2
Weightage of course contributed to each PSO	**15**	11	12	10	6	7

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	Ext	Tot
U23CA5PJ	**CORE PROJECT WITH VIVA VOCE**	Core Project	-	Y	-	-	4	4	20	80	100

Subject Code	Subject Name	Cat	L	T	P	S	C	I	Marks		
U23CA5:A	DATABASE MANAGEMENT SYSTEM	Elective	-	Y	-	-	3	4	25	75	100

Course Objective	
LO1	Describe basic concepts of database system
LO2	Design a Data model and Schemas in RDBMS
LO3	Competent in use of SQL
LO4	Analyze functional dependencies for designing robust Database
LO5	Describe basic concepts of database system

UNIT	Details	No. of Hours
I	UNIT - I Introduction to DBMS– Data and Information - Database – Database Management System – Objectives - Advantages – Components - Architecture. ER Model: Building blocks of ER Diagram – Relationship Degree – Classification – ER diagram to Tables – ISA relationship – Constraints – Aggregation and Composition – Advantages	15
II	Relational Model: CODD's Rule- Relational Data Model - Key - Integrity – Relational Algebra Operations – Advantages and limitations – Relational Calculus – Domain Relational Calculus - QBE.	15
III	Structure of Relational Database. Introduction to Relational Database Design - Objectives – Tools – Redundancy and Data Anomaly – Functional Dependency - Normalization – 1NF – 2NF – 3NF – BCNF. Transaction Processing – Database Security.	15
IV	UNIT - IV SQL: Commands – Data types – DDL - Selection, Projection, Join and Set Operations – Aggregate Functions – DML – Modification - Truncation - Constraints – Subquery.	15
V	UNIT - V PL/SQL: Structure - Elements – Operators Precedence – Control Structure – Iterative Control - Cursors - Procedure - Function - Packages – Exceptional Handling - Triggers.	15
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Understand basic concepts of database system	PO1
2	Design a Data model and Schemas in RDBMS	PO1, PO2
3	Understand Competent in use of SQL	PO4, PO6
4	Analyze functional dependencies for designing robust Database	PO4, PO5, PO6
5	Understand basic concepts of database system	PO3, PO8

Text Book	
1	TEXT BOOK: 1. S. Sumathi, S. Esakkirajan, "Fundamentals of Relational Database Management System", Springer International Edition 2007.

Reference Books	
1.	REFERENCE BOOKS:

2.	1. Abraham Silberchatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGrawHill 2019, 7th Edition.
3.	2. Alexis Leon & Mathews Leon, "Fundamentals of DBMS", Vijay Nicole Publications 2014, 2nd Edition.
Web Resources	
1.	NPTEL & MOOC courses titled Relational Database Management Systems
2.	https://nptel.ac.in/courses/106106093/
3.	https://nptel.ac.in/courses/106106095/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**1**	**3**	**-**	**-**
CO 2	**-**	**-**	**1**	**-**	**2**	**2**
CO 3	**3**	**2**	**1**	**3**	**-**	**-**
CO 4	**3**	**-**	**1**	**-**	**2**	**2**
CO 5	**3**	**2**	**1**	**3**	**2**	**2**
Weightage of course contributed to each PSO	12	6	5	9	6	6

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	ESE	Total
U23CA5:B	Artificial Neural Networks		-	Y	-	-	3	5	25	75	100

Course Objective	
LO1	Understand the basics of artificial neural networks, learning process, single layer and multi-layer perceptron networks.
LO2	Understand the Error Correction and various learning algorithms and tasks.
LO3	Identify the various Single Layer Perception Learning Algorithm.
LO4	Identify the various Multi-Layer Perception Network.
LO5	Analyze the Deep Learning of various Neural network and its Applications.

