

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB
Syllabus of B. Sc. Cyber Security
(Effective for 2020-2021 Admission Session)
Choice Based Credit System
140 Credit (3-Year UG) MAKAUT Framework
w.e.f 2020-21

4th Semester

Subject Type	Course Name	Course Code	Credit Distribution			Credit Points	Mode of Delivery			Proposed Moocs	
			Theory	Practical	Tutorial		Offline#	Online	Blended		
CC 8	Cryptography and Information Security	CYS (T) 401	4	0	0	6	✓			As per MAKAUT Notification	
		CYS 491	0	2	0						
CC 9	Software Engineering & Software Design with UML	CYS (T) 402	4	0	0	6	✓				
		CYS 492	0	2	0						
CC 10	Advanced Computer Network & Security	CYS (T) 403	4	0	0	6	✓				
		CYS 493	0	2	0						
GE 4	Students will have to choose from the GE Basket				6			✓			
SEC 2	Database Management	CYS 455	0	2	0	2	✓				
Semester Credits						26					

Only in case offline classes are not possible due to reasons like COVID Pandemic the classes will be in synchronous online mode

CC 8: Cryptography & Information Security

Code: CYS 401

Credits- 4L +2P

Course Objective: The course is designed to provide an elaborate idea about the different cryptography techniques, development of key generation algorithms for information protection.

Sl. No.	Course Outcome	Mapped Modules
1.	Understand the concept of cryptography, number system etc.	M1
2.	Understand One time pad and stream ciphers.	M2
3.	Define Block ciphers	M3
4.	Understand message integrity	M4
5.	Define public key cryptography.	M5
6.	Make use of digital signature and protocols.	M6

Theory: CYS (T) 401

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M1	Overview of cryptography, number system	10	20	1,2	
M2	One time pad and stream ciphers	10	20	1,2	
M3	Block ciphers, message integrity	14	30	2,3	
M4	Public key cryptography, digital signature	14	30	2,3	
		48	100		

Practical: CYS 491

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M5	Arithmetic modulo, programming	12	40	3,4	
M6	Cryptography algorithm design and programming	16	60	3,4	
		28	100		

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MODULE 1: Overview of cryptography, number system:

Arithmetic modulo operations, Abstract algebra, modular inverse, mathematics of Secure Communications; Classical Cryptosystems etc.

MODULE 2: Classical cryptosystem, one time pad and stream ciphers:

Classical Cryptosystems, Substitution Cipher, Play Fair Cipher, Vignere cipher, Introduction to stream cipher, RC4, ARC4 algorithms.

MODULE 3: Block ciphers, message integrity:

Symmetric key encryption, block cipher mode of operations, Fiestel Cipher, DES, AES, 3-DES, use of block cipher,

MODULE 4: Public key cryptography, digital signature:

Public key Cryptosystems Diffie-Hellman key exchange, semantically secure El-Gamal encryption, RSA and other Cryptosystems, Key Exchange Protocols, Hash Functions, Digital signature.

MODULE 5: Arithmetic modulo, programming:

Euclidean Algorithm, Extended Euclidean Algorithm, random number generation and programming.

MODULE 6: Cryptography algorithm design and programming:

Polynomial arithmetic, implementation of symmetric and asymmetric key algorithms, design of cryptography algorithms.

TEXT BOOKS

1. William Stallings: Cryptography and Network security, Pearson Education
2. V.K. Jain: Cryptography and Network security, Khanna Publishing House
3. Alfred Menezes: Handbook of Applied Cryptography.

CC 9: Software Engineering & Software Design with UML

Code: CYS 402

Credits- 4L+2P

Course Objective: This course is an introduction to the application of software design principles to the design of applications. This course approaches software design from three perspectives: the software engineering principles that enable development of quality software, modelling of software elements using the Unified Modelling Language (UML), and the application of design patterns as a means of reusing design models that are accepted best practices.

