## Master of Technology in Computer Science & Engineering
### Department of CSE&IT

The overall credit structure

<table>
<thead>
<tr>
<th>Category</th>
<th>Program Core (PC)</th>
<th>Program Elective (PE)</th>
<th>Open Elective (OE)</th>
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# Master of Technology in Computer Science & Engineering (Specialization in Cyber Security)

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<tr>
<th>Sem</th>
<th>Subject 1</th>
<th>Subject 2</th>
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<td>PE-3 3-0-2 (4) (Intrusion Detection and Prevention System)</td>
<td>PE-4 2-0-0 (2) (Risk Management Policies and principles)</td>
<td>CSL534 Programming Course – 1 3-0-2(4) (Secure Coding and Software Vulnerability Lab)</td>
<td>CSD502 Minor Project 0-0-4(2)</td>
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Total Credits of the programme: **60**
CSL501 Introduction to Logic and Functional Programming
(3-0-2) 4 Credits
Introduction to declarative programming paradigms. The functional style of programming, paradigms of developments of functional programs, use of higher order functional and pattern matching. Type, type-checking and their relationship to logic. Logic as a system for declarative programming. The use of pattern matching and programming of higher order functions within a logic programming framework. Introduction to symbolic processing. The use of resolution and theorem-proving, PROLOG Programming.

CSD502 Minor Project
(0-0-4) 2 Credits
Research and development projects based on problems of practical and theoretical interest. First part of a two semester long project activity. Problem definition, background research, development of overall project plan (detailed design, milestones, etc.) and meeting the research and development targets set up for the first part. Evaluation will be based on student seminars, written reports, and evaluation of the developed system and/or theories.

CSL502 Advanced Algorithm
(3-0-2) 4 Credits

CSL504 Architecture of High Performance Computer Systems
(3-0-2) 4 Credits
Prerequisites: Operating System Concepts. Contents: Classification of parallel computing structures; Instruction level parallelism - static and dynamic pipelining, improving branch performance, superscalar and VLIW processors; High performance memory system; Shared memory multiprocessors and cache coherence; Multiprocessor interconnection networks; Performance modeling; Issues in programming multiprocessors; Data parallel architectures.

CSL511 Advance Computer Networks
(3-0-0) 3 Credits

CSL513 Advanced Computer Graphics
(3-0-0) 3 Credits
Introduction; Open 3GL programming languages, Animations; Rendering & Volume Rendering; Ray Tracing; Shading & Illumination; Radiosity, 3D Transformations.

CSL515 Soft Computing
(2-0-2) 3 Credits
Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Logic Systems: Basics of Fuzzy Logic Theory,

CSL517 Advanced Operating System
(3-0-0) 3 Credits

CSL519 Advanced Microprocessor
(3-0-0) 3 Credits

CSL520 System Level Design and Modeling
(3-0-0) 3 Credits
Embedded systems and system-level design, models of computation, specification languages, hardware/software co-design, system partitioning, processors and memory, application specific processors and memory, low power design.

CSL521 Quantum Computing
(3-0-0) 3 Credits
Quantum statistics, Superposition, Polarization, Entanglement, Heisenberg’s Uncertainty Principle, Schrödinger’s Wave Equation, Thermodynamics of Computation, Quantum Computing Approach to NP-Complete problems, Qubit concepts, NOT, CNOT, SRNOT, Rotational Gates, Fredkin Gates, Toffili Gates, Phase Shift Gate, Implementation of quantum gates. Quantum Registers, Half adder, Full adder, Quantum Shift Register, Quantum multiplexer using quantum shift registers. NRM devices, Ion trap, high Q-optical cavities, spin resonance transistor, Quantum computers, Potential and power of Quantum Computing, Quantum Vs Classical Computers, Different algorithms-shor’s factorization algorithm, Grover’s search algorithm, prim’s algorithm, and serial and parallel quantum operations. Single photon transmission, Dense Coding, Quantum teleportation, Quantum data Compression, Quantum cryptography, Quantum error correction.

