GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

COIMBATORE – 641 018.

Learning Outcomes-based Curriculum Framework (LOCF) for

MASTER OF COMPUTER APPLICATIONS (MCA)

(Effective from the Academic year 2021-2022 Onwards)

POSTGRADUATE AND RESEARCH DEPARTMENT OF COMPUTER APPLICATIONS

MAY 2021

PREAMBLE

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects learning outcome-based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome-based curriculum will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

Tamil Nadu State Council for Higher Education (TANSCHE) has formed the State Integrated Boards of Studies, which, with great diligence and expertise has devised the mandatory areas that have to be covered for three-year undergraduation and two-year postgraduation courses to realize the facilitation of the mobility of faculty and students from one university to another and to easily solve the problem of equivalence among courses. Great care has been taken so that these areas would take 75% of the course content and the remaining 25% can be decided by the individual institutions. The areas that must be covered by the student that are mandatory for earning the degree to have due value has been worked out so that the student will gain enough depth of knowledge in the subject concerned. 25% percent of the syllabus should be designed by the institutions, and the areas covered under this also must have a weightage of 25%. This gives the autonomous institution seamless liberty on every Board of Studies (BOS) to innovate and experiment, and more importantly, it is here that the institution devises appropriate strategies by which (i) to make creative and critical applications of what has been learnt in the mandatory components, and (ii) to meaningfully connect the learners to the career demands and expectations. It is essential that the theoretical subject knowledge of the students must be translated into practical hands-on experience.

One of the significant reforms in the undergraduate education is to introduce the 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 country which will help the students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for bachelor's programmes in colleges, universities and HEIs in general. A Core Expert Committee (CEC) was constituted to formulate the modalities for developing the LOCF in various subjects being taught in the undergraduate courses in sciences, humanities, commerce and professional courses. The CEC also constituted the Subject Expert Committees (SEC) in various subjects to prepare detailed guidelines for the LOCF in subjects concerned.

The key components of the planning and development of LOCF are given in terms of clear and unambiguous description of the Graduate Attributes (GA), Qualification Descriptors (QD), Program Learning Outcomes (PLO) and Course Learning Outcomes (CLO) to be achieved at the end of the successful completion of each undergraduate program to be offered by HEIs. In post graduate education in MCA, the programme of study leading to the degree of MCA is discussed herewith.

The Qualification Descriptors (QD), Program Learning Outcomes (PLO) and the Course Learning Outcomes (CLO) were also finalized keeping the broad requirement of the programme in view. The LOCF also gives general guidelines for the Teaching Learning Process (TLP) corresponding to each component of theory, experiment, tutorials, projects and industrial / field visits to be followed in order to achieve the stated outcomes for each component. Finally, some suggestions for using various methods in the assessment and evaluation of learning levels of students are also made. It is a student centric framework where they are expected to learn vistas of Computer Applications along with the latest trends and techniques like Artificial Intelligence, Internet of Things, Machine Intelligence along with advanced skillsets that include Mobile Application Development, Object Oriented Programming, Robotics among many other courses.

1. INTRODUCTION

MCA has been evolving as an important branch of science and engineering 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 Applications 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 Science and Computer Applications also have 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 expertise in technology and knowledge of the particular application domain.

MCA has a wide range of specialties. These include Advanced Java Programming, Advanced Operating Systems, Object Oriented Analysis and Design, Advanced Python Programming, C# Programming, Data Analytics with R, Cryptography and Network Security, Soft Computing, Digital Image Processing, Big Data and IPR, Open Source Tools and Cloud Computing. 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 Applications, provides reason and logic. Science provides the methodology for learning and refinement. Engineering provides the techniques for building hardware and software.

Universities and other HEIs introduced programmes of studies in computer science as this discipline evolved itself to a multidisciplinary discipline. Computer Applications are growing rapidly. Increasing applications of computers in almost all areas of human endeavor has led to vibrant industries with concurrent rapid change in technology. Unlike other basic disciplines, developing core competency in this discipline that can be reasonably stable becomes a challenge .In India, it was initially introduced at the Master (postgraduate) level as MCA and M.Tech. Later on, engineering programmes such as B.Tech and B.E in Computer Science & Engineering and in Computer Applications were introduced in various engineering College/Institutions to cater to the growing demand for trained engineering manpower in IT industries. Parallelly, BCA and MCA programmes with specialization in Computer Application were introduced to train manpower in

this highly demanding area. Master of Computer Applications is introduced in different colleges and institutions.

The Learning Outcome-based Curriculum Framework in MCA is aimed at allowing flexibility and innovation in design and development of course content, in method of imparting training, in teaching learning process and in assessment procedures of the learning outcomes. The emphasis in computer application courses, in outcome-based curriculum framework, help students learn solving problems, accomplishing IT tasks, and expressing creativity, both individually and collaboratively. The proposed framework will help Students learn programming techniques and code using any of the programming languages.

Many of the learning outcomes of Computer Applications can be achieved only by programming a computer for several different meaningful purposes. All students must, therefore, have access to a computer with a modern programming language installed. The computer applications framework does not prescribe a specific language. More importantly, students will learn to adapt to changes in programming languages and learn new languages as they are developed.

The present Learning Outcome-based Curriculum Framework for MCA is intended to facilitate the students to achieve the following.

- ✓ To develop an understanding and knowledge of the basic theory of Computer Applications with good foundation on theory, systems and applications such as algorithms, data structures, data handling, data communication and computation.
- ✓ To develop the ability to use this knowledge to analyze new situations
- ✓ To acquire necessary and state-of-the-art skills to take up industry challenges. The objectives and outcomes are carefully designed to suit to the above-mentioned purpose.
- ✓ The ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of the real-life problems
- ✓ To learn skills and tools to find the solution, interpret the results and make predictions for the future developments.

1.1 Course Structure – Types of Courses.

The following types of courses are offered under CBCS-LOCF:

1. **Core Courses (CC):** A core course is a compulsory course. A student of Post graduate in Computer Applications has to take 18 such Computer Application courses over four semesters.

2. **Elective Courses (EC):** An elective course is a course that is to be chosen from a specified set of courses.

I. **Skill Enhancement Course**. A student has to take one such course as an individual project in Semester IV.

II. **Discipline Specific Electives (DSE):** These are elective courses that provide advanced post graduate training in specialized areas of Computer Applications. A set of 4, one each in all the four semesters of the post graduate programme.

2. LEARNING OUTCOMES- BASED APPROACH TO CURRICULUM PLANNING AND DEVELOPMENT

2.1 Nature of extent of the MCA

Framing and implementation of curricula and syllabi is envisaged to provide an understanding of the basic connection between theory and experiment and its importance in understanding the foundation of computing. This is very critical in developing a scientific temperament and to venture a career with a wide spectrum of applications as well as theoretical investigations. The post graduate curriculum provides students with theoretical foundations and practical experience in software and application aspects of computers. The curriculum in MCA is designed to be of enough depth and relevance to enhance student employment opportunities upon graduation. As a Master's degree program, the curriculum is based on the criterion that graduates are expected to function successfully in a professional employment environment immediately upon graduation.

MCA is now a two-year full time degree program consisting of four semesters which develops advanced theoretical and research skills. This programme helps in building an advanced professional or academic career. It is an appropriate course for students who wish to pursue a Master of Philosophy(M.Phil.)or Doctor of Philosophy (PhD) and a research or academic career. This program facilitates students who wish to pursue an independent research project in an area of interest under the supervision of an academic supervisor.

M.CA. follows CBCS structure as mandated by UGC. In accordance with CBCS guidelines the courses are categorized into compulsory courses, elective courses, and project.

2.2 Aims of Master's degree

The Master Degree programme emphasizes problem solving in the context of algorithm development and software implementation and prepares students for effectively using modern computer systems in various applications. The curriculum provides required Computer Applications courses such as advanced programming languages, advanced operating system, object oriented analysis and design, data analytics, cryptography and network security, soft computing, digital image processing, big data and IPR, open source tools, cloud computing as well as elective courses in machine learning, TCP/IP, software quality assurance, mobile application development and other current topics such as Robotics,

Data Sciences etc. The main aim of this Master's degree is to deliver a modern curriculum that will equip graduates with strong theoretical and practical backgrounds to enable them to excel in the workplace and to be lifelong learners. The purpose of the Master in Computer Applications are twofold: (1) to prepare the student for a position involving the design, development and implementation of computer software/hardware, and (2) to prepare the student for entry in to a program of research study in Computer Applications /computer science and related fields.

The MCA programme focuses on the concepts and techniques used in the design and development of software systems. Students in this program explore the conceptual underpinnings of computer science and Computer Applications -- its fundamental algorithms, programming languages, operating systems, and software testing techniques. In addition, students choose from a rich set of electives that includes machine learning, internet of things, TCP/IP, software quality assurance, among other topics.

3. GRADUATE ATTRIBUTES

Graduate Attributes (GA) are the qualities, skills and understandings that students should develop during their time with the HEI. These are qualities that also prepare graduates as agents of social good in future. Graduate Attributes can be viewed as qualities in following sub categories.

- Knowledge of the discipline
- Creativity
- Intellectual Rigor
- Problem Solving and Design
- Ethical Practices
- Lifelong Learning
- Communication and Social Skills

Among these attributes, categories attributes under *Knowledge of the Discipline* are specific to a programme of study

List of graduate attributes for MCA

The GAs can be summarized in the following manner.

GA 1. A commitment to excellence in all scholarly and intellectual activities, including critical judgement

GA 2. Ability to engage constructively and methodically when exploring ideas, theories and philosophies

GA 3. Ability to develop creative and effective responses to intellectual, professional and social challenges

GA 4. To be open-minded about cultural diversity, linguistic difference, and the complex nature of our world

GA 5. Ability to be responsive to change, to be inquiring and reflective in practice, through information literacy and autonomous, self-managed learning

GA 6. Ability to communicate and collaborate with individuals, and within teams, in professional and community settings

GA 7. Ability to communicate effectively, comprehending and writing effective reports and design documentation, summarizing information, making effective oral presentations and giving and receiving clear oral instructions

GA 8. Ability to demonstrate competence in the practical art of computing by understanding the practical methods, and using modern design tools competently for complex real-life

IT problems

GA 9.. Ability to use a range of programming languages and tools to develop computer programs and systems that are effective solutions to problems

GA 10. Ability to understand, design, and analyze precise specifications of algorithms, procedures, and interaction behavior.

GA 11. Ability to apply mathematics, logic, and statistics to the design, development, and analysis of software systems

GA 12. Ability of working in teams to build software systems.

GA 13.. Ability to identify and to apply relevant problem-solving methodologies

GA 14. Ability to apply decision making methodologies to evaluate solutions for efficiency, effectiveness and sustainability

GA 15. A capacity for self-reflection and a willingness to engage in self-appraisal

GA 16. Open to objective and constructive feedback from supervisors and peers.

4. QUALIFICATION DESCRIPTORS

Qualification descriptors are generic statements of the outcomes of study. Qualification descriptors are in two parts. The first part is a statement of outcomes, achievement of which a student should be able to demonstrate for the award of the qualification. This part will be of interest to those designing, approving and reviewing academic programmes. They will need to be satisfied that, for any programme, the curriculum and assessments provide all students with the opportunity to achieve, and to demonstrate achievement of, the outcomes. The second part is a statement of the wider abilities that the typical student could be expected to have developed. It will be of assistance to employers and others with an interest in the general capabilities of holders of the qualification. The framework has the flexibility to accommodate diversity and innovation, and to accommodate new qualifications as the need for them arises.

4.1. Qualification Descriptors for MCA

On completion of MCA , the expected learning outcomes that a student should be able to demonstrate

QD-1. A systematic, extensive and coherent knowledge and understanding of the field of Computer Applications as a whole and its applications, and links to related disciplinary areas; including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues in the field of Computer Applications /computer science.

QD-2. Procedural knowledge that creates different types of professionals related to Computer Applications, including research and development, teaching, industry and government and public service;

QD-3. Skills in areas related to Computer Applications and usage of tools and current developments, including a critical understanding of the latest developments in the area, and an ability to use established techniques of analysis and enquiry within the area of Computer Applications.

QD-4. Demonstrate comprehensive knowledge, including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to the chosen disciplinary areas and field of study, and techniques and skills required for identifying problems and issues relating to the disciplinary area and field of study.

