



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA-533003, Andhra Pradesh, India**

**R23 B.Tech Cyber Security**  
**(R23 – III<sup>rd</sup> YEAR COURSE STRUCTURE & SYLLABUS)**

**B.Tech - CYBER SECURITY**

**B.Tech. – III Year I Semester**

S.No.	Category	Title	L	T	P	C
1	Professional Core	Cloud Computing	3	0	0	3
2	Professional Core	Cryptography & Network Security	3	0	0	3
3	Professional Core	Automata Theory & Compiler Design	3	0	0	3
4	Professional Elective-I	1. Secure Coding Practices 2. Software Engineering 3. Artificial Intelligence 4. Microprocessors & Microcontrollers 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective- I	OR Entrepreneurship Development & Venture Creation	3	0	0	3
6	Professional Core	Cloud Computing Lab	0	0	3	1.5
7	Professional Core	Cryptography & Network Security Lab	0	0	3	1.5
8	Skill Enhancement Course	Full Stack Development-2	0	1	2	2
9	Engineering Science	UI Design-Flutter Lab	0	0	2	1
10	Evaluation of Community Service Internship		-	-	-	2
<b>Total</b>			<b>15</b>	<b>1</b>	<b>10</b>	<b>23</b>
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	3	4.5
MC	Minor Course through SWAYAM / NPTEL (Minimum 12 Week, 3 credit course)		3	0	0	3
HC	Honors Course (Student may select from the same Honors pool)		3	0	0	3
HC	Honors Course (Student may select from the same Honors Pool)		3	0	0	3



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**B.Tech.– III Year II Semester**

	Category	Title	L	T	P	Credits
1	Professional Core	Cyber Security& Digital Forensics	3	0	0	3
2	Professional Core	Blockchain Technology	3	0	0	3
3	Professional Core	Machine Learning	3	0	0	3
4	Professional Elective-II	1. Software Vulnerability Analysis 2. DevOps 3. Applied Cryptography 4. Internet of Things 5.12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Professional Elective-III	1.Design of secure protocols 2.Firewalls & VPN Security 3.Web Application Security 4.Security Assessment and Risk Analysis 5.12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
6	Open Elective – III		3	0	0	3
7	Professional Core	Cyber Security& Digital Forensics Lab	0	0	3	1.5
8	Professional Core	Malware Analysis & Reverse Engineering lab	0	0	3	1.5
9	Skill Enhancement course	Soft skills OR IELTS	0	1	2	2
10	Audit Course	Technical Paper Writing & IPR	2	0	0	0
<b>Total</b>			<b>20</b>	<b>1</b>	<b>8</b>	<b>23</b>
Mandatory Industry Internship of 08 weeks duration during summer vacation						
MC	Student may select from the same minors pool		3	0	3	4.5
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	0	3
HC	Student may select from the same honors pool		3	0	0	3
HC	Honors Course ( Student may select from the honors pool)		3	0	0	3



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**OpenElectives&Minor**

**Note: To obtain Minor Engineering, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.**

**For Minor in Cyber Security:**

	<b>L-T-P-C</b>
Open Elective I : Computer Networks	3-0-0-3
Open Elective II : Introduction to Cyber Security	3-0-0-3
Open Elective III : Cryptography & Network Security	3-0-0-3
Open Elective IV : Block Chain technology	3-0-0-3
Open Elective V : Cloud Computing	3-0-0-3
Open Elective VI : Cyber Security Lab	0-0-3-1.5
Open ElectiveVII : Cryptography & Network Security Lab	0-0-3-1.5

**OpenElectives,offeredtootherdepartmentstudents:**

- OpenElectiveI:JavaProgramming
- OpenElectiveII:OperatingSystems
- OpenElectiveIII:DataBaseManagementSystems
- OpenElectiveIV:ComputerNetworks