CSL522 Formal Systems
(3-0-0) 3 Credits
Formal languages and their related automata, Turing machines, type-0 languages, linear bounded automata and CSLs. Time and tape bounded Turing machines, time and space bounds for recognizing CFLs. Turing Computability: number theoretic computations by Turing machines and indexing. Axiomatic systems, their soundness and completeness. Recursive function theory: primitive recursive functions and primitive recursive predicates. Ackermann’s function, recursive and general recursive functions. Computability and decidability: computable functions, computable sets, decision problems. Fix point theory of programs, functions and functional, verification methods, Lambda calculus and applications.

CSL523 Cluster and Grid Computing
(3-0-0) 3 Credits
Introduction to high performance computing, basic definitions: cluster, grid, meta-computing, middleware etc., examples of representative applications.

CSL 524 Advanced Graph Theory
(3-0-0) 3 Credits

Overview of Basic Concepts: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group; Introduction to trees: Equivalent definitions of trees and forests, Cayley's formula, Matrix-Tree, and The Matrix-Tree theorem, minimum spanning trees; Connectivity: Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger’s theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, the Chinese Postman Problem, the Traveling Salesman problem, diameter and maximum degree, shortest paths; Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartite and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem; Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem; Graphs on surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces; Directed graphs: Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branching; Networks and flows: Flow cuts, Max flow min cut theorems, perfect square; Selected topics: Dominating sets, the reconstruction problem, intersection graphs, perfect graphs, random graphs.

CSL-527 Data Structures and Algorithms in C++

(3-0-2) 4 Credits


CSL 535 Data Structures using C++
(2-0-2) 3 credits


CSL 530 Probability and Mathematical Statistics
(3-0-0) 3 credits

Basic probability theory. ample spaces; random variables; normal, Poisson, and related distributions; expectation; correlation; and limit theorems. Applications in many fields (biology, physics, gambling, etc.). Central limit theorem, point estimation, interval estimation, multivariate normal distributions, tests of hypotheses, and linear models.

CSL 534 Programming Course – 1
(3-0-2) 4 Credits

Java Basics Review, Distributed Computing, Java Beans and swing, Java Enterprise Application, JNI -Servlets - Java Server Pages - JDBC - Related Java Techniques, Java Media Frame work Case study -Deploying n-tier application, E-commerce applications.

CSL 601 Ubiquitous Computing
(3-0-0) 3 Credits

**CSL603 Machine Learning**
(3-0-0) 3 Credits

**CSL605 Real Time Systems**
(3-0-0) 3 Credits

**CSL607 Parallel Distributed Algorithm**
(3-0-0) 3 Credits

**CSL609 Reconfigurable Computing**
(3-0-0) 3 Credits
Introduction to reconfigurable computing, overview of programming with VHDL, comparison of computing machines, Pipeline architecture, virtual memory, Field programmable gate arrays, comparison of different architecture viz. PDSP, RALU, VLIW, vector processor, system on chip with embedded processor, FPGA design flow, synthesis, placement routing, reconfigurable computing systems, speed-up analysis in RC, Designing state machines for FPGA, parallel computing model and pipeline technique, systolic array circuit design, systolic application, partial reconfiguration, FPGA generators, dynamically reconfigurable systems, reconfigurable example systems tool chain, cryptography, compilation from high level language, signal and image processing applications, supercomputer and scientific applications, case study on FPGA design cycle.

**CSL611 Computer Vision**
(3-0-0) 3 Credits
Camera models, Calibration, multi-views projective geometry and invariants. Edge/feature extraction, correspondence and tracking, 3D structure/motion estimation. Object recognition, Scene and activity interpretation.

**CSL613 Cryptography and Network Security**
(3-0-2) 4 Credits
Cryptographic Theory and related Mathematics, Symmetric and Asymmetric Key Encryption

**CSL615 Special Topics in Parallel Computation**
(3-0-0) 3 Credits

Research issues in areas like Parallel Computation Models, Parallel Algorithms, Parallel Computer architectures and interconnection networks, Shared memory parallel architectures and programming with OpenMP and Pthreads, Distributed memory, message-passing parallel architectures and programming, portable parallel message-passing programming using MPI.

**CSL641 Programming Course – 2**
(3-0-2) 4 Credits


**CSP 605 Lab Course – 1**
1 Credits (0-0-2)
Working with Rational Rose and MATLAB

**CST 201 Practical Training / Summer Training**
NC
Students will be sent to the industries in their Summer vacations (after 4th Semester), to have a hands on experience and exposure to industrial environment. The assessment of this training will be done in 5th semester.