Sl	Course Outcome	Mapped modules
1	Remember & Understand the Software engineering and its different aspects	M1
2	Remember & Understand the design of the various SDLC models	M2
3	Understand and identify the elements of modern Software Engineering tools	M3
4	Understand & apply the planning and managing requirements of a S/W development	M4
5	Understanding the Software design and Analysis and UML modelling	M5, M6
6	Application & Analysis using Software quality and security and risk management	M7,M8,M9

Theory- CYS (T) 402

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	SOFTWARE ENGINEERING FUNDAMENTALS	5	10	1,2	
M 2	SOFTWARE DEVELOPMENT LIFE CYCLES (SDLCs)	5	15	1,2	
M 3	SOFTWARE ENGINEERING TOOLS	5	10	2	
M 4	PLANNING AND MANAGING REQUIREMENTS	5	10	2,3	
M 5	INTRODUCTION TO SOFTWARE ANALYSIS AND DESIGN	5	10	1,2	
M 6	OBJECT MODELING USING UML	10	15	2,3	
M 7	SOFTWARE VERIFICATION AND VALIDATION	3	10	4,6	
M 8	SOFTWARE QUALITY AND SECURITY	5	10	4,6	
M 9	RISK MANAGEMENT IN SOFTWARE ENGINEERING PROJECTS	5	10	2,4	
		48	100		

Practical- CYS 492

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 3	SOFTWARE ENGINEERING TOOLS	14	40	3,4	
M 6	OBJECT MODELING USING UML USING VARIOUS OPEN SOURCE TOOLS	14	60	3,4	
		28	100		

Module I: SOFTWARE ENGINEERING FUNDAMENTALS (5T)

Introduction – Software Engineering, Software Development Challenges, Software Scope, Software Engineering Discipline, Software Methodologies and Related Process Models, The Human Side of Software Development, Introduction to Agile Software Engineering

Module II: SOFTWARE DEVELOPMENT LIFE CYCLES - SDLCs (5T)

Process Models and Solution Life Cycle Phases. Traditional Life Cycle Models: Waterfall, V, Phased, Evolutionary, Spiral, CBSE. Alternative Techniques – UP, RAD, JAD, PSP/TSP, Prototyping
 Agile Software Engineering Process Models: Extreme Programming, Agile Software Development, DevOps, Site Reliability Engineering (SRE). Roles and Types of Standards, ISO 12207: Life Cycle Standard, IEEE Standards for Software Engineering Processes and Specifications

Module III: SOFTWARE ENGINEERING TOOLS (5T + 10L)

Requirements Management Tools (e.g., IBM Rational Doors)
 Design Tools (e.g., Sparx Enterprise Architect)
 Development Tools - IDEs (e.g., Xcode, Eclipse, IntelliJ IDEA, NetBeans, Microsoft Visual Studio, Atom), Source Control Management (e.g., GitHub), Release Orchestration (e.g., OpenMake), Collaboration (e.g., Jira, Trello, Slack)
 Operations Management Tools - Database Automation (e.g., Datical), Deployment (e.g., ElasticBox), Configuration Management (e.g., Ansible, Chef, Puppet), Continuous Integration (e.g., Jenkins), Container Management (e.g., Docker, Kubernetes).
 Testing Tools and Frameworks - Testing Tools (e.g., Junit, Selenium), PaaS (e.g., PythonAnywhere, AWS Code9, Heroku)
 Management and Monitoring Frameworks - AIOps (e.g., Splunk, Logstash), Analytics (e.g., Dynatrace, ElasticSearch), Monitoring (e.g., Nagios)
 Security Frameworks (e.g., Snort, BlackDuck)
 Cloud Platforms (e.g., AWS, Azure, GCP, IBM Cloud)
 Project Management (e.g., Scoro, Basecamp, Microsoft Project)

Module IV: PLANNING AND MANAGING REQUIREMENTS (2T)

Requirements Development Methodology - Specifying Requirements - Eliciting Accurate Requirements - Documenting Business Requirements - Defining User Requirements - Validating Requirements - Achieving Requirements Traceability - Managing Changing Requirements - Reviews, Walkthroughs, and Inspections - Requirements Modeling - Agile Requirements Engineering

Module V: INTRODUCTION TO SOFTWARE ANALYSIS AND DESIGN (3T)

Roles of Analysis and Design - Traditional Data and Process Modeling Approaches - Performing Requirements Analysis - Object-Oriented Modeling - User Experience Design - Design for Mobility - Selecting and Combining Approaches - Creating a Data Model

Module VI: OBJECT MODELING USING UML (10T + 10L)

