

M.Sc. COMPUTER SCIENCE –CBCSS (EFFECTIVE FROM 2020 ADMISSION ONWARDS)

The course of the MSc (Computer Science) Programme is designed with the following objectives:

1. To equip students to take up challenging research-oriented responsibilities and courses for their higher studies/profession.
2. To train and equip the students to meet the requirements of the Software industry in the country and outside.
3. To motivate and support the students to prepare and qualify challenging competitive examinations such as JRF/NET/JAM/GATE etc.

PROGRAMME OUTCOME (PO)

After the successful completion of the Post Graduate Programme, M.Sc Computer Science at University of Calicut, a student would have :

- PO1: Attained in depth knowledge of foundations of computing.
- PO2: Development of soft skills and practicing professional ethics.
- PO3: An ability to understand, analyze and design efficient algorithms.
- PO4: Apply computer science theory and software development concepts to construct computing-based solutions.
- PO5: To make them employable according to the current demand of the IT Industry and responsible citizens.
- PO6: An ability to understand and solve emerging research problems.
- PO7: Develop programming skills to implement research projects.

PROGRAMME SPECIFIC OUTCOME (PSO)

- PSO1: Evaluate complex real-world problems by applying principles of theoretical computing, engineering and Mathematical models.
- PSO2: Modern Tool usage: Create, select, adapt and apply appropriate techniques,

resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PSO3: Understand all dimensions of the concepts of software application development and projects.

PSO4: Aware the students to publish their work in reputed journals.

PSO5: Conceive Project Management capabilities to solve real world problems in accordance to the needs of the industry, in a specific time frame.

PSO6: Design and develop computer programs/computer-based systems in the field of Computer Sciences viz. Computational Intelligence, Machine learning, Web technology, Information Retrieval Systems, Data Analytics, Communication and networking.

PSO7: To prepare the students to address the challenging requirements coming from the enterprise applications

COURSE OUTCOME

SEMESTER	COURSE	COURSE OUTCOME
	CSS1C01 – DISCRETE MATHEMATICAL STRUCTURES	CO1: Verify the validity of an argument using propositional and predicate logic. CO2: Understand allocations of set theory by applying operations on set. CO3: Apply operations of relations and functions in discrete structures. CO4: Understand applications of Lattices and Boolean algebra in computer science domain.

		<p>CO5: Identify Group, Ring and Field in Group Theory</p> <p>CO6: Understand applications of Graph Theory and Tree</p> <p>CO7: Apply the concepts of graph theory and trees to formulate problem solving</p>
<p>SEMESTER I</p>	<p>CSS1C02 – ADVANCED DATA STRUCTURES</p>	<p>CO1: Summarize different categories of data structures.</p> <p>CO2: Design algorithms to perform operations with linear and non – linear data structures.</p> <p>CO3: Describe how arrays, linked lists, stacks, queues, trees and graphs are represented in memory and used by algorithms.</p> <p>CO4: Describe common applications for arrays, linked lists, stack, queue, tree and graphs.</p> <p>CO5: Demonstrate different methods for traversing trees.</p> <p>CO6: Design and implement an appropriate hashing function for an application.</p> <p>CO7: Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing.</p>

		<p>CO8: Describes various types of trees and heap structures.</p>
	<p>CSS1C03 – THEORY OF COMPUTATION</p>	<p>CO1: Describe broad overview of the theoretical foundations of computer science.</p> <p>CO2: Understand regular languages and finite automata. CO3: Apply the concept of context free languages in problem solving.</p> <p>CO4: Solve various problems of applying normal form techniques, push down automata and Turing Machines.</p> <p>CO5: Propose solutions for the problems based on computability and decidability.</p>
	<p>CSS1C04 – THE ART OF PROGRAMMING METHODOLOGY</p>	<p>CO1: Improve ability to develop effective algorithms.</p> <p>CO2: Understand the fundamental principles of problem-solving using computers.</p> <p>CO3. Demonstrate the applications of the programming constructs including decision making, looping, arrays and strings.</p> <p>CO4. Conceptualize modular programming basics using functions, structures and Unions</p> <p>CO5. Understand features like pointers and macros and to become familiar with programming with files</p>