**CSL 543 Cyber Security**
(2-0-0) 2 credits


**CSL 536 Intrusion Detection and Prevention System**
(3-0-2) 4 credits
Understanding Intrusion Detection, IDS and IPS analysis schemes, Attacks, Detection approaches, theoretical foundations of detection, intrusion detection, reaction and architectures, legal issues and organizations standards, applications and tools, Tool Selection and Acquisition Process.

**CSL 537 Risk Management Policies and Principles**
(2-0-0) 2 credits


**CSL538 Secure Coding and Software Vulnerability Analysis Lab**
(3-0-2) 3 credits

Introduction to secure coding, types of security vulnerabilities, Buffer Overflows, Unvalidated Input Race Conditions, Inter process Communication, Insecure File Operations, Access Control Problems Secure Storage and Encryption. Avoiding buffer overflows and underflows, validating input and inter process communication, race conditions and secure file operations, elevating privileges safely, designing secure user interfaces, designing secure helpers and daemons, avoiding injection attacks and xss, security development checklists, third-party software security guidelines.
CSL539 Digital Forensics
(2-0-2) 3 credits
Context, Legal and Practical Considerations
Cybercrime; Forensic process; computer forensics, Investigative tools (Open Source and Proprietary); Email & Browsers, network forensics: Attack trace-back; Packet inspection; Log analysis, Hashing issues; Anti-forensics (encryption and stealth techniques), digital forensics, laws and acts.

CSL541 Security in Distributed System
(3-0-0) 3 credits

CSL 542 Reverse Engineering and Malware Analysis
(3-0-2) 4 credits
Understanding the terminologies related to re-engineering, forward engineering, and reverse engineering; security-related reverse engineering, advanced reverse-engineering, malware analysis, Fundamental aspects of malware analysis, techniques for malware analysis, malware analysis in different environments.

SEL505 Software Engineering Concepts and Methodologies
(3 -0- 0) 3 Credits
Software development process models from the points of view of technical development and project management, Software Development Methods: Formal, semi-formal and informal methods; Requirements elicitation, requirements specification; Data, function, and event-based modeling; Some of the popular methodologies such as Yourdon’s SAD, SSADM etc; CASE tools classification, features, strengths and weaknesses; ICASE; CASE standards. Software Project Management, Software Quality Management, Configuration Management, Brief introduction to various standards related to Software Engineering.

SEL506 Software Quality Management
(3 -0- 0) 3 Credits
Basic Concepts of software quality, software quality control and software quality assurance, evolution of SQA, major SQA activities, major SQA issues, zero defect software, Software Quality Assurance, Software Quality Assurance, Error Reporting: Trend Analysis: Error quantity, error frequency, program unit complexity, compilation frequency. Corrective action as to Cause: Identifying the requirement for corrective action, determining the action to be taken, implementing the corrective action, and documenting the corrective action, periodic review of actions taken. Records Collection, Maintenance, and Retention, quality evaluation reports. Quality standards with emphasis on ISO 9000, SEI CMM, TQM Models.

SEL507 Object Oriented Software Engineering & UML
(3 -0- 0) 3 Credits

SEL508 Software Verification, Validation & Testing
(3 -0- 2) 4 Credits
Introduction: Terminology, evolving nature of area. V&V Limitations: Theoretical foundations: impracticality of testing all data, impracticality of testing all paths, no absolute proof of correctness.
Role of V&V in Software Evolution: Types of Products: requirements, specifications, designs, implementations, changes; V&V objectives: correctness, consistency, necessity, sufficiency, performance. Software V & V Approaches and their Applicability: Software technical reviews; Software testing: levels of testing - module, integration, system, regression; Testing techniques and their applicability-functional testing and analysis, structural testing and analysis, error-oriented testing and analysis, hybrid approaches, integration strategies, transaction flow analysis, stress analysis, failure analysis, concurrency analysis, performance analysis; Proof of correctness; simulation and prototyping; Requirement tracing. Software V&V Planning: Identification of V&V Goals; Selection of V&V techniques: requirements, specifications, design, implementations, changes; Organizational responsibilities: development organization, independent test organization; software quality assurance; independent V&V contractor; V&V standards; Integrating V&V approaches; Problem tracking; Tracking test activities; Assessment.