Building an Object Model using UML - Architectural and Pattern-Based Design - Model Driven Architectures – Class Diagram - Sequence Diagram- Use case diagrams –State machine diagrams – Activity Diagrams- Using Open Source, free, paid, and Enterprise software

Module VII: SOFTWARE VERIFICATION AND VALIDATION (2T)

Unit Testing - Integration and System Testing - Static Confirmation - Dynamic Testing - Traceability Matrices - Automated Testing - Other Specialized Testing

Module VIII: SOFTWARE QUALITY AND SECURITY (3T)

Software Quality Concepts - Software Configuration Management (CM) - Software Quality Assurance (SQA) - Software Quality and Agile Methods: Automated and Manual Functional Testing, Acceptance testing, Mock objects, User interface testing (HTTPUnit, Canoo), Performance testing - Software Metrics and Analytics - Quality and Process Standards and Guidelines: ISO 9000, SWEBOK, ISO 15504, SEI's Capability Maturity Model (CMM), CMM Integration (CMMI) - Software Security Engineering

Module IX: RISK MANAGEMENT IN SOFTWARE ENGINEERING PROJECTS (5T)

Project Management Concepts - Project Planning and Estimation - Cooperative roles of software engineering and project management - Developing risk response strategies - Risk Management in Agile Processes - Agile Project Planning - Project Management Metrics - Software Support Strategies

Text Books: 1. Software Engineering - Architecture-driven Software Development By Richard F Schmidt · 2013, Elsevier Science

2. FUNDAMENTALS OF SOFTWARE ENGINEERING, FIFTH EDITION By Rajib Mall · 2018, PHI Learning Private Limited

3. UML Distilled - A Brief Guide to the Standard Object Modelling Language By Martin Fowler · 2018 , Pearson Education

CC 10: Advanced Computer Network & Security

Code: CYS 403

Credits- 4L +2P

Course Objective: The course is designed to provide an elaborate idea about the Computer networking in advance level and threats identification and prevention modelling of operating systems.

Sl. No.	Course Outcome	Mapped Modules
1.	Understand Computer Network Fundamental	M1
2.	Demonstrate Network devices, IEEE protocols	M2
3.	Relate different techniques encoding, switching, and congestion control.	M3
4.	Demonstrate advance communication protocols.	M4
5.	Understand introduction and Security Threats	M5
6.	Demonstrate network security.	M6

Theory: CYS (T) 403

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M1	Computer Network Fundamental	10	20	1,2	
M2	Network devices, IEEE protocols	14	30	2	
M3	Encoding, switching, congestion control	14	30	2,3	
M4	Advance communication protocols	10	20	2,3	
		48	100		

Practical: CYS 493

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M5	Introduction and Security Threats	14	40	2,3	
M6	Network security	14	60	2,3	
		28	100		

Module-1: Computer Network Fundamental

Data Communication, Analog-Digital Signals. TCP/IP and OSI Model, Client, Server and Peers, Client/Server architecture, Wired & Wireless transmission, Guided-Unguided Media, Bus, Star, Ring, Mesh, Hybrid, LAN, MAN, WAN, Simplex, Half duplex and Full duplex, Asynchronous and Synchronous Transmission, Parallel and Serial Transmission, Base band and Broadband transmission.

Module-2: Network devices, IEEE protocols

Different networking devices, IEEE 802.3, IEEE 802.4, IEEE 802.5, IEEE 802.11, FDDI, DQDEB, ATM, Physical Addressing, Logical Addressing, Port Addresses, IPV4, IPV6, Classfull-Classless Addressing, Subnetting and Masking, NAT, DHCP, BOOTP, ARP, RARP, ICMP

Module-3: Encoding, switching, congestion control

Different Encoding Techniques, FDM, TDM, Circuit Switching, Packet Switching, Message Switching. Routing, Routing Protocols: Distance Vector, Link State, Congestion Control: Leaky Bucket and Token Bucket Algorithm, ISDN

Module-4: Advance communication protocols

TCP, UDP, Firewalls, Proxy Router, DNS, FTP, TFTP, SMTP, TELNET, NFS, WWW, E-mail, HTTPS, Cable Network, Telephone Network

Module-5: Introduction and Security Threats

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Viruses and Worms, Intruders, Insiders, Criminal organizations, Terrorists, Information warfare, Confidentiality, Integrity, Availability, Types of attack: Denial of service (DOS), backdoors and trapdoors, sniffing, spoofing, man in the middle, replay, TCP/IP Hacking, Phishing attacks, Distributed DOS, SQL Injection. Malware: Viruses, Logic bombs.