UNIT	Details	No. of Hours
I	Artificial Neural Model- Activation functions- Feed forward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem - Multilayer Networks. Learning Algorithms- Error correction - Gradient Descent Rules, Perception Learning Algorithm, Perception Convergence Theorem.	15
II	Introduction, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning, Boltzmann learning, credit assignment problem, Learning with and without teacher, learning tasks, Memory and Adaptation.	15
III	Single layer Perception: Introduction, Pattern Recognition, Linear classifier, Simple perception, Perception learning algorithm, Modified Perception learning algorithm, Adaptive linear combiner, Continuous perception, Learning in continuous perception. Limitation of Perception.	15
IV	Multi-Layer Perception Networks: Introduction, MLP with 2 hidden layers, Simple layer of a MLP, Delta learning rule of the output layer, Multilayer feed forward neural network with continuous perceptions, Generalized delta learning rule, Back propagation algorithm	15
V	Deep learning- Introduction- Neuro architectures building blocks for the DL techniques, Deep Learning and Neocognitron, Deep Convolutional Neural Networks, Recurrent Neural Networks (RNN), feature extraction, Deep Belief Networks, Restricted Boltzman Machines, Training of DNN and Applications	15
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Students will learn the basics of artificial neural networks with single layer and multi-layer perception networks.	PO1
2	Learn about the Error Correction and various learning algorithms and tasks.	PO1, PO2
3	Learn the various Perception Learning Algorithm.	PO4, PO6
4	Learn about the various Multi-Layer Perception Network.	PO4, PO5, PO6
5	Understand the Deep Learning of various Neural network and its Applications.	PO3, PO8

Text Book	
1	Neural Networks A Classroom Approach- Satish Kumar, McGraw Hill- Second Edition.
2.	"Neural Network- A Comprehensive Foundation"- Simon Haykins, Pearson Prentice Hall, 2nd Edition, 1999.
Reference Books	
1.	Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.
Web Resources	
1.	https://www.w3schools.com/ai/ai_neural_networks.asp
2.	https://en.wikipedia.org/wiki/Artificial_neural_network
3.	https://link.springer.com/chapter/10.1007/978-3-642-21004-4_12

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	2	3	2	2	-	1
CO 2	3	2	3	2	3	3
CO 3	3	1	2	2	2	3
CO 4	2	3	3	1	3	1
CO 5	3	3	3	3	3	3
Weightage of course contributed to each PSO	13	12	13	10	11	11

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cred	Inst.	Marks		
									C I	E xt	T ot al
U23CA5I1	**INTERNSHIP/INDUSTRIAL TRAINING(SUMMER)**	Internship	-	Y	-	-	2	--	100	--	100

SEMESTER VI

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	End	Total
U23CA607	Computer Networks	Core VII	-	Y	-	-	4	6	25	75	100

Course Objective	
LO1	To understand the concept of Data communication and Computer network.
LO2	To get a knowledge on routing algorithms.
LO3	To impart knowledge about networking and inter networking devices
LO4	To study about Network communication.
LO5	To learn the concept of Transport layer

UNIT	Details	No. of Hours
I	Introduction – Network Hardware – Software – Reference Models – OSI and TCP/IP Models – Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer – Theoretical Basis for Data Communication - Guided Transmission Media	15
II	Wireless Transmission - Communication Satellites – Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues – Error Detection and Correction.	15
III	Elementary Data Link Protocols - Sliding Window Protocols – Data Link Layer in the Internet - Medium Access Layer – Channel Allocation Problem – Multiple Access Protocols – Bluetooth	15
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms – IP Protocol – IP Addresses – Internet Control Protocols.	15
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection – Simple Transport Protocol – Internet Transporet Protocols (ITP) - Network Security: Cryptography.	15
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	To Understand the basics of Computer Network architecture, OSI and TCP/IP reference model	PO1
2	To gain knowledge on Telephone systems using wireless network	PO1, PO2
3	To understand the concept of MAC	PO4, PO6
4	To analyze the characteristics of Routing and Congestion control algorithms	PO4, PO5, PO6
5	To understand network security and define various protocols such as FTP, HTTP, Telnet, DNS	PO3, PO8

Text Book	
1	A. S. Tanenbaum, "Computer Networks", 4th Edition, Prentice-Hall of India, 2008.
Reference Books	
1.	B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition, 2017
2.	F. Halsall, "Data Communications, Computer Networks and Open Systems", Pearson Education, 2008

3.	D. Bertsekas and R. Gallagher, “Data Networks”, 2nd Edition, PHI, 2008.
4.	Lamarca, “Communication Networks”, Tata McGraw- Hill, 2002
Web Resources	
1.	https://en.wikipedia.org/wiki/Computer_network
2.	https://citationsy.com/styles/computer-networks