QD-5. Demonstrate skills in identifying information needs, collection of relevant

quantitative and/or qualitative data drawing on a wide range of sources, effective analysis and interpretation of data

QD-6. Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to the chosen field of study.

QD- 7. Communicate the results of studies accurately in a range of different contexts using the main concepts ,constructs and techniques of the subjects of study;

QD-8. Address one's own learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate.

5. Programme Learning Outcomes in Course

Program Learning Outcomes (PLOs)	
On successful completion of the M.C.A Programme, students will be able to	
PLO 1	Apply knowledge of mathematics, statistics, science and computing appropriately to model the software applications.
PLO 2	Assimilate and use state of the art computing technologies, tools and techniques necessary for computing practices.
PLO 3	Design a system, component, or process to meet desired need within realistic constraints such as economic, environmental, social and ethical contexts
PLO 4	Have an ability to design, implement and evaluate sustainable computational solutions for various complex problems as per needs and specifications.
PLO 5	Communicate effectively with the computing community, and with society, about complex computing activities by being able to comprehend and write effective reports, design documentation, and make effective presentations.
PLO 6	Manage projects and function effectively as an individual and as a member or leader in diverse terms, and in multidisciplinary setting.
PLO 7	Recognize the need for and prepare themselves to engage in independent and life - long learning for continual development as a computing professional for the betterment of individuals and organizations.
PLO 8	Apply ethical principles and commit to professional responsibilities in research for better environment.
PLO 9	Utilize the education necessary to understand the impact of computing solutions in a global and societal context
PLO 10	Acquire professional ethics, innovation skills and team work towards the wellness of the society.

6. COURSE STRUCTURE IN MCA PROGRAMME
Learning Outcomes, Contents, Pedagogies etc. References

MCA – SCHEME OF EXAMINATIONS: CBCS PATTERN

(For the students admitted from Academic year 2021-2022)

Subject Code	Title of the Paper	Hrs. (Wk.)	Max. Internal Marks	Max. External Marks	Total Marks	External Marks for pass	Total Pass Marks	Credits
Semester – I								
21MCA11C	Object Oriented Programming with C++	4	50	50	100	25	50	4
21MCA12C	Relational Database Management System	4	50	50	100	25	50	4
21MCA13C	Computer Organization and Architecture	4	50	50	100	25	50	4
21MCA14C	Data Structures and Algorithms	4	50	50	100	25	50	4
21MCA15C	Operating Systems	4	50	50	100	25	50	4
21MCA16P	Practical – I: C++ Programming Lab	5	50	50	100	25	50	3
21MCA17P	Practical – II: RDBMS Lab	5	50	50	100	25	50	2
		30			700			25
Semester – II								
21MCA21C	Python Programming	4	50	50	100	25	50	4
21MCA22C	Java Programming	4	50	50	100	25	50	4
21MCA23C	Computer Networks	4	50	50	100	25	50	4
21MCA24C	Digital Image Processing	4	50	50	100	25	50	4
21MCA25C	Probability and Statistics	4	50	50	100	25	50	4
21MCA26P	Practical – III: Python Programming Lab	5	50	50	100	25	50	3
21MCA27P	Practical – IV: Java Programming Lab	5	50	50	100	25	50	2
		30			700			25

Semester – III								
21MCA31C	Big Data Analytics and R Programming	4	50	50	100	25	50	4
21MCA32C	Mobile Applications Development	4	50	50	100	25	50	4
21MCA33C	Cryptography and Network Security	4	50	50	100	25	50	4
21MCA34E	Elective 1:	4	50	50	100	25	50	4
21MCA35E	Elective 2:	4	50	50	100	25	50	4
21MCA36P	Practical – V: R Programming Lab	5	50	50	100	25	50	3
21MCA37P	Practical – VI: Mobile Applications Development Lab	5	50	50	100	25	50	2
		30			700			25
Semester – IV								
21MCA41E	Elective 3	5	50	50	100	25	50	4
21MCA42P	Practical – VII: Software Development and Testing Lab	5	50	50	100	25	50	4
21MCA43V	Project and Viva Voce	20	100	100	200	80	100	7
		30			400			15
Total / Credit					2500			90

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DEPARTMENT OF COMPUTER APPLICATIONS

ELECTIVES – FOR SEMESTER III and IV

Elective – I:	
1.1	Soft computing
1.2	Internet of Things
1.3	Software Project Management
1.4	Principles of Compiler Design
Elective – II:	
2.1	Wireless Sensor Networks
2.2	Cyber Security
2.3	Social Networking and Web Mining
2.4	Parallel and Distributed Computing
Elective – III:	
3.1	Artificial Intelligence and Expert Systems
3.2	Cloud Computing
3.3	Machine Learning
3.4	Programming for Robotics

BRIDGE COURSE FOR MCA
(FOR STUDENTS ADMITTED FROM 2021-2022 ONWARDS)

TOTAL: 60 HOURS

The objective of bridge course is to provide the fundamental concepts and practical knowledge about Computer Science and its Applications for students admitted from Non – Computer streams [with Mathematics at UG level or +2.].

Sub Code	Subject Name	Theory Hrs.	Practical Hrs.
BR1	C Programming	10	20
BR2	Computer Graphics and Multimedia	10	20
	Total hours	20	40

COURSE LEVEL OUTCOMES:	
On the successful completion of the course, students will be able to:	
1	Describe the basic concepts of structured programming
2	Design application programming using variables, operators and built-in functions to solve a specific problem
3	Illustrate different types of statements and control structures.
4	Representation of loop constructs, arrays and structures in c programming language.
5	Discover the commonly used operations in the files.

SUB CODE: BR1

C PROGRAMMING (THEORY) (10 HOURS)

- History and the importance of C as System programming and application programming - Variables, datatypes, operators and built- in functions.
- Input / Output statements, Control, escape sequences - Control structures - IF then else, Else if Ladder, Switch case statements.
- Iteration- Loops – For loop, while, do while.
- Arrays, Structures, Union, Files.

C PROGRAMMING LAB (PRACTICALS) (20 HOURS)

1) Develop a program in C for generating Fibonacci Series.
2) Develop a program in C for printing n Prime numbers.
3) Develop a program in C for generating Palindrome number.
4) Develop a program in C for finding Factorial of a number.
5) Develop a program in C to find Sum of Digits.
6) Develop a program in C to Reverse a Number.
7) Develop a program in C to find the factorial of a number using recursion.
8) Develop a C program to sort the given list of numbers in an array.
9) Develop a C Program to implement file operations

SUB CODE: BR2

COMPUTER GRAPHICS AND MULTIMEDIA (10 HOURS)

- Output Primitives - Attributes of output Primitives - 2D Transformations
- Multimedia- Text – Audio – Video

COMPUTER GRAPHICS AND MULTIMEDIA LAB (20 HOURS)

1) Develop a program to implement 2D Transformations such as Translation, Rotation and Scaling.
2) Develop a program to Draw Lines using DDA.
3) Create and move an object with sound effects.
4) Create an object and animate it using Photoshop.
5) Create a web page using Photoshop.

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	I	21MCA11C	OBJECT ORIENTED PROGRAMMING WITH C++	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe the basic concepts of Object-Oriented programming
2	Identify the classes, objects, members of a class and the relationships among them to solve a specific problem
3	Illustrate the concept of constructors and destructors and describe the mechanism of overloading the operators.
4	Examine the concept of data encapsulation, inheritance and function templates as used in C++ programming language.
5	Discover the commonly used operations in the files.

Unit - I

Principles of Object-Oriented Programming: Software Crisis – Software Evolution – Procedure Oriented Programming – Object Oriented Programming Paradigm – Basic concepts and benefits of OOP – Object Oriented Language – Application of OOP – Structure of C++ – Applications of C++. Tokens, Expressions and Control Structures: Operators in C++ – Manipulators.

Unit - II

Functions in C++: Function Prototyping – Call by Reference – Return by Reference – Inline Functions – Default, Const arguments – Function Overloading – Friend and Virtual Functions. Classes and Objects: – Member Functions – Nesting of Member Functions – Private Member Functions – Memory Allocation for Objects – Static Data Members – Static Member Functions – Array of Objects – Objects as Function Arguments – Friendly Functions – Returning Objects – Const Member Functions – Pointer to Members.

Unit – III

Constructors: Parameterized Constructors – Multiple Constructors in a Class – Constructors with Default Arguments – Dynamic Initialization of Objects – Copy and Dynamic Constructors – Destructors. Operator Overloading: Overloading Unary and Binary Operators – Overloading Binary Operators using Friend Functions – Overloading the Extraction and the Insertion Operators.

Unit – IV

Inheritance: Defining Derived Classes – Single Inheritance – Making a Private Member Inheritable – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Virtual Base Classes– Abstract Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

Unit - V

Streams: String I/O – Character I/O – Object I/O – I/O with Multiple Objects – File pointers – Disk I/O with member functions. Exception Handling – Templates – Redirection – Command Line Arguments.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1.	E. Balagurusamy, "Object Oriented Programming with C++", 6th Edition, Galgotia, Publications Pvt. Ltd., 2000.
2.	Herbert Schildt, "C++: The Complete Reference", McGraw Hill Inc., 1997.
3.	Stanley B. Lippman, "Inside the C++ Object Model", Addison Wesley, 1996.

FURTHER READING:

1	C++ programming : From Problem Analysis to Program Design / C plus plus programming. : Malik, D S. Course Technology, Boston, MA : 2009. Fourth Edition.
2	C++ programming cookbook Herb Schildt's C++ programming cookbook / C++ (Computer program language) , Schildt, Herbert. McGraw-Hill, New York: c2008.
3	C++ common knowledge : essential intermediate programming/ C++ (Computer program language) , Dewhurst, Stephen C. Addison-Wesley, Upper Saddle River, N. J.: 2005.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.learncpp.com/
2	https://www.toptal.com/c/the-ultimate-list-of-resources-to-learn-c-and-c-plus-plus
3	https://www.programiz.com/cpp-programming
4	https://www.edx.org/learn/c-plus-plus

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓			✓
	PLO-9	✓	✓	✓	✓	
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	I	21MCA12C	RELATIONAL DATABASE MANAGEMENT SYSTEM	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the basic concepts of DBMS.
2	Employ the conceptual and relational models to design large database systems
3	Understand and analyse E-R model and design
4	Apply normalization steps in database design and removal of data anomalies
5	Understand the architecture associated with DBMS

Unit - I

Introduction - Database system applications - purpose of database system - View of data - Database Languages - Relational Databases - Database Design - Data Storage and Querying - Transaction Management - Database Architecture - Database Users and Administrators.

Unit - II

Relational Databases - Relational Model - Structure of Relational Databases - Fundamental Relational Algebra Operations - Additional Relational Algebra Operations. SQL - Background - Data Definition - Basic Structure of SQL Queries - Set Operations - Aggregate Functions - Null values - Nested Sub queries - Views - Modification of the Database.

Unit – III

Database design: Database Design and the E - R Model - Design Phases - Design Alternatives - The Entity Relationship Model - Constraints - Entity Relationship Diagrams - Extended E - R features - Specialization - Generalization - Aggregation - Reduction to Relational Schemas.

Unit – IV

Relational Database Design - Features of Good Relational Designs - Atomic Domains and First Normal Form - Decomposition using Functional Dependencies - Keys and Functional Dependencies – Boyce Codd Normal Form - BCNF and Dependency Preservation - Third Normal Form - Functional Dependency Theory - Lossless Decomposition - Dependency Preservation - BCNF Decomposition Algorithm - 3NF Decomposition - Multivalued Dependencies - Fourth Normal Form - 4NF Decomposition.

Unit - V

Database System Architectures - Centralized and Client / Server Architectures - Centralized Systems - Client / Server Systems - Server System Architectures - Parallel Systems - Distributed Systems - Network Systems.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Database System Concepts" by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Fifth
2	"An Introduction to Database Systems "by Bipin c. Desai, West Publishing Company, 1990.
3	"Database Management Systems" by Elmasri and Navathe.