**COURSES OFFERED FOR HONOURS DEGREE IN CYBER SECURITY :**

S.No.	Code	Course Name	Contact Hours per week			Credits
			L	T	P	
1		Application Thread Detection	3	0	3	
2		IOT security	3	0	3	
3		Penetration Testing and Vulnerability Assessment	3	0	3	
4		Social Media Security	3	0	3	
5		NoSQL Databases	3	0	3	
6		NoSQL Databases Lab		3	1.5	
7		Social Media Security Lab		3	1.5	
<b>Total</b>					<b>18</b>	



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<b>III Year I Semester</b>	<b>CLOUD COMPUTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The main objectives of the course are to

- Explain the evolving utility computing model called cloud computing.
- Introduce the various levels of services offered by cloud.
- Discuss the fundamentals of cloud enabling technologies such as distributed computing, service-oriented architecture and virtualization.
- Emphasize the security and other challenges in cloud computing.
- Introduce the advanced concepts such as containers, serverless computing and cloud-centric Internet of Things.

**UNIT -I: Introduction to Cloud Computing Fundamentals**

Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

**UNIT-II: Cloud Enabling Technologies**

Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures (SISD, SIMD, MISD, MIMD), elements of distributed computing, technologies for distributed computing, IPC, RPC, Messaging systems, Service Oriented Architecture (SOA), Web services, virtualization.

**UNIT-III: Virtualization and Containers**

Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

**UNIT-IV: Cloud computing challenges**

Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.



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**UNIT -V: Advanced concepts in cloud computing**

Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS), serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

**Text Books:**

1. Mastering Cloud Computing, 2<sup>nd</sup> edition, Rajkumar Buyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, Mc Graw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

**Reference Books:**

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2<sup>nd</sup> edition, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)



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<b>III Year I Semester</b>	<b>CRYPTOGRAPHY &amp; NETWORK SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The main objectives of this course are to

- Explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, public key algorithms, design issues and working principles of various authentication protocols.
- Implement various secure communication standards including Kerberos, IPsec, and SSL/TLS.

**UNIT I:**

**Basic Principles:** Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography- integer arithmetic, modular arithmetic, matrices, linear congruence.

**UNIT II:**

**Symmetric Encryption:** Mathematics of Symmetric Key Cryptography-algebraic structures,  $GF(2^n)$  Fields, Introduction to Modern Symmetric Key Ciphers-modern block ciphers, modern stream ciphers, Data Encryption Standard- DES structure, DES analysis, Security of DES, Multiple DES, Advanced Encryption Standard-transformations, key expansions, AES ciphers, Analysis of AES.

**UNIT III:**

**Asymmetric Encryption:** Mathematics of Asymmetric Key Cryptography-primes, primality testing, factorization, CRT, Asymmetric Key Cryptography- RSA crypto system, Rabin cryptosystem, Elgamal Crypto system, ECC

**UNIT IV:**

**Data Integrity, Digital Signature Schemes & Key Management:** Message Integrity and Message Authentication-message integrity, Random Oracle model, Message authentication, Cryptographic Hash Functions-whirlpool, SHA-512, Digital Signature-process, services, attacks, schemes, applications, Key Management-symmetric key distribution, Kerberos.

**UNIT V:**

**Network Security-I:** Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, **Network Security-II :**Security at the Network Layer: IPsec-two modes, two security protocols, security association, IKE, ISAKMP, System Security-users, trust, trusted systems, buffer overflow, malicious software, worms, viruses, IDS, Firewalls.



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**Text Books:**

1. Cryptography and Network Security, 3<sup>rd</sup> Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill, 2015
2. Cryptography and Network Security, 4<sup>th</sup> Edition, William Stallings, (6e) Pearson, 2006
3. Everyday Cryptography, 1<sup>st</sup> Edition, Keith M. Martin, Oxford, 2016

**Reference Books:**

Network Security and Cryptography, 1<sup>st</sup> Edition, Bernard Meneges, Cengage Learning, 2018



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<b>III Year I Semester</b>	<b>AUTOMATA THEORY &amp; COMPILER DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To introduce the. Fundamental concepts of formal languages, grammars and automata theory.
- To understand deterministic and non-deterministic machines and the differences between decidability and undecidability.
- Introduce the major concepts of language translation and compiler design and impart the knowledge of practical skills necessary for constructing a compiler.
- Topics include phases of compiler, parsing, syntax directed translation, type checking use of symbol tables, intermediate code generation.