		<p>CO6: Design, develop, implement, test and document well-structured and reliable computer programs using the C programming language.</p>
	<p>CSS1C05 – COMPUTER ORGANIZATION & ARCHITECTURE</p>	<p>CO1: Identify, understand and apply different number systems and codes.</p> <p>CO2: Understand the digital representation of data in a computer system.</p> <p>CO3: Understand the general concepts in digital logic design and their use in sequential and combinational circuit design.</p> <p>CO4: Describe fundamental organization of a computer system.</p> <p>CO5: Explain addressing modes, instruction formats and program control statements. CO6: Understand computer arithmetic formulae and solve problems.</p> <p>CO7: Distinguish the organization of various parts of a system memory hierarchy. CO8: Identify and compare different methods for computer I/O.</p>
	<p>CSS1L01 – PRACTICAL I</p>	<p>CO1: Develop programming skills using the fundamentals and basics of C language.</p> <p>CO2: Develop programs using the basic elements like control statements, arrays and strings. CO3: Design and implement the effective usage of arrays, structures, functions and pointers. CO4: Implement files handling and command line arguments.</p> <p>CO5: Demonstrate the concepts of stack, queue and linked list and apply various operations on them.</p>

	<p>CSS1A01 – INTRODUCTION TO RESEARCH (ABILITY ENHANCEMENT AUDIT COURSE)</p>	<p>CO1: Understand research terminology.</p> <p>CO2: Apply the ethical principles of research.</p> <p>CO3: Identify the components of a literature review process.</p> <p>CO4: Critically analyze published research works.</p> <p>CO5: Innovate and apply research methods in the discipline of computing.</p>

SEMESTER	COURSE	COURSE OUTCOME
	<p>CSS2C06 – DESIGN AND ANALYSIS OF ALGORITHMS</p>	<p>CO1: Design algorithms in context of space and time complexity and apply asymptotic notation.</p> <p>CO2: Analyze the problem and develop the algorithms related to these problems.</p> <p>CO3: Classify the problems and apply the appropriate design strategy to develop algorithms.</p> <p>CO4: Analyze the problem and develop the algorithms related to these problems.</p> <p>CO5: Demonstrate the use of parallel algorithms.</p>
	<p>CSS2C07 – OPERATING SYSTEM CONCEPTS COURSE</p>	<p>CO1: Understand the basic components of a computer operating system.</p> <p>CO2: Compare and interpret the applications of Process and threads.</p>

<p style="text-align: center;">SEMESTER II</p>		<p>CO3: Describe the policies for scheduling, deadlocks, synchronization, system calls, and file systems.</p> <p>CO4: Illustrate the functioning of process management, memory management and file management Modules present in an OS.</p> <p>CO5: Differentiate various types of scheduling algorithms.</p> <p>CO6: Understand the concepts of Three-Tier Client/Server Architecture, Middleware and the characteristics of mobile operating systems.</p>
	<p style="text-align: center;">CSS2C08 – COMPUTER NETWORKS</p>	<p>CO1: Understand the basics concepts of computer network organization and implementation.</p> <p>CO2: Describe theoretical understanding of layered network models - OSI and TCP/IP Models.</p> <p>CO3: Illustrate the functionalities of different network layers.</p> <p>CO4: Analyze the network application such as data transmission between client and server, file transfer, real-time and multimedia transmission.</p> <p>CO5: Explain the security aspects in networks and principles of cryptography.</p>
	<p style="text-align: center;">CSS2C09 – COMPUTATIONAL INTELLIGENCE</p>	<p>CO1: Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.</p> <p>CO2: Conceptualize various knowledge representation techniques.</p>