FURTHER READING:

1	Database System Concepts by Sudarshan, Korth (McGraw-Hill Education)
2	Fundamentals of Database System By Elmasari &Navathe- Pearson Education
3	Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, 4thEdition, 2005, Elsevier India Publications, New Delhi
4	Fundamentals of Database Management System – Gillenson, Wiley India

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/projects/introduction-to-relational-database-and-sql
2	https://www.edx.org/learn/relational-databases
3	https://www.udemy.com/course/sql-and-rdbms/
4	https://www.classcentral.com/course/swayam-data-base-management-system-9914

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8					✓
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	I	21MCA13C	COMPUTER ORGANIZATION AND ARCHITECTURE	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe basic organization of computer
2	Understand the combination logic and sequential logic
3	Demonstrate and perform computer arithmetic operations and Logic Operations
4	Identify and compare different methods for computer I/O mechanisms
5	Categorize memory organization and explain the function of each element of a memory hierarchy

Unit - I

Binary Systems: Digital Computers and Digital systems – Binary Numbers – Number Base Conversions – Octal and Hexadecimal number – Complements – Binary codes. **Boolean Algebra and Logic Gates:** Basic Definition – Axiomatic Definition of Boolean Algebra – Basic Theorems and Properties of Boolean Algebra – Boolean Functions – Canonical and Standard forms – Other Logic Operations – Digital Logic Gates – Simplifications of Boolean Function.
*(**Book 1**| Chapter 1, 2)*

Unit - II

Combinational Logic: Introduction – Design Procedure – Adders – Subtractors – Code Conversions – Multiplexer – Demultiplexer – Encoder – Decoder. **Sequential Logic:** Introduction – FlipFlops: Triggering Flip-flop. – Excitation Tables. **Registers and Counters:** Registers – Shift Registers- Ripple Counters – Synchronous Counters – Timing Sequences.
*(**Book 1**| Chapter 4 ,5, 6)*

Unit – III

Register Transfer Logic: Introduction – Arithmetic, Logic and Shift Micro-operations – Fixed Point Binary data – Arithmetic Shifts – Instruction Codes. **Micro Computer System Design:** Introduction – Instructions and Addressing modes – Stack, Subroutines and Interrupt – Input-Output interface – Direct Memory Access.
*(**Book 2**| Chapter 4, 2)*

Unit – IV

CPU Organization: General Register Organization – Types of Interrupts – RISC. **Pipeline and Vector Processing:** Parallel Processing – Pipelining – Array Processors – Performance of a processor. **InputOutput Organization:** Peripheral Devices – Asynchronous Data Transfer (Strobe & Handshaking Method) – Modes of Transfer – Priority Interrupt – IOP.
*(**Book 2**| Chapter 8, 9, 11).*

Unit - V

Memory Organization: Types of Memory – Memory Hierarchy – Main Memory – Memory interface to CPU – Associative Memory – Cache Memory: Cache mapping schemes – Virtual Memory. *(**Book 2**| Chapter 12)*

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Morris Mano M, "Digital Logic and Computer Design", Pearson Education, 2016.
2	Morris Mano M, "Computer System Architecture", Pearson Education, 2012.
3	John Patrick Hayes, "Computer Architecture and Organization", Tata McGraw Hill, 2007.
4	Albert Paul Malvino, Donald P. Leach, "Digital Principles and Applications", Tata McGraw Hill, 2002.

FURTHER READING:

1	Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2	William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
3	Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson, Education Inc

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.classcentral.com/course/swayam-computer-organization-and-architecture-a-pedagogical-aspect-9824
2	https://www.edx.org/learn/computer-architecture
3	https://www.udemy.com/topic/computer-architecture/
4	https://www.coursera.org/learn/comparch\
5	https://nptel.ac.in/courses/106/103/106103068/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓	✓	✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8	✓			✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓	✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**I**	**21MCA14C**	**DATA STRUCTURES AND ALGORITHMS**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Ability to analyse the performance of algorithms using different
2	Ability to understand asymptotic notations.
3	Analyze problem and propose solution by selecting appropriate data structures like stacks, Queues, Linked List, Trees, Graphs, Hash Tables.
4	Demonstrate different methods for traversing trees and graph applications
5	Design and implement an appropriate hashing function and sorting techniques for an application

Unit - I

Introduction: Algorithmic Notation – Programming Principles – Creating Programs – Analyzing Programs. **Arrays:** One Dimensional Array – Multidimensional Array – Pointer Arrays. **Searching:** Linear Search – Binary Search – Fibonacci Search.
*(**Book 1** | Chapter 1; **Book 2** | Chapter 2, 11)*

Unit - II

Stacks: Primitive operations – Application of stacks. **Queues:** Primitive operations – Priority queues – Dequeues – Applications. **Linked list:** Singly Linked List – Doubly Linked List – Circular Linked List – linked stacks – Linked queues – Applications of Linked List – Dynamic storage management.
*(**Book 2** | Chapter 3, 4, 5)*

Unit – III

Trees: Binary tree – Terminology – Representation – Traversal – Types – Applications. **Graph:** Terminology – Representation – Traversals – Applications: Spanning Trees, Shortest Path and Transitive Closure, Topological Sort. **Sets:** Representation – Operations on Sets – Applications.
*(**Book 2** | Chapter 7, 8, 9)x*

Unit – IV

Tables: Symbol tables – Hash tables. **Sorting techniques:** Internal and External sorting: Insertion Sort – Selection Sort – Shell Sort – Bubble Sort – Quick Sort – Heap Sort – Merge Sort – Radix Sort.
*(**Book 1** | Chapter 9; **Book 2** | Chapter 6, 10)*

Unit - V

Files: Queries – Sequential Organization – Index Techniques. **B Trees:** B Tree Indexing – Operations on a B Tree – Lower and Upper Bounds of a B Tree. – B+Tree Indexing – Trie Tree Indexing. *(**Book 1** | Chapter 10; **Book 2** | Chapter7)*

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Ellis Horowitz and Sartaj Sahni "Fundamentals of Data Structures" Galgotia Book Source, Pvt. Ltd., 2004.
2	D. Samanta, "Classic Data Structures", Prentice-Hall of India, Pvt. Ltd.,
3	Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in C", Prentice-Hall of India, Pvt. Ltd., Second edition, 2007.
4	Jean Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw-Hill, Second edition, 2001.
5	Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Pearson Education, Second edition, 2006.

FURTHER READING:

1	Data structures: A Pseudocode Approach with C, 2nd edition,
2	R.F.GilbergAndB.A.Forouzan, CengageLearning.
3	Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
4	Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
5	Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/specializations/data-structures-algorithms
2	https://www.geeksforgeeks.org/data-structures-and-algorithms-online-courses-free-and-paid/ https://www.udemy.com/course/data-structures-and-algorithms-deep-dive-using-java/
3	https://www.codingninjas.com/courses/onlline-c-plus-plus-course

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓	✓	✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**I**	**21MCA15C**	**OPERATING SYSTEMS**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Illustrate the role of resource management, interfaces and system calls as handled by the operating system.
2	Apply the process scheduling algorithms to select the processes for execution and compare their performances.
3	Describe and analyze the memory management and its allocation methods.
4	Identify the storage management methods with respect to different storage management techniques.
5	Describe and analyze the basic concepts of Linux, IPC, Security.

Unit - I

Introduction: What is an OS - Mainframe systems - Desktop systems - Multiprocessor systems - Distributed systems - Clustered systems - Real-Time systems. **Operating system structures:** Systems components - OS services - System calls - System Programs - Systems structure - Virtual machines - System Design & Implementation - System Generation.
(*Chapter 1, 3****)***

Unit - II

Process Management: Process concept - Process scheduling - Operations on process - Cooperating process - Inter-process communication. **CPU scheduling:** Scheduling criteria - Scheduling algorithms - Multiple-processor Scheduling - Real-Time Scheduling. **Deadlocks:** Deadlock characterization - Methods for handling Deadlocks - Deadlocks prevention - Deadlock avoidance - Deadlock detection - Recovery from Deadlock.
(*Chapter 4, ,6, 8****)***

Unit – III

Memory Management: Background - Swapping - Contiguous memory allocation - Paging - Segmentation - Segmentation with paging. **Virtual memory:** Demand paging - Process creation - Page replacement - Allocation of frames - Thrashing. ***(****Chapter 9, 10****)***

Unit – IV

I/O Systems: Disk structure - Disk scheduling - Disk management - Swap - Space management. **File systems:** File concept - Access methods Directory structure - File system structure - File system implementation - Directory implementation - Allocation methods - Free space management.
(*Chapter 11, 12, 14****)***

Unit - V

CASE STUDY: Linux: Design Principles - Kernel modules - Process management, scheduling - Memory management - File systems - Input & Output - Inter-process Communication - Network structure - Security.

(Chapter 20)
PEDAGOGY STRATEGIES • Lecturing • Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback
REFERENCES:

1	Silberschatz, Galvin, Gagne, "Operating Systems Concepts", Sixth Edition, John Wiley & Sons, 2013.
2	Tanenbaum, "Operating systems: Design & Implementation", PHI, Second Edition, 1998.
3	Deital, "Operating Systems", Pearson Education Asia, Second Edition, 2001.
4	D. M. Dhamdhere, "System Programming and Operating Systems", TMH, 2000.

FURTHER READING:

1	Operating Systems - Internals and Design Principles. Stallings, 6th Edition-2009. Pearson education.
2	Modern Operating Systems, Andrew S Tanenbaum 3rd edition PHI.
3	Principles of Operating Systems, B.L.Stuart. Cengage learning, India Edition.
4	Operating Systems. A.S. Godboie.2nd Edition, TMH

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.javatpoint.com/os-tutorial
2	https://www.studytonight.com/operating-system/
3	https://hackr.io/tutorials/learn-operating-systems
4	https://www.udemy.com/courses/it-and-software/operating-systems/
5	https://www.lynda.com/Operating-Systems-training-tutorials/36-0.html
6	https://www.ohotraining.com/operating-system-online-training/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓	✓	✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓	✓		✓
	PLO-9	✓	✓	✓	✓	
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	I	21MCA16P	PRACTICAL – I: C++ PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Construct classes incorporating the object-oriented techniques to solve the problems.
2	Implement Object Oriented Programming Concepts in C++.
3	Identify the dynamic memory management techniques using pointers, constructors and destructors
4	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism.
5	Illustrate and implement files, exceptions to handle errors for object-oriented programs.

LIST OF PROGRAMS:

1. Implement a C++ Program using Operator Overloading Functions.
2. Implement a C++ Program using Function Overloading.
3. Implement a C++ Program using Default Arguments.
4. Implement a C++ Program using Functions with Call by Value.
5. Implement a C++ Program using Functions with Call by Reference.
6. Implement a C++ Program using Constructors and Destructors.
7. Implement a C++ Program using Exception Handling.
8. Implement a C++ Program using Type Conversion.
9. Implement a C++ Program using String Manipulation Functions.
10. Implement a C++ Program using Friend Functions.
11. Implement a C++ Program using Inheritance.
12. Implement a C++ Program using Files.
13. Implement a C++ Program using Pointers.
14. Implement a C++ Program using Templates.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOME

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓	✓	✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8					✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓	✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	I	21MCA17P	PRACTICAL – II: RDBMS LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand underlying concepts of database technologies
2	Create and populate a RDBMS, using SQL.
3	Write queries in SQL to retrieve any type of information from a data base.
4	Understand, analyze, and apply common SQL Statements including DDL, DML and DCL statements to perform different operations
5	Analyze and Select storage and recovery techniques of database system.

LIST OF PROGRAMS:

1. DDL & DML – Data Types, Create, Alter, Drop table, Integrity constraints.
2. Insert, Delete and Update commands.
3. DCL & TCL – Grant, Revoke, Rollback and Commit.
4. Select command with operators like arithmetic, comparison, logical, order by, group by etc.
5. SQL Functions – date, numeric, character, conversion, avg, max, min, sum, count.
6. Set operations – union, intersect and minus.
7. Join query concept – simple, equi, non-equi, self, outer join.
8. Complex and sub queries.
9. Database objects – view, synonym, index, sequence – create, alter and drop.
10. Report writer using SQL.
11. PL/SQL – Introduction – character set, data types – execution.
12. PL/SQL attributes %type, %row type, function comparison, if condition, loop, for, while and goto etc.
13. Record management using cursors.
14. Function – definition and implementation.
15. Database triggers – syntax, parts and types of triggers.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓	✓	✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓			
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**II**	**21MCA21C**	**PYTHON PROGRAMMING**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
2	Express proficiency in the handling of Functions.
3	Express proficiency in the handling of strings and List.
4	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

Unit - I

Introduction to Python: Python Overview - Getting Started with Python - Python Identifiers - Reserved Keywords - Variables - Standard Data Types - Operators. Statement and Expression - String Operations - Boolean Expressions - Control Statements - Iteration - while Statement - Input.