**Course Outcomes:**

- Able to employ finite state machines for modeling and solving computing problems.
- Able to design context free grammars for formal languages.
- Able to distinguish between decidability and undecidability.
- Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis.
- Acquires skills in using lex tool and design LR parsers

**UNIT-I**

**Introduction to Finite Automata:** Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory—Alphabets, Strings, Languages, Problems. **Non deterministic Finite Automata:** Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions. **Deterministic Finite Automata:** Definition of DFA, How ADFA Process Strings, The language of DFA, Conversion of NFA with  $\epsilon$ -transitions to NFA without  $\epsilon$ -transitions. Conversion of NFA to DFA

**UNIT-II**

**Regular Expressions:** Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions. **Pumping Lemma for Regular Languages:** Statement of the pumping lemma, Applications of the Pumping Lemma. **Context-Free Grammars:** Definition of Context-Free Grammars, Derivations Using a Grammar, Left most and Right most Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.



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**UNIT-III**

**Push Down Automata:** Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Acceptance by final state. **Turing Machines:** Introduction to Turing Machine, Formal Description, Instantaneous description, The language of a Turing machine. **Undecidability:** Undecidability, A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines

**UNIT-IV**

**Introduction:** The structure of a compiler, **Lexical Analysis:** The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical-Analyzer Generator Lex. **Syntax Analysis:** Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers.

**UNIT-V**

**Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's. **Intermediate-Code Generation:** Variants of Syntax Trees, Three-Address Code. **Run Time Environments:** Stack Allocation of Space, Access to Non local Data on the Stack, Heap Management

**TEXT BOOKS:**

1. Introduction to Automata Theory, Languages, and Computation, 3<sup>rd</sup> Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, 2<sup>nd</sup> Edition, Pearson.
3. Theory of Computer Science— Automata languages and computation, Mishra and Chandrashekar, 2<sup>nd</sup> Edition, PHI.

**REFERENCE BOOKS:**

1. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
2. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
3. Lex & yacc—John R. Levine, Tony Mason, Doug Brown, O'reilly
4. Compiler Construction, Kenneth C. Loudon, Thomson. Course Technology.



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<b>III Year I Semester</b>	<b>SECURE CODING PRACTICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

1. To understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities.
2. It gives an outline of the techniques for developing a secure application.

**COURSE OUTCOMES:**

Upon the completion of the course, the students will be able to:

- CO 1:** Implement security as a culture and show mistakes that make applications vulnerable to attacks.
- CO 2:** Understand various attacks like DoS, buffer overflow, web specific, database specific web-spoofing attacks.
- CO 3:** Analyze and demonstrate skills necessary to address common programming errors that lead to security issues and to learn how to develop secure applications.
- CO 4:** Analyze the nature of the threats to software and incorporate secure coding practices throughout the planning and development of the product.
- CO 5:** Apply proper techniques for handling application faults, implement secure authentication, authorization and data validation controls used to prevent common vulnerabilities.

**UNIT-I**

**INTRODUCTION: Need for secure systems:** Proactive Security development process, Secure Software Development Cycle (S-SDLC), Security issues while writing SRS, Design phase security, Development Phase, Test Phase, Maintenance Phase, Writing Secure Code – Best Practices SD3 (Secure by design, default and deployment), Security principles and Secure Product Development Timeline

**UNIT -II**

**SECURE CODING TECHNIQUES:** Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, Insecure Coding Practices in Java Technology. ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs. Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks, Canary based countermeasures using StackGuard and Propolice. Socket Security, Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM



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**UNIT–III**

**Threat modelling process and its benefits:** Identifying the Threats by Using Attack Trees and rating threats using DREAD, Risk Mitigation Techniques and Security Best Practices. Security techniques, authentication, authorization. Defense in Depth and Principle of Least Privilege.

