

5 Years Integrated MSc (Computer Science)
[Course Initiated in 2021-2023]

Semester - V

Scheme & Course Structure

Applicable from July, 2023

Course Structure with Credits

	Course Type	Subject Names & Credits	Total Credits
Semester-V	Core Courses	<ul style="list-style-type: none"> • MCSCCC311-Operating Systems (4) • MCSCCC312-Java Programming (4) • MCSCCC313- Advanced Networking (4) • MCSCCC314- Java Programming – Practical (2) • MCSCCC315- Advanced Networking – Practical (2) 	16
	Ability Enhancement Courses	<ul style="list-style-type: none"> • MCSAE311- Critical Thinking (2) 	2
	Skill Enhancement Courses	<ul style="list-style-type: none"> • MCSSE311- Project – 3 (4) 	4
	Discipline Specific Elective Courses		—
	Generic Elective Courses	<ul style="list-style-type: none"> • MCSGE311 – Cyber Security (2) 	2
	Semester-V (Total Credits)		24

TEACHING & EXAMINATION SCHEME FOR 5 YEAR INTEGRATED M. Sc. (COMPUTER SCIENCE) COURSE

Semester-V	Course		Hours per week								Credits
	Course Code	Name	Theory	Practical	Internal	Total	Lectures	Others (Tutorials)	Practical	Total	
Semester-V	MCSCC311	Operating Systems	70	***	30	100	3	1	***	4	4
	MCSCC312	Java Programming	70	***	30	100	3	1	***	4	4
	MCSCC313	Advanced Networking	70	***	30	100	4	***	***	4	4
	MCSCC314	Java Programming – Practical	***	35	15	50	***	***	4	4	2
	MCSCC315	Advanced Networking – Practical	***	35	15	50	***	***	4	4	2
	MCSSE311	Project – 3	***	70	30	100	***	***	8	8	4
	MCSAE311	Critical Thinking	35	***	15	50	2	***	***	2	2
	MCSGE311	Cyber Security	35	***	15	50	2	***	***	2	2
		Total	280	140	180	600	14	2	16	32	24

Theory/Tutorial Credits → 1 Hour = 1 Credit

Practical Credits → 2 Hours = 1 Credit

Course Name: Operating Systems

Course Code: MCSCC311

Objectives:

At the end of the course, student will be able to

- Understand the functionalities and internals of operating systems
- Optimize their programs to execute on any operating system
- Able to implement tasks using Linux shell scripting

Prerequisites:

Fundamentals of Computers

Contents:

1. Overview of Operating Systems

Role of Operating Systems(OS), Operations of OS, Resource Management, Security and Protection, Virtualization, Distributed Systems, Kernel Data Structures, Computing Environments, Free and Open-Source OS, OS Services, User and OS Interface, System Calls, System Services, OS Specific applications, OS Design and Implementation, OS Structure, Building and Booting an OS, Overview of Containers and Application Containerization

2. Process Management & Synchronization

Process Concept, Process Scheduling, Operations on Process, Interprocess Communication, IPC in Shared-Memory Systems and Message-Passing Systems, Examples of IPC Systems, Communication in Client-Server Systems, Threads & Concurrency, Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues, Concepts of CPU Scheduling, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiprocessor Scheduling, Overview of Real-Time Scheduling, Algorithm Evaluation

Process Synchronization:

Overview of Synchronization Tools, The Critical-Section Problem, Peterson's Solution, Hardware Support for Synchronization, Mutex Locks, Semaphores, Monitors, Liveness, Evaluation, Classical Problems of Synchronization, POSIX and Java Synchronization, Overview of Deadlocks, Deadlock in Multithreaded Applications, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

3. Memory Management & Storage Management

Memory Management:

Background, Contiguous Memory Allocation, Paging, Structure of the Page Table, Swapping, Virtual Memory Overview, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory Compression, Allocating Kernel Memory, Considerations for Virtual Memory Management

Storage Management:

Overview of Mass Storage Structure, Hard Disk Scheduling, NVM Scheduling, Error Detection and Correction, Storage Device Management, Swap-Space Management, Storage Attachment, RAID Structure, Overview of I/O Systems, Application I/O Interface, Streams, Performance of I/O

4 File System & Basics of Linux

File System:

Overview of File-System Interface, File-System Structure, File-System Operations, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, File Systems, File-System Mounting, Partitions and Mounting, File Sharing, Virtual File Systems, Remote File Systems, NFS

Case Study of Linux OS:

Basic commands of Linux, Process related commands of Linux, Linux APIs for process management and Inter Process Communication, Linux Memory Management, File Systems

References:

1. Silberschatz, A., Peter B. Galvin and Greg Gagne, "Operating System Concepts", 10th edition , Wiley International Edition
2. Stallings W, "Operating Systems", 7th edition, Pearson Education.
3. Bach M J, "The Design of Unix Operating System", Prentice Hall India.
4. Flynn I. M, "Understanding Operating Systems", Cengage India Publication
5. Tanenbaum A.S., "Modern Operating Systems", 4th Edition, Pearson Education India
6. Venkateshmurthy, Introduction to Unix and Shell Programming, Pearson Education (India)
7. Eric Foster, John Welch, Micah Anderson, "Beginning Shell Scripting", Wrox Publication
8. Sibsankar Haldar, Alex Aravind, "Operating Systems", 1st Edition Pearson Education

Accomplishments of the student after completing the Course:

At the end of the work students will be able to

- Gain working knowledge of Linux System
 - Harness the facilities provided by Operating System in application development
 - Optimize the programs for specific Operating System
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Course Name: Java Programming

Course Code: MCSCC312

Objectives:

The main objective of this course is to enable students to

- Understand the concepts of Object Oriented Programming Language and easily use Java
- Get good understandings of developing platform independent applications using the Java Programming Language

Prerequisites:

Basic knowledge of C/C++ programming language

Contents:

1. Introduction, Data Types, Variables and Constants, Loops and Logic

Features of the Java Language, Java Environment, Object Oriented Programming in Java, Java Program Structure, Java and Unicode, Data and Variables, Integer Data Types, Floating Point Data Types, Arithmetic Calculations, Mixed Arithmetic expressions, Mathematical functions and constants, Bitwise operators, Enumerated data type, Boolean Variables Operator precedence, Program comments, Loops and Logic Making decisions, Logical operators, The Conditional Operator, The switch Statement, Variable scope, Loops, Assertions.

2. Arrays, Strings, Classes, Extending Classes & Inheritance

Arrays, Strings, Operations on Strings, Mutable Strings, Significance of class, Defining classes, Defining methods, Defining constructors, Defining and using a class, Method overloading, Using Objects, Understanding packages, controlling access to class members, Nested classes, The finalize() method, Native method, Class inheritance, choosing base class access attributes, Polymorphism, Multiple Levels of inheritance, Abstract classes, The Universal superclass, Methods accepting a variable number of arguments, Casting, Object, Enumeration in detail, Using the final modifier, Interfaces, Anonymous classes

3 Exceptions, File Handling & I/O Operations, Threads

Types of Exceptions, Dealing with exceptions, Exception Objects, Defining your own exceptions, The File Class, I/O Stream, Classes for Reading & Writing to Files, RandomAccessFile Class, Serializing Objects

Understanding Threads, the Thread class, creating thread of executing using Runnable and using sub-class of Thread, various properties of Thread, using synchronized keyword, using wait and notify

4 Collection Framework, Few other useful classes

The Collection Framework from java.util package, Collection, Iterable, List, Set, Map, Queue, Dequeue, utility methods from Collections class, java.time package, classes, LocalDate, LocalTime, LocalDateTime, OffsetDate, ZonedDateTime, Duration, Period, Clock and Instant classes, from java.util package, understanding the Optional class Utility Methods for Arrays, Generating Random Numbers, Dates and Times, Regular Expressions, Date and Time APIs, Lambda Expressions, Type Annotations, Method References, Collectors Class

References:

1. Cay S Horstmann, Gary Cornell, "Core Java, Volume 1 – Fundamentals", Pearson Education
2. Jain Pravin, "The class of Java", Pearson India
3. Horton I., "Beginning Java", 7th ed., Wrox India
4. Ken Arnold, James Gosling, David Holmes, "The Java Programming Language", Addison-Wesley Pearson Education.
5. Subramian V., "Functional Programming in Java", Pragmatic Bookshelf
6. Urma R., Fusco M., Mycroft A., "Java 8 in action", Manning Publications

Accomplishments of the student after completing the Course:

After completion of this course, students will be able to

- Create appropriate classes using the Java Programming Language to solve a problem using Object Oriented Approach and use concepts of Functional programming
- Develop platform independent applications using the Java Programming Language

Course Name: Advanced Networking

Course Code: MCSCC313

Objectives:

The objective of the course is to enable students to

- Understand the need for dividing network functionalities into layers
- Understand the functionality of each layer of OSI and TCP/IP models
- Understand the concepts of data transfer and how different protocols implement these concepts
- Design network-based services using programming languages

Prerequisites:

Linux Operating Systems

Contents:

1. Overview of Computer Networks

Introduction to Computer Networks and the Internet, The Network Edge, The Network Core, Delay, Loss and Throughput in Packet-Switched Networks, Protocol Layers and their Service Models, Networks under attack

2. The Application Layer & Transport Layer

Application Layer:

Principles of Network Applications, The Web and HTTP, E-mail Services and its Protocols, DNS, FTP, SSH and Telnet, Peer-to-Peer Applications, Video Streaming & Content Distribution Networks, Overview of Socket Programming for designing Network based applications

Transport Layer:

Transport Layer Services, Multiplexing and Demultiplexing, Connectionless Transport, Principles of Reliable Data Transfer, Connection Oriented Transfer, Principles of Congestion Control, TCP Congestion Control, Variants of TCP

3. The Network Layer

Data Plane:

Overview of Network Layer, Functioning of Router, Routing mechanism, Internet Protocol (IPv4 and IPv6), Network Address Translation, Virtual Private Network (VPN) Overview of SDN

Control Plane:

Routing Algorithms (LS & DV), Intra-AS routing in the Internet, SDN Control Plane, ICMP, Overview of Network Management and SNMP

4. Link Layer, LANs & Wireless Networks

Link Layer:

Introduction, Error-Detection and Error-Correction Techniques, Multiple Access Links & Protocols, Switched LANs, Link Virtualization

Wireless Networks:

Introduction, Wireless Links & Network Characteristics, WiFi 802.11 and Wireless LANs, Overview of Sensor Networks & IoT

References:

1. Kurose J., Ross K., "Computer Networks: A Top-Down Approach", Pearson Education
2. Comer D., "Internetworking with TCP/IP - Vol I", Prentice Hall India
3. Hasan M. Jain R., "High Performance TCP/IP Networking", Prentice Hall India
4. Trivedi B., "Computer Networks", Oxford University Press - India
5. Tanenbaum A., Wetherall D., "Computer Networks", Pearson Education
6. Forouzan B., "Data Communications and Networking", Tata McGraw-Hill
7. Schiller J., "Mobile Communications", Pearson Education
8. Harold E., "Java Network Programming", 4th Edition, O'Reilly Media

Accomplishments of the student after completing the course:

At the end of the course, students will be able to

- Implement appropriate client/server programming solutions for network-based services
- Appreciate the role of protocols and layered services in Computer Networking

Course Name: Java Programming - Practical

Course Code: MCSCC314

Objectives:

The aim of this course is

- Understand the concepts of Object Oriented Programming Language and easily use Java
- Get good understandings of developing platform independent applications using the Java Programming Language

Prerequisites:

Basic knowledge of C/C++ programming language

Contents:

1. Basics of Java Programming

Using Integrated Development Environment for Java Programming, Compiling & Executing Java Programs, Using Different Data Types in Java, Using various Operators & Performing Arithmetic Calculations, Decision Making with Java Programming, Looping, Implementation of Assertions, Use of Classes in Java, Constructors in Java, Exception Handling