		<p>CO3: Analyze the problem-solving methods and algorithms related to searching, reasoning, game playing and machine learning.</p> <p>CO4: Understand the functioning of expert systems and its importance.</p> <p>CO5: Demonstrate the implementation various AI algorithms to solve real life problems.</p>
	<p>CSS2C10 – PRINCIPLES OF SOFTWARE ENGINEERING</p>	<p>CO1: Understand the software process and development models.</p> <p>CO2: Understand the software design process and structured analysis of systems.</p> <p>CO3: Distinguish different types of modelling like DFD and UML.</p> <p>CO4: Illustrate the knowledge about the design of user interface.</p> <p>CO5: Apply the skill of project management and report preparation.</p>
	<p>CSS2L02 – PRACTICAL II</p>	<p>CO1: Discuss and formulate the problems based on the basic principles of networks.</p> <p>CO2: Implementation of different memory management techniques in OS.</p> <p>CO3: Implement various system operations of the operating system and also the various process scheduling algorithms.</p> <p>CO4: Understand the TCP/IP configuration for Windows and Linux.</p> <p>CO5: Design and implement various network applications such as data transmission between</p>

		<p>client and server, file transfer, real-time multimedia transmission.</p> <p>CO6: Understand different Linux/UNIX shell scripts and execute various shell programs.</p>
	<p>CSS2A02 – TERM PAPER (PROFESSIONAL COMPETENCY AUDIT COURSE)</p>	<p>CO1: Apply critical thinking skills analytical ability in problem solving.</p> <p>CO2: Apply foundational research skills to address research problem. CO3: Innovate, experiment and analyze research findings.</p> <p>CO4: Demonstrate capacity to lead and manage change through a collaborative environment. CO5: Innovate, experiment and analyze research findings and practice the process of scientific publishing.</p>

SEMESTER	COURSE	COURSE OUTCOME
	<p>CSS3C11 – ADVANCED DATABASE MANAGEMENT SYSTEM</p>	<p>CO1: Explain the basics of database management system, concepts of relational data model, entity-relationship model, relational database design, relational algebra and calculus.</p> <p>CO2: Apply the normalization techniques to improve the database design.</p> <p>CO3: Describe various database manipulation commands in SQL.</p> <p>CO4: Understand Transaction Processing & Locking using the concept of Concurrency control.</p>

SEMESTER III		CO5: Conceptualize advanced features of Object-Oriented Database Management Systems and Distributed databases.
	CSS3C12 – OBJECT ORIENTED PROGRAMMING CONCEPTS	<p>CO1: Recall the object-oriented programming concepts and basics of Java.</p> <p>CO2: Design and implement object-oriented programs including packages and interfaces.</p> <p>CO3: Explain and handle exceptions and threads.</p> <p>CO4: Develop interactive programs using applets, AWT and swings.</p> <p>CO5: Explain the concepts of JDBC, sockets and gives an introduction to Unified Modelling Language (UML).</p>
	CSS3C13 – PRINCIPLES OF COMPILERS	<p>CO1: Understand the major phases of compilation, identify tokens of a typical high -level programming language, define regular expressions for tokens, design and implement a lexical analyzer.</p> <p>CO2: Develop the parsers and experiment the knowledge of different parsers design without automated tools.</p> <p>CO3: Construct the intermediate code representations and generation.</p> <p>CO4: Explain the role of different types of runtime environments and memory organization for implementation of typical programming languages.</p> <p>CO5: Apply the optimization techniques to have a better code for code generation.</p>

	<p>CSS3L03 – PRACTICAL III</p>	<p>CO1: Design and development of relational database systems.</p> <p>CO2: Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger and views.</p> <p>CO3: Apply various software to design and build ER Diagrams, UML, Flowchart for related database systems.</p> <p>CO4: Design and implement database applications on their own.</p> <p>CO5: Apply JDBC to provide a program level interface for communicating with database using Java programming.</p> <p>CO6: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.</p> <p>CO7: Understand Java programming concepts and utilize Java Graphical User Interface in program writing.</p> <p>CO8: Design and develop Java programs that solve real-world problems</p>
	ELECTIVE I	
	<p>CSS3E01a – COMPUTER GRAPHICS</p>	<p>CO1: Understand the basics of computer graphics, different graphics systems and applications of computer graphics.</p>