**UNIT-IV**

**AND WEB SPECIFIC INPUT ISSUES:** SQL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms. Validating Input and Inter process Communication, Securing Signal Handlers and File Operations. XSS scripting attack and its types – Persistent and Non persistent attack XSS Countermeasures and Bypassing the XSS Filters. Testing Secure Applications: Security code overview, secure software installation. The Role of the Security Tester, Building the Security Test Plan. Testing HTTP-Based Applications, Testing File-Based Applications, Testing Clients with Rogue Servers

**UNIT -V**

**SOFTWARE SECURITY ENGINEERING:** Requirements engineering for secure software: Misuse and abuse cases- SQUARE process model- Software security practices and knowledge for architecture and design.

**Text Books:**

1. Writing Secure Code, Michael Howard and David LeBlanc, Microsoft Press, 2nd Edition, 2004.
2. Threat Modeling, Frank Swiderski and Window Snyder, Microsoft Professional, 1<sup>st</sup> Edition, 2004.

**Reference Books:**

1. Robert C.Seacord, “ *Secure Coding in C and C++*”, Pearson Education, 2nd edition, 2013.
2. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, “ *Software Security Engineering : A guide for Project Managers*”, Addison-Wesley Professional, 2008.
3. Buffer Overflow Attacks: Detect, Exploit, Prevent by Jason Decker, Syngress, 1<sup>st</sup> Edition, 2005.



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<b>III Year I Semester</b>	<b>SOFTWARE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objectives:**

**The objectives of this course are to introduce**

- Software life cycle models
- Software requirements and SRS document.
- How to plan for a project.
- The quality control and how to ensure good quality software.
- Testing **Course** methods of software, use of CASE tools
- Implementation issues, validation and verification procedures.

**Course Outcomes:**

<b>CO</b>	<b>Course Outcomes</b>	<b>Knowledge Level(K)#</b>
<b>CO1</b>	Compare and analyse various process models	<b>K1</b>
<b>CO2</b>	Develop SRS document and estimate the modularity of the project	<b>K2</b>
<b>CO3</b>	Develop data flow diagrams and compare the user interface design	<b>K2</b>
<b>CO4</b>	Compare testing strategies and analyse the software quality	<b>K3</b>
<b>CO5</b>	Apply Computer Aided Software Engineering tools and analyse the components of software maintenance and reuse.	<b>K2</b>

#basedonsuggestedRevisedBTL

**UNIT-I**

**INTRODUCTION:** Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering. **SOFTWARE LIFE CYCLE MODELS:** Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model and Spiral model.



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**UNIT -II:**

**SOFTWARE PROJECT MANAGEMENT:** Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead's software science, and risk management. **REQUIREMENTS ANALYSIS AND SPECIFICATION:** Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

**UNIT III:**

**SOFTWARE DESIGN:** Overview of the design process, How to characterise a good software design? Layered arrangement of modules, Cohesion and Coupling. approaches to software design. **FUNCTION-ORIENTED SOFTWARE DESIGN:** Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review. **USER INTERFACE DESIGN:** Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

**UNIT IV:**

**CODING AND TESTING:** Coding, Code review, Software documentation, Testing, Black-box testing, White-Box testing, Debugging, Program analysis tools, Integration testing, Testing object-oriented programs, Smoke testing, and Some general issues associated with testing. **SOFTWARE RELIABILITY AND QUALITY MANAGEMENT:** Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000. SEI Capability maturity model. Few other important quality standards, and Six Sigma.

**UNIT V:**

**COMPUTER-AIDED SOFTWARE ENGINEERING (CASE):** CASE and its scope, CASE environment, CASE support in the software life cycle, Other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment. **SOFTWARE MAINTENANCE:** Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost. **SOFTWARE REUSE:** What can be reused? Why almost no reuse so far? Basic issues in any reuse program, A reuse approach, and Reuse at organisation level.