2. Object Oriented Java Programming

Implementation of Inheritance using Classes & Interfaces, Implementing Lambda, Implementation & Use of Packages in Java, Commonly used classes & Methods, File Handling using different techniques, Implementing Thread Class & Runnable Interface in Java, Implementation of various collection frameworks

References:

1. Cay S Horstmann, Gary Cornell, "Core Java, Volume 1 – Fundamentals", Pearson Education
2. Jain Pravin, "The class of Java", Pearson India
3. Horton I., "Beginning Java", 7th ed., Wrox India
4. Ken Arnold, James Gosling, David Holmes, "The Java Programming Language", Addison-Wesley Pearson Education.
5. Subramian V., "Functional Programming in Java", Pragmatic Bookshelf
6. Urma R., Fusco M., Mycroft A., "Java 8 in action", Manning Publications

Accomplishments of the student after completing the Course:

After completion of this course, students will be able to

- Create appropriate classes using the Java Programming Language to solve a problem using Object Oriented Approach and use concepts of Functional programming
- Develop platform independent applications using the Java Programming Language

Course Name: Advanced Networking - Practical

Course Code: MCSCC315

Objectives:

The aim of this course is

- Implement Client Server based programs using Network Programming
- Understand the implementation of networking related functionalities provided by programming language

Prerequisites:

Basic knowledge of Java / Python programming language

Contents:

1. Basics of Network Programming

Overview of Client-Server Networking, Functions provided by programming language for Network Programming, Using IP Address & Port Numbers in Network Programming, Implementing IP Address Scanner & Port Scanner, Fetching Network Configuration Details using Programming Language, Use of URLs, DNS in Networking, Studying different exceptions in Network Programming, Use of tools like nmap and Wireshark

2. Building Networking Based Applications

Socket programming using functionalities of User Data Protocol, Socket programming using functionalities of Transmission Control Protocol, Building basic Client-Server applications like Data-Time Services, File Services, DNS Services, DHCP Services, etc.

References:

1. Stevens, Comer D., Douglas E., "Internetworking with TCP/IP Vol. III", Prentice Hall
2. Galbraith J., "Network Programming in Python: The Basic: A Detailed Guide to Python 3 Network Programming and Management", BPB Publication
3. Neidinger M., "Python Network Programming Techniques", Packt Publishing Ltd.
4. Harold E.R., "Java Network Programming", O'Reilly Media

Accomplishments of the student after completing the Course:

After completion of this course, students will be able to

- Build simple networking utilities
 - Build Client-Server applications
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Course Name: Critical Thinking

Course Code: MCSAE311

Objectives:

The main objective of this course is to enable students to

- Rigorously understand and evaluate arguments and evidence, and to use these things to come to a reasoned judgment
- Enhance the ability to become a good critical thinker

Prerequisites:

NIL

Contents:

1. Arguments & Generalizations

Overview of Critical Thinking, Role of Reasoning & Arguments

Short Arguments: Identifying premises and conclusion, Developing Ideas in a natural order, Starting from reliable premises, Being concrete and concise, Building on substance, Use of consistent terms

Generalizations: Using multiple examples, Using representative examples, Identifying relative background rates, Working with statistics, Considering counter examples, Evaluating arguments for Generalizations

Arguments by Analogy: Identifying important similarities & differences, Evaluating arguments by analogy, Constructing arguments by analogy

Sources: Seeking information from sources, Citing sources, Identifying biased sources, Identifying independent sources, Evaluating arguments that use sources, Using sources in arguments

2. Arguments & its Types

Arguments about Causes: Causal Arguments, Correlations, Most likely explanation in arguments, Complexity, Evaluating arguments about causes, Constructing arguments about causes

Deductive Arguments: Modus ponens, Modus tollens, Hypothetical syllogism, Disjunctive syllogism, Identifying deductive arguments, Drawing conclusions, Reductio ad absurdum, Deductive arguments in several steps

Extended Arguments: Exploring the issue, Spelling out basic ideas as arguments, Defending basic premises, Considering objections, Considering alternatives