		<p>CO2: Extract scene with different clipping methods and its transformation to graphics display device.</p> <p>CO3: Explore projections and visible surface detection techniques for display.</p> <p>CO4: Explore object representations and surface detection methods.</p> <p>CO5: Understand techniques and OpenGL programming concepts.</p>
	<p>CSS3E01b – INTRODUCTION TO SOFT COMPUTING</p>	<p>CO1: Understand soft computing techniques and their role in problem solving.</p> <p>CO2: Conceptualize and parameterize various algorithms in problem solving.</p> <p>CO3: To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations.</p> <p>CO4: Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.</p> <p>CO5: Conceptualize advanced topics of evolutionary algorithms and swarm intelligence.</p>
	<p>CSS3E01c – WEB TECHNOLOGY</p>	<p>CO1: Understand the basics of HTML, XML and CSS.</p> <p>CO2: Learn client-side programming and basics of Javascript.</p> <p>CO3: Explore web servers and server-side technologies.</p>

		<p>CO4: Able to do server-side programming with PHP.</p> <p>CO5: Illustrate and apply content management systems and its features.</p>
	<p>CSS3E01d – BIOINFORMATICS</p>	<p>CO1: Understand the basic concepts of Bioinformatics and its significance in Biological data analysis.</p> <p>CO2: Demonstrate various techniques, algorithms and tools employed in computational biology.</p> <p>CO3: Identify steps in sequence alignment.</p> <p>CO4: Analyze various databases and tools on nucleic acids and protein.</p> <p>CO5: Understand the types of data found at NCBI and EBI resources.</p>
	<p>CSS3E01e – COMPUTER OPTIMIZATION TECHNIQUES</p>	<p>CO1: Understand linear programming methods and formulate real world problems into mathematical problems.</p> <p>CO2: Apply linear programming methods like transportation and network problems.</p> <p>CO3: Understand different linear programming methods and applications.</p> <p>CO4: Understand integer linear programming and algorithms to solve it.</p> <p>CO5: Understand the basics of dynamic programming and nonlinear programming</p>
	<p>CSS3E01f – NUMERICAL AND STATISTICAL METHODS</p>	<p>CO1: Recognize the error in the number generated by the solution.</p> <p>CO2: Compute solution of algebraic and transcendental equation by numerical methods like</p>

		<p>the Bisection method and Newton Rapshon method.</p> <p>CO3: Understand the concepts of solving integrals mathematically.</p> <p>CO4: Understand different probabilities and its properties.</p> <p>CO5: Solve linear programming problems.</p>
ELECTIVE II		
	<p>CSS3E02a – PATTERN RECOGNITION</p>	<p>CO1: Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.</p> <p>CO2: Recognize the principles of Bayesian parameter estimation. CO3: Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.</p> <p>CO4: Apply pattern recognition techniques for pre-processing, feature extraction and feature selection.</p> <p>CO5: Understand supervised and unsupervised classification methods to detect and characterize patterns in real-world data.</p>
	<p>CSS3E02b – WIRELESS & MOBILE NETWORKS</p>	<p>CO1: Understand the fundamental concepts of wireless and mobile networks.</p> <p>CO2: Illustrate the wireless application protocols for mobile content development.</p> <p>CO3: Analyze various wireless mobile programming methodologies.</p> <p>CO4: Understand security aspects of wireless networks.</p>

		CO5: Understand TCP/IP extensions for wireless mobile networking.
	CSS3E02c – CRYPTOGRAPHY AND NETWORK SECURITY	CO1: Understand the fundamentals of cryptography. CO2: Describe data integrity, authentication, digital signatures. CO3: Analyze different network security applications CO4: Familiarize standard algorithms that provide confidentiality, integrity and authenticity. CO5: Understand network security technologies.
	CSS3E02d – ADVANCED WEB TECHNOLOGY	CO1: Understand the concepts of Web 2.0. CO2: Conceptualize web services and its architecture. CO3: Develop applications using Python programming language. CO4: Analyze server-side programming with Python. CO5: Develop applications with Python-SQLite integration.
	CSS3E02e – VIRTUALISATION AND CLOUD COMPUTING	CO1: Understand the basics of cloud computing. CO2: Describe different types of virtualization.