Unit - II

Functions: Introduction - Built-in Functions - Composition of Functions - User Defined Functions – P`2fqaarameters and Arguments - Function Calls. The Return Statement - Python Recursive Function- The Anonymous Functions - Writing Python Scripts.

Unit – III

Strings: Strings - Compound data types - len function - String slices - String traversal - String formatting operators and functions. Lists: Values and accessing elements - lists are mutable - Traversing and deleting elements - Built-in operators and methods.

Unit – IV

Tuples: Creating tuples-accessing values - tuples assignment - tuples as return values - variable length argument tuples - basic tuple operations - built-in tuple functions. Dictionaries: Creating and accessing a dictionary - updating and deleting - properties of dictionary keys - operations and built-in dictionary methods. Exceptions: Exceptions with Arguments - User-Defined Exceptions.

Unit - V

Classes and Objects: Overview of OOP (Object-Oriented Programming) - Class Definitions - Creating Objects-Objects as Arguments - Objects as Return Values - Built-in Class Attributes – Inheritance - Method Overloading.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	E. Balagurusamy, "Introduction to Computing and Problem-Solving Using Python", McGraw Hill Education Private Limited, New Delhi.
2	Mark Lutz, David Ascher, "Learning Python", Shroff Publishers & Distributors Private Limited,2009.

FURTHER READING:

1	Starting Out with Python (2009) Pearson , Tonny Gaddis
2	Beginning Pyhton Wrox Publication Peter Norton, Alex Samuel
3	Python Algorithms Apress, Magnus Liet Hetland,
4	Python Object Oriented Programming PACKT Press, Dusty Phillips
5	Python for Unix and Linux System Administration O'Relly, Noad Gif

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.python.org/about/gettingstarted/
2	https://www.learnpython.org/
3	https://www.programiz.com/python-programming
4	https://mikkegoes.com/learn-python-online-best-resources/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	
	PLO-3	✓		✓	✓	
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓	✓	✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA22C	JAVA PROGRAMMING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Knowledge of the structure and model of the Java programming language
2	Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem
3	Write Java programs to implement error handling techniques using exception handling
4	Develop the skills to apply java programming in problem solving and design GUI based applications
5	Develop software in the Java programming language

Unit - I

The Genesis of Java - The Java class Libraries - Data types, Variables - Operators - Arrays. Control Statements: Selection statements - Iteration statements - Jump statements. Introducing classes: Class Fundamentals - Declaring objects - Methods.

Unit - II

Constructors - this keyword - Garbage collection. Overloading Methods - Access controls - Nested and Inner classes. Inheritance: Inheritance basics - using Super - Method overriding - Dynamic method Dispatch - Abstract classes - using final with inheritance. Packages and Interfaces: Packages - Access protection - Importing Packages - Interfaces.

Unit – III

Exception Handling: Exception Handling Fundamentals - Java's Built in Exceptions - creating own Exception subclasses. Multithreaded Programming: The Java Thread Model - Creating a Thread - Synchronization - Inter Thread communication.

Unit – IV

I/O Basics - Reading console Input -Writing Console Output - Reading and writing Files - Exploring java.io. Applet Fundamentals - Applet Basics - Introducing the AWT.

Unit - V

Software Development using Java: Java Beans introduction - Servlets: Life cycle - A simple servlet - servlet API - Handling HTTP Request and Responses - Session tracking. Networking Basics - Remote Method Invocation (RMI) - Accessing Database with JDBC.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment

• Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Herbert Schildt, “The Complete Reference Java 2”, 2nd Ed, Tata McGraw Hill (I) Pvt. Ltd.,2002.
2	H.M. Deitel and P. J. Deitel, “Java How to Program”, 6th Ed, PHI/Pearson Education Asia 2005.
3	Keyur shab, “Java 2 Programming”, Tata McGraw-Hill pub. Company Ltd.
4	C. Xavier, “Programming with Java 2”, SciTech Publications (India) Pvt. Ltd.
5	Cays S. Horstmann, Gary Cornell, “Core Java2 Volume I- Fundamentals”, Person Edition, 2001.
6	Cays S. Horstmann, Gary Cornell, “Core Java2 Volume II - Fundamentals”, Person Edition, 2003.
FURTHER READING:	
1	Head First Java, O’rielly publications
2	T. Budd (2009), An Introduction to Object Oriented Programming, 3rd edition, PearsonEducation, India.
3	J. Nino, F. A. Hosch (2002), An Introduction to programming and OO design using Java, John Wiley & sons, New Jersey.
4	Y. Daniel Liang (2010), Introduction to Java programming, 7th edition, Pearson education, India
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.codecademy.com/learn/learn-java
2	https://www.learnjavaonline.org/
3	https://www.udemy.com/topic/java/
4	https://www.classcentral.com/course/udacity-java-programming-basics-6686

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8	✓			✓	
	PLO-9		✓	✓		✓
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA23C	COMPUTER NETWORKS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Describe the functions of each layer in OSI and TCP/IP model
2	Explain the functions of physical layer paradigms and Protocols
3	Apply the knowledge of error correction and detection algorithms; understand data link layer
4	Understand the IP protocols.
5	Understand and analyze application layer protocols, internet routing protocols, and transport layer protocols.

Unit - I

Introduction: Use of computer networks - Network Hardware - Network Software - Reference models - Example of networks.

Unit - II

The Physical Layer: The Theoretical basis for data communication - Guided transmission Media - Wireless transmission - Communication satellites - The Public switched Telephone network - Cable Television - Mobile telephone system.

Unit – III

Data Link Layer: Data link layer design issues - Error detection and correction - Elementary data link protocols - Sliding window protocols -Example data link Protocols.

Unit – IV

Network Layer: Network layer design issues - Routing algorithms - Congestion, Control algorithms - Quality of service - Internetworking - Network layer in the internet.

Unit - V

Transport Layer: The transport service - Elements of transport protocol - A simple transport protocol - The internet Transport Protocols: UDP - The Internet Transport Protocols: TCP.

Application Layer: DNS - Electronic mail: The World Wide Web- Basics of Network Security.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice

• Providing feedback	
REFERENCES:	
1	Andrew S. Tanenbaum, "Computer Networks", 2012, Pearson Education,
2	P. Green - Computer Network Architectures and Protocols, Plenum Press, 1982.
3	Harry Katzan - An Introduction to "Distributed Data Processing", A Petrocelli Book, New York / Princeton.
4	Tittel - Theory and Problems of Computer Networking, Schaum's outline series, TMH.
5	Godbole - Data Communication & Networking, TMH.
6	Leon Garcia - Communication Networks: Fundamental Concepts & Key Architecture, TMH.
FURTHER READING:	
1	An Engineering Approach to Computer Networks-S.Keshav,2nd Edition,Pearson Education
2	Understanding communications and Networks,3rd Edition, W.A.Shay,Cengage Learning.
3	Computer and Communication Networks ,Nader F. Mir, Pearson Education
4	Computer Networking:A Top-Down Approach Featuring the Internet,James F.Kurose,K.W.Ross,3rd Edition,Pearson Education.
5	Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition TMH,2006.
6	An Engineering Approach to Computer Networks-S.Keshav,2nd Edition,Pearson Education
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
2	https://www.omnisecu.com/basic-networking/index.php
3	https://www.udemy.com/topic/computer-network/
4	https://www.edx.org/learn/computer-networking
5	https://www.udacity.com/course/computer-networking--ud436

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓			✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA24C	DIGITAL IMAGE PROCESSING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Remember the fundamental concepts of Image Processing
2	Explain different Image enhancement techniques
3	Understand and review image transforms
4	Analyze the basic algorithms used for image processing &image compression with morphological image processing.
5	Understand Image processing applications in python.

Unit - I

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels.

Unit - II

Image Enhancement in the Spatial Domain: Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters.

Unit – III

Color Image Processing: Color Fundamentals - Color Models - Pseudo color Image Processing - Color Transformations – Smoothing and Sharpening -Color Segmentation - Noise in Color Images.

Unit – IV

Morphological Image processing: Preliminaries-Dilation and Erosion-Opening and Closing-The Hit-or-Miss Transformation-Some Basic Morphological Algorithms. Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary detection – Thresholding – Region-Based segmentation- Segmentation by Morphological watersheds.

Unit - V

Image Processing with OpenCV - Python: Introduction to OpenCV – Python - OpenCV GUI - Basic operations on Images - Arithmetic operations on Images – Image Processing in OpenCV: Changing Color Spaces- Geometric Transformation of Images – Smoothing Images – Morphological Transformations- Image Gradients-Edge Detection – Contours – Histograms.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Second Edition, PHI/Pearson Education.
2	Alexander M., Abid K., "OpenCV-Python Tutorials", 2017.
3	B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2003.
4	Nick Efford, "Digital Image Processing a practical introducing using Java", Pearson Education, 2004

FURTHER READING:

1	Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
2	Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
3	Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.
4	John C.Russ, "The Image Processing Handbook", CRC Press,2007.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://eeweb.poly.edu/~onur/lectures/lectures.html.
2	http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3	https://www.coursera.org/learn/digital
4	https://www.classcentral.com/course/swayam-digital-image-processing-14005
5	https://onlinecourses.nptel.ac.in/noc19_ee55/preview

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓	✓	✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA25C	CORE PAPER V – PROBABILITY AND STATISTICS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Distinguish between different types of probability concepts.
2	Demonstrate an understanding of the basic concepts of random variables.
3	Understand the concept of expectation and joint probability distribution of random variables.
4	Describe the main properties of probability distributions and its applications.
5	Distinguish different types of probability distributions with real life problems.
6	Understand and apply the test of significance concept for large and small sample theories.
7	Identify the applications of z-test, t-test and Chi-Square test with appropriate examples.

Unit - I

Probability - Basic Definitions - Mathematical Probability - Statistical Probability - Axiomatic Approach to Probability - Addition Theorem - Multiplication Theorem - Independent Events – Baye's Theorem - Simple Problems.

Unit - II

Random Variables - Discrete Random Variable - Probability Mass Function – Continuous Random Variable - Probability Density Function - Simple Problems.

Unit – III

Mathematical Expectation of a Random Variable – Properties of Expectation - Moment Generating Function - Joint Probability Distribution of Two-Dimensional Random Variables - Marginal and Conditional Distributions - Simple Problems.

Unit – IV

Discrete Distributions - Binominal and Poison Distributions - Results and it's Applications - Continuous Distributions – Rectangular (Uniform) and Normal Distributions - Results and it's Applications - Simple Problems. (No derivations).

Unit - V

Tests of Significance for Large Samples - Basic Definitions - Normal Test of Single Mean and Difference of Means - Tests of Significance for Small Samples - t-Test for Single Mean and Difference of Means - Chi-Square Test for Independence of Attributes.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice

• Providing feedback	
REFERENCES:	
1	Gupta, S.C. and Kapoor, V.K. (2018) - Fundamentals of Mathematical Statistics, Sultan Chand &Sons, New Delhi, 11th revised Edition.
2	Hogg R.V and craig A.H. (2012) – Introduction to Mathematical Statistics, Seventh Edition, Pearson Education.
FURTHER READING:	
1	Kapoor J. N. and Sexena H. C. (2011) – Mathematical Statistics - Sultan Chand & Sons.
2	Gupta, S.P. (2014) - Statistical Methods, Sultan Chand & Sons, New Delhi, 44th Thoroughly Revised Edition.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/105/111105041/
2	https://nptel.ac.in/courses/111/106/111106112/
3	https://www.dcpehvpm.org/EContent/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5	CLO-6	CLO-7
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓	✓	✓
	PLO-2			✓	✓	✓		✓
	PLO-3							
	PLO-4		✓	✓		✓		✓
	PLO-5							
	PLO-6							
	PLO-7						✓	✓
	PLO-8	✓	✓			✓		✓
	PLO-9	✓				✓		✓
	PLO-10							

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA26P	PRACTICAL – III: PYTHON PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Write, Test and Debug Python Programs
2	Describe the Python language syntax including control statements, loops and functions to write programs for a wide variety problem in mathematics, science, and games.
3	Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.
4	Interpret the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance.
5	Discover the capabilities of Python regular expression for data verification and utilize in-built functions to develop performance efficient Python programs.