Oral Arguments: Reaching out to the audience, Signposting arguments, Reframing arguments, Ending in Style, Evaluating Oral Presentations

Argumentative Essays: Writing good leads, Making a definite claim or proposal, Writing out the arguments, Detailing and Meeting objections

References:

1. Morrow D., Weston A., "A Workbook for Arguments – A Complete Course in Critical Thinking", 2nd Edition, Hackett Publishing Company Inc.
2. Haber J., "Critical Thinking", MIT Press
3. Inch E., Warnick B., "Critical Thinking & Communication", Pearson India
4. Fisher A., "Critical Thinking – An Introduction", Cambridge University Press

Accomplishments of the student after completing the Course:

At the end of the work students will be able to

- Effectively apply reasoning on different situations
- Think Critically on various scenarios
- Effectively communicate with the team and clients of IT Industry

Course Name: Project - 3

Course Code: MCSSE311

Objectives:

The aim of this course is

- To introduce structured development of software systems
- To acquaint students to various techniques of requirements determination
- To introduce the concepts of analysis and design
- To model the system with various software diagrams
- To develop a system using software engineering concepts
- To prepare document/report of the system

Prerequisites:

Knowledge of Programming

Contents:

1. Introduction to System Analysis & Design

Concepts of System Analysis & Design, Components of a System, Users of a System, System Development Life Cycle, Role of System Analyst, Various approaches to develop a system, Using a “systems” approach to build whole system

2. Structured Systems Development Approach

Requirements Gathering, surveying existing systems, Performing Feasibility Study before building a system, Formulating SRS, Designing Data Flow Diagrams, Entity-Relationship Diagrams, Designing Data Dictionary, Designing effective Input and Reports, Implementing EOD, EOM and EOY Procedures, Documenting the system

Guidelines for Project:

1. Projects can be created by a single student or in a group of 2-3 students.
2. The definition of project is to be submitted within 15 days of the starting of the semester.
3. The project should be free from plagiarism.
4. A student/group is required to report to their project guides on regular basis.
5. A student/group is required to present the project during internal exams.
6. It is advisable that the project must include different forms and reports.
7. It is necessary to prepare system diagrams, data dictionary as per the convention.
8. Project documentation should be prepared for the semester end examination.
9. In the semester end examination, the project should be presented to the examiners along with the documentation (report).

References:

1. Kendall & Kendall. "System Analysis and Design ", Prentice Hall India (PHI)
2. James Sen, "Analysis and Design of Information System", PHI
3. Arthur Langer, "Analysis and Design of Information Systems ", Springer
4. Jeff Johnson, "Designing with the Mind in Mind ", Morgan Kaufmann
5. Dennis, Wixom, Roth "System Analysis and Design", Wiley India
6. Joseph Valacich, Joey F. George, "Modern Systems Analysis and Design", Pearson
7. Priti Srinivas Sajja., "Essence of System Analysis and Design", Springer

Accomplishments of the student after completing the Course:

After completion of this course, students will be able to

- Analyse and Design a system based on user requirements
- Develop a software system using software engineering concepts
- Prepare a document for the system

Course Name: Cyber Security

Course Code: MCSGE311

Objectives:

The main objective of this course is to enable students to

- Understand the cyber security threat landscape
- Develop a deeper understanding and familiarity with various types of cyberattacks, cybercrimes, vulnerabilities and remedies thereto
- Analyze and evaluate existing legal framework and laws on cyber security
- Analyze and evaluate the digital payment system security and remedial measures against digital payment frauds
- Take measures for self-cyber-protection as well as societal cyber-protection

Prerequisite: Nil

Contents:

1. Cyber Security & Cyber Crimes, Vulnerabilities & Management Practices

Introduction to Information Systems, Evolution and Types of Information Systems, Evolution and Growth of the Internet, Information System Development and Maintenance, Cyberspace and Cybersecurity, Overview of Information Security, Organization and Governance of the Internet and Cybersecurity, Information Security Models