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**-**	**2**	**1**	**-**
CO 2	**3**	**2**	**1**	**2**	**2**	**-**
CO 3	**3**	**-**	**-**	**2**	**-**	**2**
CO 4	**3**	**1**	**-**	**2**	**1**	**-**
CO 5	**3**	**3**	**-**	**2**	**1**	**-**
Weightage of course contributed to each PSO	15	8	1	10	5	2

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cr	Ins	Marks		
									CIA	Ext	Tot
U23CA608	DATA ANALYTICS USING R Programming	Core VIII	Y	-	-	-	4	6	25	75	100

Course Objective	
LO1	To understand the problem solving approaches
LO2	To learn the basic programming constructs in R Programming
LO3	To learn the basic programming constructs in R Programming
LO4	To use R Programming data structures - lists, tuples, and dictionaries.
LO5	To do input/output with files in R Programming.

UNIT	Details	No. of Hours	Course Objective
I	Evolution of Big data — Best Practices for Big data Analytics — Big data characteristics — Validating — The Promotion of the Value of Big Data — Big Data Use Cases- Characteristics of Big Data Applications — Perception and Quantification of Value -Understanding Big Data Storage — A General Overview of High-Performance Architecture — HDFS — MapReduce and YARN — Map Reduce Programming Model	18	C1
II	CONTROL STRUCTURES AND VECTORS -Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations	18	C2
III	LISTS- Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations	18	C3
IV	FACTORS AND TABLES - Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions R PROGRAMMING .	18	C4

V	OBJECT-ORIENTED PROGRAMMING S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation	18	C5
	Total	**90**	

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Work with big data tools and its analysis techniques.	PO1
2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO2
3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO4, PO6
4	Perform analytics on data streams.	PO4, PO5, PO6
5	Learn NoSQL databases and management.	PO3, PO8
Text Book		
1	Roger D. Peng, "R Programming for Data Science", 2012.	
2	Norman Matloff, "The Art of R Programming- A Tour of Statistical Software Design", 2011.	
Reference Books		
1.	Garrett Grolemund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014.	
2.	Venables , W.N. and Ripley, "S programming", Springer, 2000.	
Web Resources		
1.	https://www.simplilearn.com	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**-**	**3**	**1**	**-**
CO 2	**3**	**3**	**2**	**2**	**-**	**2**
CO 3	**1**	**2**	**3**	**1**	**2**	**1**
CO 4	**2**	**2**	**1**	**-**	**2**	**1**
CO 5	**2**	**2**	**2**	**1**	**3**	**1**
Weightage of course contributed to each PSO	11	11	8	7	8	5

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Cre	Inst	CIA	Extern	Total
U23CA6P6	R PROGRAMMING - LAB	Core Prac.VI	-	-	Y	-	4	6	40	60	100

Course Objective	
LO1	To understand the problem-solving approaches.
LO2	To learn the basic programming constructs in R Programming.
LO3	To practice various computing strategies for R Programming -based solutions to real world problems.
LO4	To use R Programming data structures - lists, tuples, and dictionaries.
LO5	To do input/output with files in R Programming.

Sl. No	Details	
1.	Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.	
2.	Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.	
3.	Write a program to find list of even numbers from 1 to n using R-Loops.	
4.	Create a function to print squares of numbers in sequence.	
5.	Write a program to join columns and rows in a data frame using cbind() and rbind() in R.	
6.	Implement different String Manipulation functions in R.	
7.	Implement different data structures in R (Vectors, Lists, Data Frames)	
8	Write a program to read a csv file and analyze the data in the file in R.	
9	Create pie chart and bar chart using R.	
10	10. Create a data set and do statistical analysis on the data using R.	
11	Program to find factorial of the given number using recursive function	
12	Write a R program to count the number of even and odd numbers from array of N numbers.	
	Total	

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
1	Acquire programming skills in core R Programming	PO1,PO4,PO5
2	Acquire Object-oriented programming skills in R Programming.	PO1, PO4,PO8
3	Develop the skill of designing graphical-user interfaces (GUI) in R Programming	PO1,PO3,PO6
4	Acquire R Programming skills to move into specific branches	PO3,PO4
5		PO1,PO5,PO6

Text Book	
1	Roger D. Peng," R Programming for Data Science ", 2012
2	Norman Matloff, "The Art of R Programming- A Tour of Statistical Software Design", 2011

Reference Books	
1	Garrett Grolemund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014