LIST OF PROGRAMS:

1. Develop Python Program using standard input/output .
2. Develop Python Program using various operators.
3. Develop Python Program using control statements and iteration.
4. Develop Python Program Using Strings.
5. Develop Python Program Using Functions.
6. Develop Python Program Using Python Scripts.
7. Develop Python Program Using Lists.
8. Develop Python Program Using Tuples.
9. Develop Python Program Using Dictionaries.
10. Develop Python Program Using Exceptions.
11. Develop Python Program Using Classes and Objects.
12. Develop Python Program using Inheritance.
13. Develop Python Program using Method overriding.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8	✓	✓		✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓			✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA27P	PRACTICAL – IV: JAVA PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Apply object-oriented programming, exception handling and multithreading concepts in problem solving.
2	Design and implement Applets, Parameterized Applets program and incorporating multithreading and event handling mechanisms.
3	Use of Swings aspects in graphical interactive application development and JDBC for database transactions, Handling HTTP requests and responses.
4	Develop applications using Socket connection and RMI and JSP.
5	Demonstrate the concepts of polymorphism and inheritance

LIST OF PROGRAMS:

1. **Develop Java Applications for the following:**
   a. Reverse and sum of individual digits of a given number (while, do...while and for loops)
   b. Arranging numbers in Ascending and Descending order (One Dimensional Array).
   c. Matrix Manipulation (Two Dimensional Arrays with switch statement).
2. **Classes and Objects:**
   a. Develop a Java application for finding the area and perimeter of a Rectangle. (Class).
   b. Develop a Java application for Pay-roll preparation. (Array of Objects).
3. **Inheritance:**
   a. Develop a Java application to implement inheritance concept.
4. **Interfaces and Packages:**
   a. Define an interface Area to find the area of the circle, area of the Rectangle and area of the Triangle.
   b. Prepare an Electricity Bill using the package concept.
5. **String Handling:**
   a. Develop a program to test the methods in String and String Buffer classes.
   b. Develop a program for arranging the given names in Alphabetical order.
6. **I/O Streams: Write java programs using stream for;**
   a. Displaying contents of the file.
   b. Copying files.
   c. Updating files.
7. **Multi-Threading Programs using:**
   a. Thread Class.
   b. Runnable Interface.
   c. Methods in the Thread Class.
8. **Networking: Write a server and client programs for sending and receiving text messages using:**
   a. Server Socket and Socket classes.
   b. Datagram Sockets.
9. **Exception Handling:**

a. Develop a Java program to implement built-in exceptions.
b. Develop a Java program to implement user-defined exceptions.
10. Swings:
a. Develop a Swing program to implement GUI components interactions with Event Handling.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓		✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓		✓		✓
	PLO-8		✓		✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA31C	BIG DATA ANALYTICS AND R PROGRAMMING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2	Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
3	Design algorithms to analyze Big data like streams, Web Graphs and Health care data
4	Understand the basics in R programming in terms of constructs, control statements, string functions
5	Understand the use of R for Big Data analytics

Unit - I

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives –Association rule mining: Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various kinds of association rules.

Unit - II

Classification and Clustering: Classification and Prediction - Basic Concepts- Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation Cluster Analysis - Types of Data – Categorization of Major Clustering Methods–K-means-Partitioning Methods – Hierarchical Methods – Clustering High Dimensional Data-Constraint Based Cluster Analysis-Outlier Analysis – Data Mining Applications.

Unit – III

Big Data Analytics: Introduction to the Big Data Era – Description of Big Data – Industry Examples of Big Data – Descriptive power and predictive Pattern Matching – The Value of Data – Big Data Analytics – Architectures, Frameworks, and Tools – Big Data Analytics Methodology – Challenges-Big Data Analytics in Healthcare.

Unit – IV

Getting Started with R- R Nuts and Bolts - Getting Data in and Out of R - Using Textual and Binary Formats for Storing Data- Interfaces to the Outside World- Sub setting R Objects - Vectorized Operations - Managing Data Frames with the dplyr package.

Unit - V

Control Structures -Functions- Scoping Rules of R - Loop Functions- Debugging Tool in R- Profiling R Code- Simulation.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion

• Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier, 2007. (Unit I and II)
2	Stephan Kudyba Foreword by Thomas H.Davenport, “Big Data, Mining, and Analytics”, CRC Press, 2015. (Unit III)
3	Roger D. Peng, “R Programming for Data Science” Lean Publishing, 2014. (Unit IV & V).
4	K.P. Soman, Shyam Diwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
5	G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
6	Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, “A Beginner’s Guide to R”, Springer, 2009.
FURTHER READING:	
1	Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
2	Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press (2013)
3	Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle REnterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media (2013), Oracle press.
4	ArvindSathi, “BigDataAnalytics: Disruptive Technologies for Changing the Game”, MC Press, 2012
5	Big Data and Hadoop: Learn by Example by Mayank Bhushan
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/learn/r-programming
2	https://www.udemy.com/topic/r-programming-language/
3	https://www.futurelearn.com/courses/big-data-r-hadoop
4	https://tell.colvee.org/course/view.php?id=17

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓	✓	✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9	✓		✓		✓
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**III**	**21MCA32C**	**MOBILE APPLICATIONS DEVELOPMENT**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand mobile devices and mobile platforms
2	Design User Interface and develop activity for Mobile App
3	knowledge concerning mobile operating systems and their architecture
4	Describe Android platform, Architecture and features
5	Design and implement Database Application and Content providers.

Unit - I

Introduction: Introduction to mobile applications - Importance of mobile applications – Strategies and challenges – Software and hardware requirements for developing mobile applications – Types of mobile applications – Benefits of creating mobile applications – Marketing and advertising mobile applications

Unit - II

Mobile User Interface Design: Mobile application users – Social aspect of mobile interfaces - Accessibility – Design patterns – Designing for the platforms.

Unit – III

Mobile Applications Architecture: Smart Client – Smart Client Architecture – Messaging Architecture – The Model-View-Controller Model - Delegate Pattern- Building Smart Client Applications-Design, Development, implementation, testing and deployment phase- MVVM mobile architecture design.

Unit – IV

Mobile Application Development: Introduction to Android Platform – Android architecture overview - Application life cycle - UI design for Android - UI fragments - Different types of layouts – Widgets – List view – View pager - Dialogs.

Unit - V

Database: Files and database – SQLite on Android – Loading asynchronous data - Map API.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	Jeff McWherter and Scott Gowell , “Professional Mobile Application Development”, John Wiley & Sons, 2012.
2	Bill Philips, Kristin Marsicano and Chris Stewart, “Android Programming: The big Nerd Ranch guide”, O’Reilly, 2017.
3	Martyn Mallick, “Mobile and Wireless Design Essentials”, Wiley, 2003
4	Ronan Schwarz, Phil Dutson, James Steele and Nelson To, “The Android Developer's Cookbook - Building Applications with the Android SDK”, Addison Wesley, 2013.
5	Mark Murphy, “The Busy Coder's Guide to Android Development”, Commons Ware, 2009.
FURTHER READING:	
1	Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd
2	Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
3	Android Application Development All in one for Dummies by Barry Burd, Edition: I
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.edx.org/learn/app-development
2	https://www.fita.in/mobile-app-development-course/
3	https://www.udemy.com/courses/development/mobile-apps/
4	https://www.coursera.org/learn/android-app

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓		✓	✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8		✓	✓	✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA33C	CRYPTOGRAPHY AND NETWORK SECURITY	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts of finite fields.
2	Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3	Apply network security basics, analyze different attacks on networks and evaluate the security protocols like SSL, IPSec, and PGP.
4	Evaluate the performance of Web security includes firewall
5	Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

Unit - I

Introduction to Cryptography – Security Attacks – Security Services – Security Algorithm – Stream cipher and Block cipher – Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

Unit - II

Public-key Cryptosystem: Introduction to Number Theory – RSA Algorithm – Key Management – Diffie-Hell man Key exchange – Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

Unit – III

Network Security Practice: Authentication Applications – Kerberos – X.509 Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.

Unit – IV

Web Security – Secure Socket Layer – Secure Electronic Transaction. System Security – Intruders and Viruses – Firewalls– Password Security

Unit - V

Case Study: Implementation of Cryptographic Algorithms – RSA – DSA – ECC (C / JAVA Programming). Network Forensic – Security Audit – Other Security Mechanism: Introduction to: Stenography – Quantum Cryptography – Water Marking – DNA Cryptography.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar

• Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	William Stallings, “Cryptography and Network Security”, PHI/Pearson Education.
2	Bruce Schneir, “Applied Cryptography”, CRC Press.
3	A.Menezes, PVanOorschotand , S.Vanstone,“Hand Bookof Applied Cryptography”, CRC Press, 1997 (Free Downloadable).
4	Ankit Fadia, “Network Security”, MacMillan.
FURTHER READING:	
1	Wade Trappe, Lawrence C Washington, “ Introduction to Cryptography with coding theory”, Pearson.
2	W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education.
3	Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India. 4. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
4	Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
5	Wade Trappe, Lawrence C Washington, “ Introduction to Cryptography with coding theory”, Pearson.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.classcentral.com/course/swayam-cryptography-and-network-security-9896
2	https://onlinecourses.nptel.ac.in/noc21_cs16/preview
3	https://www.coursera.org/lecture/managing-network-cybersecurity/cryptography-and-network-security-w9SuJ
4	https://www.edx.org/learn/cryptography
5	https://www.udemy.com/topic/cryptography/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6					✓
	PLO-7	✓	✓	✓	✓	
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA36P	PRACTICAL – V: R PROGRAMMING LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Install and use R for simple programming tasks.
2	Extend the functionality of R by using add-on packages
3	Extract data from files and other sources and perform various data manipulation tasks on them.
4	Use R Graphics and Tables to visualize results of various statistical operations on Data
5	Able to appreciate and apply the R programming from a statistical perspective

LIST OF PROGRAMS:

1. Implement an R program for classification using decision tree using PARTY PACKAGE.
2. Implement an R program for clustering using K-Means.
3. Implement an R program for Partitioning around Medoid (PAM) Clustering.
4. Implement an R program for Hierarchical clustering.
5. Implement an R program for Association Rule Mining.
6. Implement an R program for outlier detection.
7. Implement an R program to visualize the data using histogram.
8. Implement an R Program to visualize the data using Box plot.
9. Implement an R program to visualize the data using Scatter plot.
10. Implement an R program to implement preprocessing concept

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓		✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	II	21MCA37P	**PRACTICAL – VI:** MOBILE APPLICATIONS DEVELOPMENT LAB	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Experiment on Integrated Development Environment for Android Application Development.
2	Design and Implement User Interfaces and Layouts of Android App.
3	Design and Implement Database Application and Content Providers
4	Develop Android App with Security features.
5	Apply essential Android Programming concepts.

LIST OF PROGRAMS:

1. Android SDK installation and study.
2. Defining Layouts.
3. Single Activity Application, Application with multiple activities, using intents to Launch Activities.
4. Application using GUI Widgets.
5. Application with Notifications.
6. Creating and Saving Shared Preferences and Retrieving Shared Preferences.
7. Usage of SQLite Databases for storage.
8. Case Study: Developing mobile applications for problems in the field like e-learning, banking, insurance, sales and health services.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5		✓	✓		✓
	PLO-6	✓		✓	✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓	✓	✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	IV	21MCA42P	**PRACTICAL – VII:** **SOFTWARE DEVELOPMENT AND TESTING LAB**	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Develop software in C #
2	Propose the use of certain technologies by implementing them in the C # programming language to solve the given problem
3	Create and manipulate GUI components in C#
4	Create user interactive web pages using ASP.Net.
5	Performing Database operations for Windows Form and web applications

LIST OF PROGRAMS:

1. Implement a C# program to perform arithmetic operations.
2. Implement a C# program to Calculate nCr and nPr values.
3. Implement a C# program to Find the area and circumference of circle.
4. Implement a C# program to implement the Student details using inheritance.
5. Implement a C# program Sales bill preparation using interface.
6. Implement a C# program to display the clock time using delegates and events.
7. Implement a C# program to find the area of square, triangle, and rectangle using method overloading.
8. Implement a C# program to Pass values from one form to another form.
9. Implement a C# program to implement Calculator.
10. Implement a C# program to Insert record using data grid view.
11. Implement a C# program to calculate the Cut-off mark.
12. Implement an ASP .NET program to Create a login form, to expire, if the user does not type the Password within 100 seconds.
13. Implement an ASP .NET program to Create an advertisement for a bookshop.
14. Create a course registration form with name, address and list of available courses. Reply with the corresponding course fees on selection of a single course or a collection of courses.
15. Create an employee database and manipulate the records using command object in ASP.