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**Text Books**

1. Fundamentals of Software Engineering, Raji b Mall, Fifth Edition, PHI.

**Reference Books**

1. Software Engineering Apractitioner's Approach, Roger S. Pressman, Ninth Edition, McGraw Hill International Edition.
2. Software Engineering, Ian Sommerville, Tenth Edition, Pearson Education.
3. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

**e-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105182/>
- 2) [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01260589506387148827\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01260589506387148827_shared/overview)  
[https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_013382690411003904735\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview)



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<b>III Year I Semester</b>	<b>ARTIFICIAL INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Outcome(s):**

This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence.

**UNIT-I**

**Introduction, Overview of Artificial intelligence:** Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. **Problem Solving, Problem Space & search:** Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

**UNIT-II**

**Search techniques:** Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A\* search, AO\* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

**UNIT-III**

**Constraint satisfaction problems:** Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

**UNIT – IV**

**Knowledge & reasoning:** Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

**UNIT – V**

**Probabilistic reasoning:** Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. **Expert Systems:** Representing and using domain knowledge, expert system shells, and knowledge acquisition.



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**Home Assignments:**

Assignments should include problems related to the topics covered in lectures, like heuristics, optimal search, and graph heuristics. Constraint satisfaction problems, k-nearest neighbors, decision trees, etc. can be included in home assignments.

**Text Books:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach
2. Artificial Intelligence, Russel, Pearson

**Reference Books:**

1. Artificial Intelligence, Ritch & Knight, TMH
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
3. Logic & Prolog Programming, Saroj Kaushik, New Age International
4. Expert Systems, Giarranto, VIKAS



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**R23 B.Tech Cyber Security**  
**(R23 – III<sup>rd</sup> YEAR COURSE STRUCTURE & SYLLABUS)**

<b>III Year I Semester</b>	<b>MICROPROCESSORS &amp; MICROCONTROLLERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**Course Objectives:**

- To introduce fundamental architectural concepts of microprocessors and microcontrollers.
- To impart knowledge on addressing modes and instruction set of 8086 and 8051
- To introduce assembly language programming concepts
- To explain memory and I/O interfacing with 8086 and 8051
- To introduce 16 bit and 32 bit microcontrollers.

**UNIT I**

**8086 Architecture:** Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

**UNIT II**

**8086 Programming:** Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

**UNIT III**

**8086 Interfacing:** Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

**UNIT IV**

Microcontroller, Architecture of 8051, Special Function Registers(SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

**UNIT V**

Interfacing Microcontroller, Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation, Comparison of Microprocessor, Microcontroller, PIC and ARM processors

**Textbooks:**

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3<sup>rd</sup> Edition, 1994.



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2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3<sup>rd</sup> edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2<sup>nd</sup> edition, Pearson, 2012.

**References:**

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6<sup>th</sup> edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3<sup>rd</sup> edition, Cengage Learning, 2004.



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<b>III Year I Semester</b>	<b>CLOUD COMPUTING LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**Course Objectives:**

- To introduce the various levels of services offered by cloud.
- To give practical knowledge about working with virtualization and containers.
- To introduce the advanced concepts such as serverless computing and cloud simulation.

**Course Outcomes:** At the end of the course, the student should be able to

- Demonstrate various service types, delivery models and technologies of a cloud computing environment.
- Distinguish the services based on virtual machines and containers in the cloud offerings.
- Assess the challenges associated with a cloud-based application.
- Discuss advanced cloud concepts such as serverless computing and cloud simulation.
- Examine various programming paradigms suitable to solve real world and scientific problems using cloud services.