2.	Venables , W.N.,and Ripley, “S programming”, Springer, 2000.
Web Resources	
1.	https://www.simplilearn.com

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**3**	**3**	**3**	**1**	**2**
CO 2	**2**	**3**	**3**	**3**	**1**	**2**
CO 3	**2**	**3**	**3**	**3**	**1**	**2**
CO 4	**2**	**3**	**3**	**3**	**1**	**2**
CO 5	**2**	**3**	**3**	**3**	**1**	**2**
Weightage of course contributed to each PSO	11	15	15	15	5	10

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	Ex	To
U23CA6:A	CRYPTOGRAPHY	Elective III	5	-	-	-	3	25	75	100

Learning Objectives		
LO1	To understand the fundamentals of Cryptography.	
LO2	To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.	
LO3	To understand the various key distribution and management schemes.	
LO4	To understand how to deploy encryption techniques to secure data in transit across data networks.	
LO5	To design security applications in the field of Information technology.	
UNIT	**Contents**	**No. Of. Hours**
I	**Introduction:** The OSI security Architecture – Security Attacks – Security Mechanisms – Security Services – A model for network Security.	**12**
II	**Classical Encryption Techniques:** Symmetric cipher model – **Substitution Techniques:** Caesar Cipher – Monoalphabetic cipher – Play fair cipher – Poly Alphabetic Cipher – Transposition techniques – Stenography	**12**
III	**Block Cipher and DES:** Block Cipher Principles – DES – The Strength of DES –**RSA:** The RSA algorithm.	**12**
IV	**Network Security Practices**: IP Security overview - IP Security architecture – Authentication Header. **Web Security**: Secure Socket Layer and Transport Layer Security – Secure Electronic Transaction.	**12**
V	Intruders – Malicious software – Firewalls.	**12**
	TOTAL HOURS	**60**

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Analyze the vulnerabilities in any computing system and hence be able to design a security solution.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Apply the different cryptographic operations of public key cryptography	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Apply the various Authentication schemes to simulate different applications.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand various Security practices and System security standards	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	**William Stallings,** "Cryptography and Network Security Principles andPractices".
Reference Books	
1.	**Behrouz A. Foruzan,** "Cryptography and Network Security", Tata McGraw-Hill, 2007.
2	**AtulKahate**, "*Cryptography and Network Security*", Second Edition, 2003,TMH.

3	**M.V. Arun Kumar**, "*Network Security*", 2011, First Edition,USP.
	Web Resources
1	https://www.tutorialspoint.com/cryptography/
2	https://gpgtools.tenderapp.com/kb/how-to/introduction-to-cryptography

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	1	2	3	2
CO 2	3	2	3	2	3	3
CO 3	2	3	2	2	2	1
CO 4	2	3	3	1	2	3
CO 5	3	2	3	3	3	3
Weightage of course contributed to each PSO	13	13	12	10	13	12

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Cat	L	T	P	S	C	I	Marks		
U23CA6:B	SOFTWARE ENGINEERING	Elective IV	Y	-	-	-	3	5	25	75	100

Course Objectives	
LO1	Gain basic knowledge of analysis and design of systems
LO2	Ability to apply software engineering principles and techniques
LO3	Model a reliable and cost-effective software system
LO4	Ability to design an effective model of the system
LO5	Perform Testing at various levels and produce an efficient system.

UNIT	Details	No. of Hours	Course Objectives
I	**Introduction**: The software engineering discipline, programs vs. software products, why study software engineering, emergence of software engineering, Notable changes in software development practices, computer systems engineering. **Software Life Cycle Models**: Why use a life cycle model, Classical waterfall model, iterative waterfall model, prototyping model, evolutionary model, spiral model, comparison of different life cycle models.	12	CO1
II	**Requirements Analysis and Specification:** Requirements gathering and analysis, Software requirements specification (SRS) **Software Design**: Good software design, cohesion and coupling, neat arrangement, software design approaches, object- oriented vs function-oriented design	12	CO2
III	**Function-Oriented Software Design:** Overview of SA/SD methodology, structured analysis, data flow diagrams (DFD's), structured design, detailed design.**User-Interface design:** Characteristics of a good interface; basic concepts; types of user interfaces; component based GUI development, a user interface methodology.	12	CO3
IV	**Coding and Testing:** Coding; code review; testing; testing in the large vs testing in the small; unit testing; black-box testing; white-box testing; debugging; program analysis tools; integration testing; system testing; some general issues associated with testing.**Software Reliability and Quality Management:** Software reliability; statistical testing; software quality; software quality management system; SEI capability maturity model; personal software process.	12	CO4
V	**Computer Aided Software Engineering:** CASE and its scope; CASE environment; CASE support in software life cycle; other characteristics of CASE tools; towards second generation CASE tool; architecture of a CASE environment. **Software Maintenance:** Characteristic of	12	CO5