**SEL509 Software Project Management**
(3 -0- 2) 4 Credits

Introduction to software project management, creation of project plan, software estimation, project scheduling, project cost management, project team and project manager, cost management, human resource management, project communication management, project management process group, risk management, project monitoring and control, quality control. Alternative approaches and emerging issues.

**SEL525 Software Design, Construction & Testing**
(3 -0- 0) 3 Credits


**SEL526 System Performance & Evaluation**
3 Credits (3 -0- 0)

**SEL528 Advanced Database Management Systems**
(3 -0- 2) 4 Credits
Introduction, Data Modeling, Data Models, Relational Model, Database Design, Query Languages - SQL, DDL, DML, DCL, File Organization, Indexing and Hashing, Data Security.

**SEL529 Software Systems for Data Mining and warehousing**
(2 -0- 2) 3 Credits
Warehouse Implementation, Data Preprocessing: Needs Data Mining Primitives, Languages, and System Architectures, Data Mining Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems, Concepts Description: Characterization and Comparison, Data Generalization and Summarization-Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases. Mining Association Rules in Large Databases, Classification and Prediction, Cluster Analysis Introduction, Mining Complex Types of Data.

SEL530 System Software (3 -0- 0) 3 Credits

Introduction- System Software and Machine Architecture; The Simplified Instructional Computer; traditional CISC Machines; RISC Machines. Assemblers Basic Assembler Functions; Machine Dependent Assembler Features; Machine- Independent Assembler Features; Assembler Design Options; AIX Assembler. Loaders and Linkers Basic Loader Functions; Machine Dependent Loader Features; Machine-Independent Loader Features; Loader Design Options. Macro Processors Basic Macro Processor Functions; Machine Independent Macro Processor Features; Macro Processor Design Options. Compilers Basic Compiler Functions; Machine Dependent Compiler Features; Machine independent Compiler Features; Compiler Design Options. Operating Systems Basic OS functions; Machine Dependent OS Features; Machine independent OS Features; Operating System Design Options. Other System Software Text editors; Interactive Debugging Systems.

SEL531 Object Oriented Analysis & Design (3 -0- 0) 3 Credits


SEL617 Software Metrics (3 -0- 0) 3 Credits


SEL619 Embedded & Real Time Systems (3 -0- 0) 3 Credits


SEL621 Cooperative Computing (3 -0- 0) 3 Credits

Computer Oriented Programs; Cooperative Planning; Cooperative Programs; guidelines Information Networks; Institutional Cooperation; Models; Networks Program Development

SEL623 Component Based Software Development & Computing (3 -0- 0) 3 Credits

Foundations of Component-Based Systems: Object
Orientation Vs Component Orientation.

SEL627 Software Process Maturity (3-0-0) 3 Credits
Software Processes: Process selection, definition and conformance, Standards Process maturity: Basic principles and misconceptions about the SW process. Introduction to the personal software process (PSP), Basics principles of software process improvement (SPI); six different contexts, Software inspections and defect causal analysis, Relationship between lifecycles , methods (methodologies ),process. Capability maturity Model, Difference between CMM and CMMI., quality assurance, Key Process Area, Six Sigma.

SEL629 United Software Configuration Management (3-0-0) 3 Credit

SEL631 E-Business (3-0-0) 3 Credits
The course is organized in three parts which move from macro to micro level issues related to ecommerce management.
Part 1 provides a high level view of e-commerce business models, the ways that e-commerce technology changes value chains and creates new roles in the Marketspace. We also learn about analysis techniques and tools.
Part 2 shifts the level of analysis to the firm level as we examine competing companies in certain industries.
Part 3 moves into the organization and considers internal management issues related to e-commerce technology and the differences between conventional organizations and companies running on Internet time.

SEL633 Network Security (3-0-0) 3 Credits

SEL635 Web Services
(3 -0- 0) 3 Credits

SEL637 Distributed Operating System
(3 -0- 0) 3 Credits
Introduction, goals and advantages of distributed system, Synchronization in distributed system, Process and processes in distributed systems, Distributed file system, distributed shared memory, Study of real time distributed operating system.

SEL639 Human Interface Design
(3 -0- 0) 3 Credits