		<p>CO3: Identify the cloud infrastructure and the key application features delivered on virtual infrastructures.</p> <p>CO4: Describe parallel and distributed programming models and programming paradigms.</p> <p>CO5: Understand mapping applications and Hadoop configuration.</p> <p>CO6: Analyze security challenges in the cloud.</p>
	<p>CSS3E02f – DATA WAREHOUSING AND DATA MINING</p>	<p>CO1: Understand the basic concepts of Data mining and warehousing.</p> <p>CO2: Identify the different techniques of data preprocessing.</p> <p>CO3: Analyze patterns that can be discovered by classification and clustering.</p> <p>CO4: Understand data mining techniques of clustering.</p> <p>CO5: Identify complex data types based on spatial and web mining.</p>

SEMESTER	COURSE	COURSE OUTCOME
	<p>CSS4P01 – PROJECT WORK</p>	<p>CO1: Demonstrate a depth of knowledge of modern technology.</p>

SEMESTER IV		<p>CO2: Practice to communicate effectively and to present ideas clearly and coherently to specific audiences in both the written and oral forms.</p> <p>CO3: Understand the project requirements, reflect on their learning and take appropriate actions to implement it.</p> <p>CO4: Estimate, plan, calculate, and adjust project variables.</p> <p>CO5: Understand the importance of iteration, evaluation and prototyping in design of a software system.</p>
	ELECTIVE III	
	<p>CSS4E03a – DATA COMPRESSION</p>	<p>CO1: Understand various database systems, data models and schemas.</p> <p>CO2: Understand database architecture, ER and duties of DBA.</p> <p>CO3: Analyze compression techniques for strings and images</p> <p>CO4: Illustrate various relevant transforms in image compression.</p> <p>CO5: Recognize video-audio file formats and the compression techniques used</p> <p>CO6: Compare and analyze different algorithms used in audio and video file formats</p>

	<p>CSS4E03b – PERVASIVE COMPUTING</p>	<p>CO1: Familiarize conceptual foundation in pervasive computing area.</p> <p>CO2: Understand various application fields associated to pervasive computing</p> <p>CO3: Identify the devices, interfaces, security and protocols in pervasive computing field.</p> <p>CO4: Understand pervasive computing in web applications</p> <p>CO5: Understand the WAP architecture, languages and security issues.</p> <p>CO6: Apply knowledge on personal digital assistant devices and java programming for pervasive computing</p> <p>CO7 Understand pervasive computing web application architecture, MVC and user interfaces.</p>
	<p>CSS4E03c – SYSTEM SECURITY</p>	<p>CO1: Familiarize with different types of securities in information systems, security goals and CIA.</p> <p>CO2: Illustrate computer system threats and various types of system attacks</p> <p>CO3: Identify different issues associated with system attacks and how attacking occurs; and various types of attackers</p> <p>CO4: Provide knowledge in operating system security, file protections, security assurance</p> <p>CO5: Understand important elements of Database security</p> <p>CO6: Define security planning, various types of security policies and risk analysis</p>