**List of Experiments:**

1. Lab on web services
2. Lab on IPC, messaging, publish/subscribe
3. Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows8 or above.
4. Install a C compiler in the virtual machine created using VirtualBox and execute Simple Programs.
5. Create an Amazon EC2 instance and set up a web-server on the instance and associate an IP address with the instance. In the process, create a security group allowing access to port 80 on the instance.

OR

6. Do the same with OpenStack
7. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
8. Start a Docker container and set up a web-server (e.g. apache2 or Python based Flask micro web framework) on the instance. Map the host directory as a data volume for the container.
9. Find a procedure to transfer the files from one virtual machine to another virtual machine. Similarly, from one container to another container.
10. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
11. Install Hadoop single node cluster and run simple applications like word count.
12. Utilize OpenFaaS – Serverless computing framework and demonstrate basic event driven function invocation.
13. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.



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**Text Books:**

1. Mastering Cloud Computing, 2<sup>nd</sup> edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, McGraw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

**Reference Books:**

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2<sup>nd</sup> edition, MK Elsevier, 2018.
2. Cloud Computing: Principles and Paradigms by RajkumarBuyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
3. Online documentation and tutorials from cloud service providers (e.g. AWS, Google App Engine)
4. Docker, Reference documentation, <https://docs.docker.com/reference/>  
OpenFaaS, Serverless Functions Made Simple, <https://docs.openfaas.com/>



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<b>III Year II Semester</b>	<b>CRYPTOGRAPHY &amp; NETWORK SECURITY LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		0	0	3	1.5

**Course Objectives:**

- To learn basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
- To understand and implement encryption and decryption using Ceaser Cipher, Substitution Cipher, Hill Cipher.

**List of Experiments:**

1. Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should AND or and XOR each character in this string with 127 and display the result
3. Write a Java program to perform encryption and decryption using the following algorithms:
  - a) Ceaser Cipher
  - b) Substitution Cipher
  - c) Hill Cipher
4. Write a Java program to implement the DES algorithm logic
5. Write a C/JAVA program to implement the BlowFish algorithm logic
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Using Java Cryptography, encrypt the text "Hello world" using BlowFish. Create your own key using Java key tool.
8. Write a Java program to implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.



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### (R23 – III<sup>rd</sup> YEAR COURSE STRUCTURE & SYLLABUS)

III Year I Semester	FULLSTACK DEVELOPMENT - II	L	T	P	C
		0	1	2	2

#### Course Outcomes:

At the end of the Course, Student will be able to:

- CO1: Make use of router, template engine and authentication using sessions to develop application in ExpressJS.
- CO2: Build a single page application using RESTful APIs in ExpressJS.
- CO3: Make use of components, props, state and render data in ReactJS.
- CO4: Apply router and hooks in designing ReactJS application.
- CO5: Make use of MongoDB queries to perform CRUD operations on document database.

#### Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	3		2				2	2		2
CO 2	2	3	2		2				2	2		2
CO 3	2	2	3		2				2	2		2
CO 4	2	3	2		2				2	2		2
CO 5	2	2	3		2				2	2		2

#### List of Experiments:

##### Experiment 1: Node.js

- a. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
- b. Write a program to transfer data over http protocol using http module.
- c. Create a text file src.txt and add the following content to it. (HTML, CSS, Javascript, Typescript, MongoDB, Express.js, React.js, Node.js)
- d. Write a program to parse an URL using URL module.
- e. Write a program to create an user-defined module and show the workflow of Modularization of application using Node.js

##### Experiment 2: Typescript

- a. Write a program to understand simple and special types.
- b. Write a program to understand function parameter and return types.
- c. Write a program to show the importance with Arrow function. Use optional, default and REST parameters.
- d. Write a program to understand the working of typescript with class, constructor, properties, methods and access specifiers.
- e. Write a program to understand the working of namespaces and modules.
- f. Write a program to understand generics with variables, functions and constraints.

##### Experiment 3-15:

Augmented Programs: (Any 2 must be completed from **Experiment 3-5**)

3. Write a CSS program, to apply 2D and 3D transformations in a web page.
4. a web page with new features of HTML5 and CSS3.
5. Design a to-do list application using JavaScript.