	software maintenance; software reverse engineering; software maintenance process models; estimation of maintenance cost;		
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Gain basic knowledge of analysis and design of systems	PO1	
CO2	Ability to apply software engineering principles and techniques	PO1, PO2	
CO3	Model a reliable and cost-effective software system	PO4, PO6	
CO4	Ability to design an effective model of the system	PO4, PO5, PO6	
CO5	Perform Testing at various levels and produce an efficient system.	PO3, PO8	
Text Books			
1.	Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, Prentice-Hall of India, 2018.		
References Books			
1.	Richard Fairley, Software Engineering Concepts, Tata McGraw-Hill publishing company Ltd, Edition 1997.		
2.	Roger S. Pressman, Software Engineering, Seventh Edition, McGraw-Hill.		
3.	James A. Senn, Analysis & Design of Information Systems, Second Edition, McGraw-Hill International Editions.		

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**3**	**2**	**1**	**-**
CO 2	**3**	**-**	**1**	**-**	**-**	**2**
CO 3	**1**	**2**	**3**	**2**	**2**	**1**
CO 4	**3**	**-**	**2**	**2**	**-**	**1**
CO 5	**1**	**2**	**3**	**3**	**1**	**1**
Weightage of course contributed to each PSO	11	6	12	9	4	5

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Date	L	T	P	S	C	In	Marks		
U23CA6G1	QUANTITATIVE APTITUDE	PCS	Y	-	-	-	2	2	100	--	100

Course Objective	
LO1	To understand the basic concepts of numbers
LO2	Understand and apply the concept of percentage, profit & loss
LO3	To study the basic concepts of time and work, interests
LO4	To learn the concepts of permutation, probability, discounts
LO5	To study about the concepts of data representation, graphs

UNIT	Details	No. of Hours	Course Objective
I	Numbers-HCF and LCM of numbers-Decimal fractions - Simplification-Square root and cube roots - Average-problems on Numbers.	6	CO1
II	Problems on Ages - Surds and Indices - percentage - profits and loss - ratio and proportion-partnership-Chain rule.	6	CO2
III	Time and work - pipes and cisterns - Time and Distance - problems on trains -Boats and streams - simple interest - compound interest - Logarithms - Area-Volume and surface area -races and Games of skill.	6	CO3
IV	Permutation and combination-probability-True Discount-Bankers Discount – Height and Distances-Odd man out & Series.	6	CO4
V	Calendar - Clocks - stocks and shares - Data representation - Tabulation – Bar Graphs-Pie charts-Line graphs.	6	CO5
	Total	**30**	

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	understand the concepts, application and the problems of numbers	PO1
2	To have basic knowledge and understanding about percentage, profit & loss related processings	PO1, PO2
3	To understand the concepts of time and work	PO4, PO6
4	Speaks about the concepts of probability, discount	PO4, PO5, PO6
5	Understanding the concept of problem solving involved in stocks & shares, graphs	PO3, PO8

Text Book	
1	"Quantitative Aptitude", R.S. AGGARWAL.,S.Chand & Company Ltd.,
Reference Books	
1.	Disha Experts, "Shortcuts in Quantitative Aptitude for Competitive Exams", 3rd Edition, Disha Publications.
Web Resources	
1.	https://www.javatpoint.com/aptitude/quantitative
2.	https://www.toppr.com/guides/quantitative-aptitude/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**2**	**3**	**1**	**2**	**-**	**2**
CO 2	**2**	**2**	**2**	**3**	**3**	**1**
CO 3	**3**	**2**	**2**	**2**	**3**	**3**
CO 4	**3**	**2**	**3**	**2**	**3**	**3**
CO 5	**2**	**3**	**1**	**2**	**3**	3
Weightage of course contributed to each PSO	12	12	9	11	12	12

S-Strong-3 M-Medium-2 L-Low-1