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓			✓
	PLO-3	✓				✓
	PLO-4	✓	✓	✓	✓	
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓		✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓			✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	IV	21MCA43V	PROJECT AND VIVA VOCE	20

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Discover potential research areas in the field of IT
2	Conduct a survey of several available literature in the preferred field of study
3	Demonstrate an ability to work in teams and manage the conduct of the research study
4	Formulate and propose a plan for creating a solution for the research plan identified
5	To report and present the findings of the study conducted in the preferred domain

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓		✓
	PLO-3	✓	✓	✓	✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓			✓	
	PLO-6	✓	✓	✓	✓	✓
	PLO-7	✓	✓			✓
	PLO-8		✓		✓	
	PLO-9	✓				✓
	PLO-10	✓	✓	✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA34E	ELECTIVE 1.1: SOFT COMPUTING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Outline facts to identify process/procedures to handle real world problems using soft computing
2	Evaluate various techniques of soft computing to defend the best working solutions.
3	List the facts and outline the different process carried out in fuzzy logic
4	List the facts and outline the different process carried out in ANN
5	List the facts and outline the different process carried out in Genetic Algorithms

Unit - I

Artificial Intelligence (AI): Characteristics of AI problem – state space representation – AI search strategies: Brute force, depth first, breadth first, best first, hill climbing and A* algorithms.

Unit - II

Knowledge Representation: Logic – Propositional calculus – Predicate calculus – rules of inference – resolution – unification algorithm – semantic networks – frames – script. Soft Computing and Conventional AI: Constituents – characteristics – hybrid models.

Unit – III

Fuzzy Set Theory: Fuzzy sets – basic definitions – membership functions – fuzzy rules and reasoning – fuzzy relations – fuzzy if-then rules – fuzzy reasoning.

Unit – IV

Neural Networks: Basic concepts – network properties – learning in simple neurons – single layer perceptron's – multilayer perceptron's – supervised and unsupervised learning – Backpropagation network, Kohonen's self-organizing network, Hopfield network.

Unit - V

Genetic Algorithms: Survival of the fittest – fitness computations – cross over – mutation – reproduction – rank method – rank space method.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	Patrick Henry Winston, "Artificial Intelligence", Pearson Education, 2000.
2	Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall, 1994.
3	Ross Timothy J., " Fuzzy Logic with Engineering Applications", Tata McGraw Hill , 1997.
4	Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 2002.
5	Patterson Dan W., "Artificial Neural Networks", Prentice Hall, 1996.
6	Jang J. S. R., Sun C. T. and Mizutani E., "Neuro- fuzzy and Soft Computing", Prentice Hall, 1997
FURTHER READING:	
1	S.N.Sivanandam and S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt Ltd, 2011.
2	S.Rajasekaran and G.A.Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice-Hall of India Pvt. Ltd., 2006.
3	David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning Pearson Education India, 2013.
4	James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn.,
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.classcentral.com/course/swayam-introduction-to-soft-computing-10053
2	https://nptel.ac.in/courses/106/105/106105173/
3	https://onlinecourses.nptel.ac.in/noc20_cs17/preview
4	https://freevideolectures.com/course/4565/nptel-introduction-soft-computing
5	http://www.cs.rpi.edu/courses/fall01/soft-computing/
6	http://www.myreaders.info/html/soft_computing.html

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓				✓
	PLO-4	✓	✓			✓
	PLO-5		✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	
	PLO-9		✓	✓	✓	✓
	PLO-10	✓	✓		✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA34E	ELECTIVE 1.2: INTERNET OF THINGS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Implement state of the art architecture in IoT.
2	Analysis and evaluate protocols used in IOT
3	Determine the Web of things of IoT
4	Analysis Business model of IOT
5	Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.

Unit - I

Introduction: Definitions and Functional Requirements – Motivation – Architecture - Web 3.0 View of IOT – Ubiquitous IOT Applications – Four Pillars of IOT – DNA of IOT - The Toolkit Approach for End - user Participation in the Internet of Things. Middleware for IOT: Overview – Communication middleware for IOT – IOT Information Security.

Unit - II

IOT Protocols: Protocol Standardization for IOT - Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IOT Standardization - Unified Data standards - Protocols – IEEE 802.15.4-BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security.

Unit – III

Web of Things: Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WOT – Platform Middleware for WOT – Unified Multitier WOT Architecture – WOT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware- Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

Unit – IV

Integrated: Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behaviour in Networks - The Small - World Phenomenon.

Unit - V

Applications: The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments – Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging.

PEDAGOGY STRATEGIES

- Lecturing

• Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Honbo Zhou,"The Internet of Things in the Cloud: A Middleware Perspective", CRC Press 2012.
2	Dieter Uckelmann; Mark Harrison; Florian Michahelles, "Architecting the Internet of Things", Springer 2011.
3	David Easley and Jon Kleinberg,"Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4	Olivier Hersent, Omar Elloumi and David Boswarthick,"The Internet of Things: Applications to the Smart Grid and Building Automation",Wiley 2012.
5	Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
FURTHER READING:	
1	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013
3	CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/specializations/iot
2	https://online.stanford.edu/courses/xee100-introduction-internet-things
3	https://www.udemy.com/topic/internet-of-things/
4	https://www.futurelearn.com/courses/internet-of-things
5	https://www.futurelearn.com/courses/the-rise-of-connected-devices

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓		
	PLO-4	✓		✓	✓	✓
	PLO-5			✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓		✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA34E	ELECTIVE 1.3: SOFTWARE PROJECT MANAGEMENT	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Identify and describe the key phases of project management
2	Estimate project cost and perform cost-benefit evaluation among projects
3	Perform project scheduling, activity network analysis
4	Perform Risk management task
5	Use and application of tools to facilitate the software project management process

Unit - I

Introduction: Software Projects various other types of projects - Problems with software projects - an overview of project planning - Project evaluation - Project Analysis and technical planning

Unit - II

Project estimates - Preparation of Estimates - COCOMO model - Function Point Analysis - Putnam Model - Non-development overheads.

Unit – III

Activity Planning: Project schedules - Sequencing and scheduling projects - Network planning models - Shortening project duration - Identifying critical activities.

Unit – IV

Risk Management: Resource allocation - Monitoring and Control - Managing people and organizing teams - Planning for small projects - Handling large projects - Divide and Conquer - Software Project survival.

Unit - V

Software Configuration Management: Basic functions, responsibilities, standards, configuration Management, Prototyping - Models of prototyping. Case study using Project management tools.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	Mike Cotterell and Bob Hughes, "Software Project Management - Inclination", Tata McGraw Hill, 2014.
2	Robert K Wysocki, Robert Beck Jr and David B Crane, "Effective Project Management", John Wiley, 2012.
3	Steve McConnell, "Software Project Survival Guide", Microsoft Press, 2011.
4	Gerald M Weinberg,"Quality Software Management:Systems Thinking“, Dorset House, 2014.
5	Gerald M. Weinberg," Quality Software Management:First Order Measurement”, Dorset House,2009.
FURTHER READING:	
1	Shailesh Mehta, “Project Management and Tools & Technologies – An overview”,1st edition,2017.
2	Bob Hughes, Mike Cotterell, Rajib Mall,” Software Project Management”,TMH,2018
3	Gopalaswamy Ramesh, Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.edx.org/learn/project-management
2	https://www.udemy.com/course/software-project-management-the-complete-course/
3	https://www.qaiglobalinstitute.com/product/certificate-program-in-software-project-management/
4	https://www.lynda.com/learning-paths/Business/become-a-software-project-manager

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓		✓	✓	✓
	PLO-4	✓	✓		✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓	✓	✓
	PLO-8		✓		✓	
	PLO-9	✓	✓	✓	✓	✓
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA34E	ELECTIVE 1.4: PRINCIPLES OF COMPILER DESIGN	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Illustrate the structure of a compiler including its phases and components
2	Acquire the working principles of parser with its types
3	Design and describe the various LR parsers for a given CFG.
4	Exemplify the knowledge of language specifications using CFG by designing SDT's
5	Describe the storage organization of compiler's run time environment. Apply code optimization techniques to improve the performance of a program in terms of speed &space and demonstrate the use of memory/register allocation and instruction selection in code generation.

Unit - I

Introduction – Structure of a Compiler – Compilerwriting Tools – Basic constructs of High level Programming languages: Data structures, Parameter transmission. Lexical analysis – Role of lexical analyzer – Finite automata – Regular expressions to Finite automata – NFA to DFA – Minimizing the number of states of a Deterministic Finite Automata – Implementation of a Lexical Analyzer.

Unit - II

Parsing techniques – Context free grammars – Derivations and Parse trees – Ambiguity – Capabilities of Context free grammars – Top down and Bottom up parsing – Handles – Shift Reduce parsing- Operator precedence parsing – Recursive descent parsing – Predictive parsing.

Unit – III

Automatic parsing techniques – LR parsers – Canonical collection of LR(0) items – Construction of SLR parsing table – LR(1) sets of items Construction – Construction of canonical LR Parsing Tables.

Unit – IV

Syntax Direction Translation – Semantic actions – Implementation of Syntax Directed Translators – Intermediate Code: Postfix notation, Quadruples, Triples, Indirect triples – Methods of translation of Assignment statements, Boolean expressions.

Unit - V

Symbol tables and Code generation: Representing information in a Symbol Table – Data Structures for Symbol table – Introduction to Code Optimization: Basic blocks – DAG representation – Error detection and recovery – Introduction to Code Generation.

PEDAGOGY STRATEGIES

- Lecturing

• Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Alfred V. Aho, Ravi Sethi Jeffrey D. Ullman, "Compilers- Principles, Techniques, and Tools", Pearson Education Asia, 2007.
2	Dhamdhere D. M., Compilers construction Principles and Practice, Macmillan India Ltd.
FURTHER READING:	
1	K. L. P Mishra, N. Chandrashekaran (2003), Theory of computer science- Automata Languages and computation, 2nd edition, Prentice Hall of India, New Delhi, India.
2	Andrew W. Appel (2004), Modern Compiler Implementation C, Cambridge University Press, UK.
3	Steven S. Muchnick, "Advanced Compiler Design & Implementation", Morgan Kaufmann Pulishers, 2000.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://freevideolectures.com/course/3448/principles-of-compiler-design
2	https://nptel.ac.in/courses/106/108/106108113/
3	https://www.classcentral.com/course/swayam-compiler-design-12926
4	https://www.tutorialspoint.com/compiler_design_online_training/index.asp
5	https://www.cse.iitd.ac.in/~sanjiva/compilers.html
6	https://www.udacity.com/course/compilers-theory-and-practice--ud168

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓	✓	✓
	PLO-6	✓		✓	✓	
	PLO-7	✓	✓	✓		✓
	PLO-8				✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓			✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA35E	ELECTIVE 2.1 WIRELESS SENSOR NETWORKS	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the basics and challenges of Wireless sensor Networks
2	Apply the knowledge of MAC and link layer protocols of wireless sensor networks.
3	Explain the design considerations for deploying the wireless network infrastructure.
4	Understand the basis of Sensor network database
5	Explore and implement solutions to real world problems using sensor devices, enumerating its principles of working

Unit - I

Introduction: Unique Constraints and Challenges -Advantages of Sensor Networks - Energy advantage - Detection advantage - Sensor Network Applications - Habitat monitoring - Tracking chemical plumes - Smart transportation- Collaborative Processing - Key Definitions of Sensor Networks. Canonical Problem: Localization and Tracking - A Tracking Scenario - Problem Formulation – Sensing model - Collaborative localization. Bayesian state estimation - Distributed Representation and Inference of States - Impact of choice of representation.

Unit - II

Networking Sensors: Key Assumptions -Medium Access Control - The S-MAC Protocol - IEEEStandard and ZigBee - General Issues - Geographic, Energy - Aware Routing - Unicast Geographic Routing - Routing on a Curve – Energy - Minimizing Broadcast – Energy - Aware Routing to a Region – Attribute - Based Routing - Directed Diffusion.

Unit – III

Infrastructure Establishment - Topology Control - Clustering - Time Synchronization -Clocks and Communication Delays - Interval Methods- Reference Broadcasts -Localization and Localization Services Ranging Techniques – Range Based Localization Algorithms - Other Localization Algorithms - Location Services.