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**Experiment 6:**

**ExpressJS – Routing, HTTP Methods, Middleware**

- Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.
- Write a program to accept data, retrieve data and delete a specified resource using http methods.
- Write a program to show the working of middleware.

**Experiment 7:**

**ExpressJS – Templating, Form Data**

- Write a program using templating engine.
- Write a program to work with form data.

**Experiment 8:**

**ExpressJS – Cookies, Sessions, Authentication**

- Write a program for session management using cookies and sessions.
- Write a program for user authentication

**Experiment 9:**

**ExpressJS – Database, RESTful APIs**

- Write a program to connect MongoDB database using Mongoose and perform CRUD operations.
- Write a program to develop a single page application using RESTful APIs

**Experiment 10:**

**ReactJS – Render HTML, JSX, Components – function & Class**

- Write a program to render HTML to a web page.
- Write a program for writing markup with JSX.
- Write a program for creating and nesting components (function and class).

**Experiment 11:**

**ReactJS – Props and States, Styles, Respond to Events**

- Write a program to work with props and states.
- Write a program to add styles (CSS & Sass Styling) and display data.
- Write a program for responding to events.

**Experiment 12:**

**ReactJS – Conditional Rendering, Rendering Lists, React Forms**

- Write a program for conditional rendering.
- Write a program for rendering lists.
- Write a program for working with different form fields using react forms



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**Experiment 13:**

**ReactJS – React Router, Updating the Screen**

- a. Write a program for routing to different pages using react router.
- b. Write a program for updating the screen.

**Experiment 14:**

**ReactJS – Hooks, Sharing data between Components**

- a. Write a program to understand the importance of using hooks.
- b. Write a program for sharing data between components

**Experiment 15:**

**ReactJS Applications – To-do list and Quiz**

- a. Design to-do list application

**Experiment 16:**

**MongoDB – Installation, Configuration, CRUD operations**

- a. Install MongoDB and configure ATLAS
- b. Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()

**Experiment 17:**

**MongoDB – Databases, Collections and Records**

- g. Write MongoDB queries to Create and drop databases and collections.  
Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate()

**Experiment 18-20:**

Augmented Programs: (Any 2 must be completed)

18. Design a to-do list application using NodeJS and ExpressJS.
19. Design a Quiz app using ReactJS.
20. Complete the MongoDB certification from MongoDB University website.

**Text Books:**

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, 2013.
2. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2<sup>nd</sup> edition, A Press, O'Reilly.

**Web Links:**

1. ExpressJS - <https://www.tutorialspoint.com/expressjs>
2. ReactJS - <https://www.w3schools.com/REACT> (and) <https://react.dev/learn#>
3. MongoDB - <https://learn.mongodb.com/learning-paths/introduction-to-mongodb>



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<b>III Year I Semester</b>	<b>UI DESIGN - FLUTTER LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**Course Objectives:**

- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widgets and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data

**List of Experiments:**

Students need to implement the following experiments

1. a) Install Flutter and Dart SDK.  
b) Write a simple Dart program to understand the language basics.
2. a) Explore various Flutter widgets (Text, Image, Container, etc.).  
b) Implement different layout structures using Row, Column, and Stack widgets.
3. a) Design a responsive UI that adapts to different screen sizes.  
b) Implement media queries and breakpoints for responsiveness.
4. a) Set up navigation between different screens using Navigator.  
b) Implement navigation with named routes.
5. a) Learn about stateful and stateless widgets.  
b) Implement state management using set State and Provider.
6. a) Create custom widgets for specific UI elements.  
b) Apply styling using themes and custom styles.
7. a) Design a form with various input fields.  
b) Implement form validation and error handling.
8. a) Add animations to UI elements using Flutter's animation framework.  
b) Experiment with different types of animations (fade, slide, etc.).
9. a) Fetch data from a REST API.  
b) Display the fetched data in a meaningful way in the UI.
10. a) Write unit tests for UI components.  
b) Use Flutter's debugging tools to identify and fix issues.