	<p align="center">CSS4E03d – MOLECULAR SIMULATION AND MODELLING</p>	<p>CO1: Understand different molecular modelling methods and model types.</p> <p>CO2: Illustrate concepts, principles of mathematical modelling and discrete system simulation.</p> <p>CO3: Analyze different mapping techniques and Microarray technology</p> <p>CO4: Analysis of different prediction strategies of Structural Modelling</p> <p>CO5: Demonstrate protein structure classification and prediction</p> <p>CO6: Familiarize steps in molecular visualization, protein family databases, software tools and basic operations</p>
	<p align="center">CSS4E03e – FUNDAMENTALS OF BIGDATA</p>	<p>CO1: Understand basic concepts of Bigdata, its dimensions and currently available other Databases.</p> <p>CO2: Describe bigdata analytics and familiarize data analytics using a tool – R</p> <p>CO3: Understand NOSQL databases and introduce MongoDB</p> <p>CO4: Understand in basic functions of NOSQL database</p> <p>CO5: Illustrate the basics of the HADOOP Ecosystem</p> <p>CO6: Understand the elementary concepts of MapReduce.</p>

	<p>CSS4E03f – WEB ENGINEERING</p>	<p>CO1: Understand basic concepts Web engineering</p> <p>CO2: Describe Requirements Engineering (RE) for web applications and familiarize Web application architecture and architecture for multimedia data.</p> <p>CO3: Understand NOSQL databases and introduce MongoDB</p> <p>CO4: Understand the basics of Modelling web applications and web application design</p> <p>CO5: Understand the elementary concepts of testing web applications.</p>
ELECTIVE IV		
	<p>CSS4E04a – DIGITAL IMAGE PROCESSING</p>	<p>CO1: Understand the fundamental concepts of a digital image processing</p> <p>CO2: Apply various image enhancement techniques</p> <p>CO3: Describe various image enhancement techniques</p> <p>CO4: Implement algorithms for handling intensive image restoration problems.</p> <p>CO5: Identify and compare various image segmentation and representation techniques</p> <p>CO6: Understand various image compression procedures.</p>
	<p>CSS4E04b – ADVANCED TOPICS IN DATABASE DESIGN</p>	<p>CO1: Understand the basic concepts of the database and data models. Design a database using ER and EER diagrams</p>

		<p>CO2: Familiarize the students to OPSS Database concepts and its features</p> <p>CO3: Understand the concepts of Object relational and extended database</p> <p>CO4: Describe the basics of Client server, distributed and parallel Databases.</p> <p>CO5: Exemplify XML data model and how-to retrieval information in Databases</p>
	<p>CSS4E04c – SOFTWARE DEVELOPMENT FOR PORTABLE DEVICES</p>	<p>CO1: Understanding on Mobile web and CSS3</p> <p>CO2: Understand the role of jQuery - methods - manipulations</p> <p>CO3: Describe the basics of Android and smartphones its architecture, environment, life cycle and various XML layouts</p> <p>CO4: Understand the role of content providers and databases</p> <p>CO5: Understand networking and location-based services.</p> <p>CO6: Illustrate how exchange of data to and from a web server like JSON is taking place.</p>
	<p>CSS4E04d – STORAGE AREA NETWORKS</p>	<p>CO1: Understand basic networking and SAN topologies</p> <p>CO2: Illustrate SAN basics technology and configuration</p> <p>CO3: Understand storage networking architecture and SAN emerging technologies</p>

		<p>CO4: Illustrate the storage infrastructure and management activities</p> <p>CO5: Demonstrate how to build SAN and security guidelines.</p>
	<p>CSS4E04e – SEMANTIC WEB</p>	<p>CO1: Understand semantic web basics</p> <p>CO2: Represent data from a chosen problem in XML with appropriate semantic tags</p> <p>CO3: Conceptualize the phases of ontology learning, algorithm and evaluation</p> <p>CO4: Understand ontology management, tools and development</p> <p>CO5: Describe the implementation details of web services and security issues.</p>
	<p>CSS4E04f – ADVANCED JAVA PROGRAMMING</p>	<p>CO1: Understand advanced concept of Java Programming, RMI and servlets</p> <p>CO2: Develop manipulate servlets and configuration</p> <p>CO3: Illustrate the basic functionalities of JNDI and EJB</p> <p>CO4: Develop JSP pages by understanding the technology and execution</p> <p>CO5: Understand the basics of ORM environment configuration mappings and HQL foundations</p>