Unit – IV

Sensor Network Databases : Sensor Database Challenges - Querying The Physical Environment - Query Interfaces - Cougar sensor database and abstract data types - Probabilistic queries - High-level Database Organization - In-Network Aggregation - Query propagation and aggregation – TinyDB query processing - Query processing scheduling and optimization - Data-Centric Storage - Data Indices and Range Queries – One-dimensional indices - Multi-dimensional indices for orthogonal range searching – Non orthogonal range searching.

Unit - V

Sensor Network Platforms and Tools - Sensor Network Hardware -Berkeley motes - Sensor Network Programming Challenges - Node-Level Software Platforms - Operating system: TinyOS

- Imperative language: nesC - Dataflow style language: TinyGALS - Node-Level Simulators - ns-2 and its sensor network extensions.
PEDAGOGY STRATEGIES • Lecturing • Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback

REFERENCES:	
1	"Wireless Sensor Networks An Information Processing Approach", Feng Zhao and Leonidas Guibas , Morgan Kaufmann Publishers (An imprint of Elsevier) , 2004.
2	Wireless Sensor Networks A Networking Perspective", Jun Zheng, Abbas Jemalipour, Wiley Publications 2014.
3	Fundamentals of Wirelss Sensor Networks Theory and Practice", Waltenegus Dargie, Christian Poellabauer,Wiley Publications,2013.
FURTHER READING:	
1	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.
2	William Stallings, "Wireless Communications and Networks ", Pearson Education – 2004
3	Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
4	Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.mooc-list.com/tags/wireless-sensor-network
2	https://www.classcentral.com/course/swayam-wireless-ad-hoc-and-sensor-networks-7888
3	https://alison.com/course/introduction-to-connectivity-technologies-and-sensor-networks
4	https://nptel.ac.in/courses/106/105/106105160/
5	https://ict.iitk.ac.in/courses/wireless-ad-hoc-and-sensor-networks/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓		✓		✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓	✓		✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓	✓		✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA35E	ELECTIVE 2.2: CYBER SECURITY	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Knowledge about threat, risk, attack and vulnerability
2	Design operational and strategic cyber security strategies and policies.
3	Understand the fundamental elements that make up an Access Control System
4	Classify information and supporting assets
5	Discuss the cyber law with reference to IT Act.

Unit - I

Threats to Information Security: What is information Security - Common threats. The structure of an Information Security Program: Overview - Business Unit Responsibilities - awareness program - Program Infrastructure.

(Chapter 2 & 3).

Unit - II

Information Security Policies: Policy is the corner stone- why implement an information security policy - corporate policies - Organization wide (Tier1) policies - Policy document - Legal requirements - Business requirements - Definitions - Policy key elements - Policy formats. (Chapter 4).

Unit – III

Asset Classification: Introduction - overview - Why classify information - What is information classification - where to begin - Category examples - urge to add the categories - Constitution of confidential information - Employee responsibilities - classification examples - Declassification of information - Records management Policy- Information handling standards matrix - Information classification Methodology - Authorization for access. (Chapter 5).

Unit – IV

Access Control: Business requirements for Access control - User Access Management - System and network access control - Operating system access control - Monitoring access control - Cryptography. Physical Security: Data centre requirement - Physical access control - Fire prevention and detection - Verified disposal of documents - Agreements - Intrusion Detection Systems. (Chapter 6 & 7).

Unit - V

Information Security and Cyber Law: Introduction - Objectives - Intellectual property rights - Strategies for cyber security - Policies to mitigate cyber risk - Network security - IT Act - Signatures - Offence and penalties.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Thomas R. Peltier Justin Peltier, John Blackley, "Information Security and Fundamentals", Auer bach Publications.
2	"Information Security and Cyber Law", tutorials point simply easy learning, "**www.tutorialspoint.com/information_security_cyber_law/information_security_cyber_law_tutorial.pdf** " (E-book).
3	Bhushan / Rathore / Jamshed, Fundamentals of Cyber Security, First Edition, BPB Publication, 2017.

FURTHER READING:

1	William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006.
2	Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi
3	Bothra Harsh, "Hacking", Khanna Publishing House, Delhi 4. V.K. Pachghare, "Cryptography and Information Security", PHI Learning
4	William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.udemy.com/topic/cyber-security/
2	https://www.cyberdegrees.org/resources/free-online-courses/
3	https://www.edx.org/learn/cybersecurity
4	https://www.classcentral.com/course/swayam-cyber-security-13978
5	https://www.futurelearn.com/courses/introduction-to-cyber-security

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓			
	PLO-3	✓				✓
	PLO-4	✓	✓	✓	✓	
	PLO-5		✓			✓
	PLO-6	✓		✓	✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓			✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA35E	ELECTIVE 2.3: SOCIAL NETWORKING AND WEB MINING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand Data mining, Web Mining fundamentals and Social network analysis
2	Formalize different types of entities and relationships as nodes and edges and represent this information as relational data.
3	Use advanced network analysis software to generate visualizations and perform empirical investigations of network data.
4	Investigate how web search engines crawl, index, rank web content, how the web is structured
5	Develop an in-depth knowledge of the fundamental web data mining concepts and techniques, and how previously acquired knowledge of data mining applies to the web

Unit - I

Introduction: Data mining and web mining – web community and social network analysis – Evolution of social networks – Basic concept in social networks

Unit - II

Social Network Data and Representation: Structural – composition - affiliation variables-modes-boundary specification and sampling- type of networks- measurement and collection – Notation for social network data - Review of graph theory - Data set - Tools - Pajek, Netdraw, UCInet

Unit – III

Structural Properties of Social Networks: Notions of centrality, cohesiveness of subgroups, roles and positions, block models - stochastic block models – Information diffusion – power law.

Unit – IV

Web Mining: Web crawler – types of web crawler - Web search – Characteristic of Web data – types of web mining.

Unit - V

Web Content Mining: Web Content Mining: Vector Space Model, Web Search, Activities on Web archiving, Personalized Web Search, Feature Enrichment of Short Texts, Latent Semantic Indexing, Automatic Topic Extraction from Web Documents Opinion Search and Opinion Spam. WEB Linkage Mining: Hyperlinks- co-citation and bibliographic coupling- page rank and HITS algorithm – web community discovery – web graph measurement and modelling - using link information for web page classification.

PEDAGOGY STRATEGIES • Lecturing • Classroom Discussion • Questioning • Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Stanley Wasserman and Katherine Faust, "Social network analysis: methods and applications", Cambridge University Press, 1999.
2	Guandong xu and Yanchun zhang, "Web mining and social networking: techniques", "Springer Science and Business Media", 2011.
3	Bing Liu, "Web Data Mining", Springer, 2010.
4	Anthony Bonato, "A Course on Web Graphs", Americal Mathematical Society, 2008.
FURTHER READING:	
1	"Web Data Mining: Exploring Hyperlinks", Contents, and Usage Data, 2007.
2	Peter Mika, "Social Networks and the Semantic Web", 2007.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/lecture/process-mining/5-5-mining-social-networks-8jdQn
2	https://www.javatpoint.com/social-media-data-mining

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓			✓
	PLO-3	✓			✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓			✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8	✓			✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	III	21MCA35E	ELECTIVE 2.4: PARALLEL AND DISTRIBUTED COMPUTING	4

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Develop an understanding of various basic concepts associated with parallel computing environment
2	Experience in designing and testing parallel computing solutions to programming problems
3	Describe fundamentals concepts of pipeline and vector processing
4	Identifying specialized multi-processing architectures (i.e. SISD, MIMD)
5	Apply the basic algorithmic techniques and design algorithms in a shared memory as well as a distributed memory environment

Unit - I

Introduction to Parallel Processing - Trends towards parallel processing - Parallelism in uniprocessor Systems - Parallel Computer structures - Architectural Classification schemes - Parallel Processing Applications.

Unit - II

Solving Problems in parallel: Utilizing Temporal Parallelism - Utilizing Data Parallelism - Comparison of Temporal and Data Parallel Processing - Data parallel processing with specialized Processor- Inter-task Dependency. Structure of Parallel Computers: A Generalized structure of a parallel computers - Vector Computers - Array Processors.

Unit – III

Principles of Pipelining and Vector Processing: Pipelining: An overlapped parallelism - Instruction and Arithmetic pipelines - Principles of Designing pipelined processors.

Unit – IV

Structures and Algorithms for Array Processors: SIMD Array Processors - SIMD Interconnection Networks. Multiprocessor Architecture and programming Functional structures - interconnection Networks.

Unit - V

Parallel Algorithms: Models of computation - Analysis of Parallel Algorithms Prefix Computation- Sorting - Searching - Matrix Operations.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment

• Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" Tata Mc Graw - Hill Book Company, 1985.
2	V. Rajaraman, C. Siva Ram Murthy, "Parallel Computers Architectures and Programming",PHI, 2003.
3	Kai Hwang - "Advanced Computer Architecture -Parallelism, Scalability, Programmability" Tata Mcgraw Hill 1993.
4	Bary Wilkinson, Michael Allen - "Parallel Programming" - Pearson Education, 2002.
5	Michael J. Quinn, "Parallel Computing Theory and Practice", TMCH, Second Edition.
FURTHER READING:	
1	Kai Hwang, Jack Dongarra & Geoffrey C. Fox, "Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet (DCC)", 2012.
2	Andrew S. Tanenbaum & Maarten van Steen, "Distributed Systems: Principles and Paradigms", Prentice Hall, 2017.
3	Principles of Parallel Programming, by Calvin Lin, Larry Snyder Addison-Wesley, 2008
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udemy.com/topic/distributed-computing/
2	https://www.coursera.org/specializations/pcdp
3	https://www.mooc-list.com/course/introduction-high-performance-and-parallel-computing-coursera
4	http://courses.washington.edu/css434/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓		✓	✓
	PLO-2		✓			
	PLO-3	✓		✓	✓	
	PLO-4	✓	✓			✓
	PLO-5			✓		✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8		✓		✓	
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	✓

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	IV	21MCA41E	ELECTIVE 3.1: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Analyze and formalize the problem as a state space
2	Demonstrate awareness of heuristic search methods.
3	Attain the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.
4	Formulate and solve problems with uncertain information using Bayesian approaches
5	Develop knowledge of learning methods and Solve various problems using Expert System

Unit - I

Introduction: AI Problems – Al techniques – Criteria for success. Problems, Problem Spaces, Search: State space search – Production Systems – Problem Characteristics – Issues in design of Search.

Unit - II

Heuristic Search Techniques: Generate and Test – Hill Climbing – Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings – Approaches to Knowledge representations – Issues in Knowledge representations – Frame Problem.

Unit – III

Using Predicate Logic: Representing simple facts in logic – Representing Instance and Isa relationships – Computable functions and predicates – Resolution – Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge – Logic programming – Forward Vs Backward reasoning – Matching – Control knowledge.

Unit – IV

Statistical Reasoning: Probability and Bayes Theorem- Certainly Factors and Rule- Based systems Bayesian Networks - Dempster - Shafer Theory-Fuzzy logic. Knowledge representation: Syntactic- Semantic Spectrum of Representation-Logic and Slot-and Filter Structures - Other Representational Techniques – Planning – Understanding.

Unit - V

Learning – Common sense – Perception and Action – Expert System.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning

• Seminar • Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Elaine Rich and Kevin Knight," Artificial Intelligence", Tata McGraw Hill Publishers company Pvt. Ltd, Second Edition, 1991. (Chapters 1 – 6 only).
2	George F Luger, "Artificial Intelligence", 4th Edition, Pearson Education Publ., 2002.
FURTHER READING:	
1	Nils J. Nilsson: Principles of Artificial Intelligence, Narosa Publication house.
2	Artificial Intelligence- A Modern Approach Stuart Russel, Peter Norvig PEI 3rd edition,2015
3	Winston, Patrick, Henry, Artificial Intelligence, Pearson Education.
4	Gopal Krishna, Janakiraman, Artificial Intelligence.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/lecture/uol-machine-learning-for-all/artificial-intelligence-XGOL3
2	https://www.edx.org/learn/artificial-intelligence
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/
4	https://www.udemy.com/topic/artificial-intelligence/
5	https://nptel.ac.in/courses/106/105/106105077/
6	https://www.umsl.edu/~joshik/msis480/chapt11.htm

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓		✓
	PLO-3	✓			✓	✓
	PLO-4		✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓			✓	✓
	PLO-7		✓	✓		✓
	PLO-8	✓			✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓	✓	✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	IV	21MCA41E	ELECTIVE 3.2: CLOUD COMPUTING	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Define Cloud Computing and memorize the different Cloud service and deployment Models
2	Understand the Cloud computing stack such as SaaS, IaaS, PaaS
3	Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
4	Design different workflows according to requirements and apply map reduce programming model.
5	Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application

Unit - I

Introduction: Cloud computing in a nutshell, Layers and types, Features, Deployment models, Challenges and tasks, Migration into a cloud.