Cybercrimes, Classification of Cybercrimes, Forms of Cybercrimes, Cyber Scams and Frauds, Sources of Threats: Threat Actors and their Motivations, Tools and Methods Used in Cyberattacks/Cybercrimes, Overview of a Cyberattack, Responding to Cyberattacks and the Cyber Kill Chain, Cyberattacks: Organizational Implications, Cyberattacks Impacting Citizens and Communities, Prevention of Cybercrime, International Efforts to Deal with Cybercrime, National Cybersecurity Policy, Online Code of Conduct and Computer Ethics

Introduction, Security Considerations and Challenges, Types of Vulnerabilities, Project OWASP, Vulnerabilities Assessment, Common Vulnerabilities and Exposures (CVE): Institutional Mechanisms

Overview of Cybersecurity Management, Information Classification Process, Security Policies, Security Procedures and Guidelines, Security Controls, Security Organization, Incident Response, Business Continuity and Disaster Recovery

2. Cyber Law, Cybersecurity in E-commerce

Information Security Governance and Risk Management, Cyber Risk Management, Cybersecurity Frameworks, Cyber Resilience, Industry-specific Cybersecurity Frameworks, The Human Factor in Cybersecurity, Algorithms and Techniques for Cybersecurity

Introduction, Securing Networks, Web Applications, Services and Servers, Email Security, Antivirus Technologies and Solutions, Identity and Access Management, Authentication, Cryptography, How Do Digital Money, Cryptocurrency and NFTs, Digital Signatures, Advanced Technologies and Approaches in Cybersecurity, Internet Protocols and Ports

Need for Cyber Laws and Regulations, Role of International Law and Governments, Challenges for Law-makers and Law Enforcement Agencies, Cybersecurity Regulations, Cyber Forensics, Cybercrime Techniques, Prevention of Cybercrime and Protection, Cybercrime Investigation, Evidence Collection and Analysis, Intellectual Property Issues in Cyberspace

Introduction to Personal Cybersecurity, Common Causes of Personal Security Breaches, Personal Cybersecurity Best Practices, Privacy Regulations and Cybersecurity, Ethics in CyberSecurity

Future Challenges in Cybersecurity, Web 3.0, Harnessing Artificial Intelligence for Cybersecurity, Blockchain for Cybersecurity, Quantum Computing and Cybersecurity, Combating Advanced Persistent Threats, Digital Trust and Identity Management, 5G Networks and Cybersecurity, Adopting a 'Secure-by-Design' Approach, Supply Chain Cybersecurity

Introduction to E-commerce, Elements of E-commerce Security, E-commerce Security Best Practices, Digital Payments, RBI Guidelines on Digital Payments and Customer Protection, Laws on Privacy and Data Protection for E-commerce Companies

Introduction to Social Networks, Types of Social Media and Popular Platforms, Social Media Marketing, Social Media Monitoring, Social Media Privacy, Social Media Privacy Laws and Personal Data Protection, Flagging and Reporting of Inappropriate Content, Laws Regarding Posting of Inappropriate Content, Data Harvesting and Personal Data Protection, Best Practices for the Use of Social Media

References:

1. Singh Ajay, "Introduction to Cyber Security", University Press
2. Denning D., "Information Warfare & Security", Addison Wesley
3. Belapure S., Godbole N., "Cyber Security Understanding Cyber Crimes, Computer Forensics & Legal Perspectives", Wiley India
4. Oliver H., "Security in the Digital Age: Social Media Security Threats and Vulnerabilities", Create Space Independent Publishing Platform
5. Venkartarman N. & Shriram A., "Data Privacy Principles and Practic", CRC Press
6. Kragbrothy W., "Information Security Governance, Guidance for Information Security Managers", Wiley Publication
7. Weiss M., Solomon M., "Auditing IT Infrastructure for Compliance", Jones Bartlett Learning

Accomplishments of the student after completing the Course:

After completion of this course, students will be able to

- Strengthen the cyber security of end user, IT infrastructure
- Effectively report cyber threats and cyber-crimes through the prescribed legal and government channels
- Perform risk based assessment, cyber security audit & compliance