Module 6: Network security

Centralized or decentralized infrastructure, private key protection, Trust Models: Hierarchical, peer to peer, hybrid, Firewalls: working, design principles, trusted systems, Kerberos, Security topologies, IP security: overview, architecture, IPSec configurations, IPSec security, Email security : security of email transmission, malicious code, spam, mail encryption.

References/Text Books:

1. B. Fourauzan, “Data Communications and Networking”, 4th Edition, Tata McGraw-Hill
2. Tanenbaum, Computer Networks, 3rd Edition, PHI, New Delhi
3. D. Comer, “Computer Networks and Internet”, 2nd Edition, Pearson Education
4. Data and Communication by W. Stallings
5. An integrated approach to Computer Networks by Bhavneet Sidhu, Khanna Publishing H

SEC 2: Database Management

Code: CYS 455

Credits- 2P

Course Objective: The course is designed to introduce the concepts of Database Programming and to understand, develop and implement the queries with the database programming. In this course, you will learn to create relational databases, write SQL statements to extract information in order to satisfy the required requests. As you develop these skills, you will use either Oracle or MySQL to execute SQL statements

Sl. No	Course Outcome	Mapped modules
1	Remember & understand the concepts of Database Programming which aims to implement real-world entities for creating relational databases.	M1, M2
2	Understand and identify the ability to design, implement, and evaluate a query using the concepts of Relational Model	M2, M3
3	Understand & apply the appropriate SQL statements to extract information in order to satisfy the required requests.	M2,M3, M4
4	Understand & apply more features of SQL commands to get into depth of SQL queries.	M2,M3,M4

Module Number	Headline	Total Hours	%age of questions	Blooms Level	Remarks (If any)
M 1	Introduction to DBMS	6	20	1,2	
M 2	Features of Relational Model	6	20	2	
M 3	Introduction to SQL	8	30	2,3	
M 4	More features of SQL	8	30	2,3	
		28	100		

Module I: Introduction to DBMS(4L)

Concept & Overview of DBMS, Components of Database System, Basics of Database Management System, File-based System and Database Management System, Advantages of using Database over File based system, Data Models, Database Languages, Database Administrator, Database Users.

Module II: Features of Relational Model (4L)

Concept of Relational Model, Relational Model – Introduction, Advantages and Disadvantages, Keys, Entity integrity Rule, Functional Dependency, Relational Set Operators, Relational Algebra.

Module III: Introduction to SQL (6L)

Introduction, Features of SQL, Database Languages - Data definition and Data manipulation languages, Data Definition Commands, Data Manipulation Commands, (SELECT Statement and different Clauses, SQL Functions - Date and Time Functions, String Functions, Null Values, Domain Constraints, Referential Integrity Constraints.

Module IV: More features of SQL (6L)

Describing Oracle tables, Using the set commands, Joining Oracle tables -Equi-join, Outer join Hiding joins by creating views, Using IN, NOT IN, EXISTS and NOTEXISTS, Subqueries, Exercise – write a subquery, Correlated subquery, Non-correlated subqueries, Advanced SQL operators - Between operator, IN and NOT IN operators, Sub-queries-EXISTS clause, Using wildcards in queries (LIKE operator), Aggregation in SQL -Count (*), Sum, Avg, Min and max. Using the group by clause, SQL access methods.

Study and lab Resources:

1. Korth, Silberschatz, Sudarshan – Database System Concepts; Tata Mc. Graw Hill
2. Ramez Elmasri, Shamkant B Navathe - Fundamentals of Database Systems; Pearson
3. Walter Shields -SQL QuickStart Guide: The Simplified Beginner's Guide to Managing, Analyzing, and Manipulating Data With SQL
4. Ben Forta- SQL in 10 Minutes a Day, Sams Teach Yourself
5. <https://www.w3schools.com/sql/>
6. <https://www.tutorialspoint.com/sql/index.htm>