Unit - II

Cloud Services: Web based applications, Pros and Cons of cloud services: Platform as a service- Infrastructure as a service - service - software as a service, Discovering cloud services, development services and tools, cloud maturity levels, clouds.

Unit – III

Virtual Machines: Provisioning and manageability, migration, provisioning in the cloud context, Management of VM Anatomy of cloud infrastructures - Scheduling techniques.

Unit – IV

Map Reduce Paradigms: Introduction, GFS Architecture, HDFS Architecture, Hbase, Google big Tables, Amazon's key value pair storage and Microsoft's Azure infrastructure, Map reduce programming model and implementations.

Unit - V

Monitorzing And Management: Federated cloud computing, SLA Management: Types - Lifecycle - Automated policy management in cloud. Cloud Computing Framework: Amazon EC3, S3 storage services, Aneka framework, Google App Engine, Eucalyptus cloud computing platform, IBM Bluemix.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment

• Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Rajkumar Buyya, James Broberg and Andrzej Goscinskj, "Cloud Computing: Principles and Paradigms", John willey and Sons, New Delhi, 2011.
2	Judith Hurwitz, Marcia Kaufman, Fern Halper and Daniel Kirsch," Hybird Cloud for Dummies", Willey Publications, New Delhi,2012.
FURTHER READING:	
1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
3	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
4	Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/browse/information-technology/cloud-computing
2	https://www.udemy.com/topic/cloud-computing/
3	https://www.edx.org/learn/cloud-computing
4	https://www.lynda.com/Cloud-Computing-training-tutorials/1385-0.html

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓			✓
	PLO-3	✓			✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓			✓
	PLO-6	✓			✓	
	PLO-7	✓	✓	✓		✓
	PLO-8	✓			✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓		✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	IV	21MCA41E	ELECTIVE 3.3: MACHINE LEARNING	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the objectives of Machine Learning and to learn how to use different notations of it and different types of Learning
2	Understanding and Learning the fundamental algorithms
3	Understanding ,Learning the concepts of Neural Networks and Deep Learning.
4	Understanding,Learning, Analysing and Using the different types of classification and clustering as per the necessity of application.
5	Understanding and Learning the different concepts in Unsupervised Learning such as to evaluate Density Estimation , number of clusters,etc.

Unit - I

Introduction: What is Machine Learning-(Supervised Learning, Unsupervised Learning ,Semi-Supervised Learning ,Reinforcement Learning)*.Notation and Definition-Data Structures, Capital Sigma Notation, Capital Pi Notation, Operation on Sets, Operation on Vectors, Functions , Max and Arg Max, Assignment Operator, Derivative and Gradient, Random Variable ,Unbiased Estimators, Bayes Rule, Parameter Estimation, Parameters Vs Hyper parameters, Classification vs Regression, Model-Based vs Instance-Based Learning, Shallow vs Deep Learning.

Unit - II

Fundamental Algorithms: Linear Regression- Logistic Regression- Decision Tree Learning-(Support Vector Machine)*- Dealing with Noise, Dealing with Inherent: Non-Linearity-k-Nearest Neighbors-Anatomy of a Learning Algorithm-Building Blocks of a Learning- Algorithm Gradient Descent.

Unit – III

Neural Networks and Deep Learning: (Neural Networks)*-Multilayer Perceptron Example, Feed-Forward Neural Network Architecture-Deep Learning-Convolutional Neural Network, Recurrent Neural Network

Unit – IV

Classification and Clustering: Kernal Regression, Multiclass Classification ,One-class Classification, (Multi-Label Classification)*,Ensemble Learning, Learning to Label Sequences, Sequence-to- Sequence Learning, Active Learning ,Semi-Supervised Learning ,One-Shot Learning, Zero-Shot Learning.

Unit - V

Unsupervised Learning: Unsupervised Learning- Density Estimation-(Clustering, K-Means)* DBSCAN and HDBSCAN-Determining the Number of Clusters-Dimensionality Reduction-Principal Component Analysis-Outlier Detection.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar

• Assignment • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	Andriy Burkov,(2019).”The Hundred-Page Machine Learning Book”.
2	Introducing Machine Learning,(2019)MATLAB eBook, Math works Inc.
FURTHER READING:	
1	Y. S. Abu - Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.
2	P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.geeksforgeeks.org/machine-learning/
2	https://www.tutorialspoint.com/machine_learning_with_python/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2		✓	✓	✓	✓
	PLO-3	✓	✓		✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓		✓	✓
	PLO-6	✓			✓	✓
	PLO-7	✓	✓	✓		✓
	PLO-8	✓		✓	✓	✓
	PLO-9		✓	✓	✓	
	PLO-10	✓	✓	✓	✓	

Year	Sem	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	IV	21MCA41E	ELECTIVE 3.4: PROGRAMMING FOR ROBOTICS	5

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Understand the concept of Robot drive mechanism
2	Learning the basic operation of ROS.
3	Analyse Block diagram and description of the Chefbot robot
4	Elaborate the different sensors in the robot
5	Analyse vision libraries such as Open Source Computer Vision (OpenCV), Open Natural Interaction (OpenNI), and Point Cloud Library (PCL).

Unit - I

Basics of Robotics: History – Definition – Components – Building a robot – The Robot drive mechanism.

Unit - II

Robot Simulation: Mathematical modeling of the robot - Robot kinematics – Concepts of ROS and Gazebo.

Unit – III

Designing Chefbot Hardware: Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad - Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators.

Unit – IV

Working With Robotic Sensors: Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit.

Unit - V

Python and ROS: Introduction to Open CV, Open NI, and PCL - Programming Kinect with Python using ROS, Open CV, and Open NI - Working with Point Clouds using Kinect, ROS, OpenNI, and PCL.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	Lentin Joseph, “Learning Robotics using Python”, PACKT Publishing, 2015.
2	Bill Smart, Brian Gerkey, Morgan Quigley, “Programming Robots with ROS: A Practical Introduction to the Robot Operating System”, O’Reilly Publishers, 2015.
3	Aaron Martinez and Enrique Fernandez, “Learning ROS for Robotics Programming”, PACKT Publishing, 2013
FURTHER READING:	
1	Carol Fairchild and Thomas Harman, “ROS Robotics by Example”, PACKT Publishing, 2016.
2	Wyatt Newman, “A Systematic Approach to Learning Robot Programming with ROS”, 2017.
3	Robot Operating System (ROS): The Complete Reference (Volume 1-4), Springer International Publishing, 2017
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udemy.com/topic/robotics/
2	https://dotnet.microsoft.com/learn/python
3	https://www.edx.org/learn/robotics
4	https://www.learnrobotics.org/blog/learn-robotics-online/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

		CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
Program Level Outcomes (PLO)	PLO-1	✓	✓	✓	✓	✓
	PLO-2	✓	✓	✓	✓	✓
	PLO-3	✓			✓	✓
	PLO-4	✓	✓	✓	✓	✓
	PLO-5	✓	✓	✓		✓
	PLO-6	✓		✓	✓	✓
	PLO-7		✓	✓		✓
	PLO-8	✓			✓	✓
	PLO-9		✓	✓	✓	✓
	PLO-10	✓	✓	✓	✓	

7. TEACHING LEARNING METHODOLOGIES

The teaching-learning process should be in-line with the course objective and outcomes. Teaching has to ensure that the suggested outcomes are ensured for each course and overall programme. Teaching-aids should be used wherever required to facilitate proper and impactful learning. Blended learning is recommended with the use of MOOC platforms and classroom teaching**.**

To meet the set objectives of the course and enable students achieve the expected outcomes of the course the teaching-learning process should be appropriately chosen. Though the teachers are best positioned to create innovative models suitable for teaching the course, certain well accepted and widely tested processes are suggested to achieve the desired outcomes.

CLASSROOM TEACHING- Regular classroom and face to face teaching and tutorials can be primarily used for imparting theoretical foundations of Computer Applications. Applications of the same may be explained from time to time so that the student can appreciate the theory.

LABORATORY- Lab exercises in programming and usage of package/ software tools should be made mandatory and integral part. Open source software/Packages should be preferred over proprietary tools wherever available.

SEMINARS- Guest lectures and seminars involving industry experts and eminent teachers should be arranged to help the students understand the practices in the industry and developments in the field.

ASSIGNMENTS – Home assignments should be designed to make student collect information from various sources and solve unfamiliar problems and make comparisons of solutions

PROJECT - The project in the final semester should be defined based on the student proposals keeping in mind that opportunity to demonstrate the knowledge and skills gained during the course. One-One mentoring support should be provided.

SIMULATION AND ROBOTICS- Packages to provide for simulated environments to teach various components of networking and hardware working should be used wherever feasible.

8. ASSESSMENT AND OUTCOME MEASUREMENT METHODS

The recommendations given by UGC is that assessment should be viewed not only merely as a testing by the institution to evaluate the students' progress, but also as a valuable tool for a student to learn what is expected of him/her, where their level of knowledge and skill is lacking, and perhaps most importantly, what he/she could do to improve these levels with the valuable inputs of the lecturers. Assessment methods are the strategies, techniques, tools and instruments for collecting information to determine the extent to which students demonstrate desired learning outcomes. In the MCA programme, the assessment and evaluation methods focus on testing the conceptual understanding of the basic ideas of computer software, development of programming skills and experimental techniques, retention and ability to apply the knowledge acquired to real-life applications, and to solve new problems and communicate the results and findings effectively Several methods can be used to assess student learning outcomes.

Continuous Assessment

The continuous assessment occurs on a regular and continuous basis, involves the monitoring of students, is integrated with teaching, involves a systematic collection of marks into a final score, and may be used to determine the students' final grades.

SEMESTER EXAMINATION QUESTION PAPER FORMAT FOR PG

Max. Marks: 50

PART – A

I Choose the Best Answers(5*1=5 Marks)
With 4 distractors – Avoid using none of the above, all of the above
Question 1 from Unit – I
Question 2 from Unit –II
Question 3 from Unit – III
Question 4 from Unit – IV
Question 5 from Unit – V

II. Answer any three questions(3*2=6 Marks)
Short answers not exceeding 25 words each
Question 6 from Unit – I
Question 7 from Unit – II
Question 8 from Unit – III
Question 9 from Unit – IV
Question 10 from Unit – V

PART – B(5*3=15 Marks)

Short Answers not exceeding 100 words each
Answer all Questions
Question 11.a) or b) from Unit – I
Question 12 a) or b) from Unit – II
Question 13 a) or b) from Unit – III
Question 14 a) or b) from Unit – IV
Question 15 a) or b) from Unit – V

PART – C(3*8=24 Marks)

Answer any Three questions not exceeding 750 words each
Question 16. from Unit – I
Question 17. from Unit – II
Question 18. from Unit – III
Question 19. from Unit – IV
Question 20. from Unit – V

INTERNAL EXAMINATION QUESTION PAPER FORMAT FOR PG

Max. Marks: 50

PART – A

I Choose the Best Answers(5*1=5 Marks)
With 4 distractors – Avoid using none of the above, all of the above
Question 1 from Unit – I
Question 2 from Unit –II
Question 3 from Unit – III
Question 4 from Unit – IV
Question 5 from Unit – V

II. Answer any three questions(3*2=6 Marks)
Question 6 from Unit – I
Question 7 from Unit – II
Question 8 from Unit – III
Question 9 from Unit – IV
Question 10 from Unit – V

PART – B(5*3=15 Marks)

Short Answers not exceeding 25 words each
Answer all Questions
Question 11.a) or b) from Unit – I
Question 12 a) or b) from Unit – II
Question 13 a) or b) from Unit – III
Question 14 a) or b) from Unit – IV
Question 15 a) or b) from Unit – V

PART – C(3*8=24 Marks)

Answer any Three questions not exceeding 200 words each
Question 16. from Unit – I
Question 17. from Unit – II
Question 18. from Unit – III
Question 19. from Unit – IV
Question 20. from Unit – V