**Text Book:**

1. Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.
2. Rap Payne, Beginning App Development with Flutter: Create Cross-Platform Mobile Apps 1<sup>st</sup> Edition, Apres



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<b>III Year II Semester</b>	<b>CYBER SECURITY &amp; DIGITAL FORENSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The aim of the course is to

- Identify security risks and take preventive steps
- understand the forensics fundamentals
- understand the evidence capturing process
- understand the preservation of digital evidence

**UNIT I: Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

**UNIT II: Tools and Methods :**Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

**UNIT III: Cyber Crime Investigation:** Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

**UNIT IV: Computer Forensics and Investigations:** Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Finger print Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

**UNIT V: Cyber Crime Legal Perspectives:** Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenge to Indian Law and Cyber crime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cyber crime and Punishment, Cyber law, Technology and Students: Indian Scenario.



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**Text Books:**

1. Sunit Belapure Nina Godbole “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, WILEY, 2011.
2. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009.

**Reference Books:**

1. Michael T. Simpson, Kent Backman and James E. Corley, “Hands on Ethical Hacking and Network Defence”, Cengage, 2019.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
3. Alfred Basta, Nadine Basta, Mary Brown and Ravinder Kumar “Cyber Security and Cyber Laws”, Cengage, 2018.

**E-Resources:**

1. CERT-In Guidelines- <http://www.cert-in.org.in/>
2. <https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks> [ Online Course]
3. <https://computersecurity.stanford.edu/free-online-videos> [ Free Online Videos]
4. Nickolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, <https://ocw.mit.edu> License:CreativeCommonsBY-NC-SA.



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<b>III Year II Semester</b>	<b>BLOCKCHAIN TECHNOLOGYS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
- To understand public block chain system, Private block chain system and consortium block chain.
- Able to know the security issues of blockchain technology.

**UNIT – I:**

**Fundamentals of Blockchain:** Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

**Blockchain Types and Consensus Mechanism:** Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. **Cryptocurrency:** Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

**UNIT – II:**

**Public Blockchain System:** Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. **Smart Contracts:** Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

**UNIT – III:**

**Private Blockchain System:** Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. **Consortium Blockchain:** Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. **Initial Coin Offering:** Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.



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**UNIT – IV:**

**Security in Blockchain:** Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

**Applications of Blockchain:** Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

**UNIT – V:**

Blockchain Case Studies:

Case Study 1 – Retail,

Case Study 2 – Banking and Financial Services,

Case Study 3 – Healthcare,

Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

**Text book:**

1. “Block chain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

**Reference Books:**

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley



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<b>III Year II Semester</b>	<b>MACHINE LEARNING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The objectives of the course is to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

**Course Outcomes: At the end of the course, student will be able to**

- Enumerate the Fundamentals of Machine Learning
- Build Nearest neighbour based models
- Apply Models based on decision trees and Bayes rule
- Make use of Linear discriminants for machine Learning
- Choose appropriate clustering technique

**UNIT-I: Introduction to Machine Learning:** Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

**UNIT-II: Nearest Neighbor-Based Models:**Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

**UNIT-III: Models Based on Decision Trees:** Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.

**The Bayes Classifier:** Introduction to the Bayes Classifier, Bayes’ Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

**UNIT-IV: Linear Discriminants for Machine Learning:** Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.



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**UNIT-V: Clustering** : Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

**Text Books:**

1. “Machine Learning Theory and Practice”, M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

**Reference Books:**

1. “Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017
2. “Machine Learning in Action”, Peter Harrington, DreamTech
3. “Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.



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<b>III Year II Semester</b>	<b>SOFTWARE VULNERABILITY ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**Course Objectives:**

- This course provides the user to know the software vulnerabilities in the real software world.
- Different application-level security
- Able to find the malicious code actions and different protection techniques.

**Course Outcomes:** At the end of the course, student will be able to

	<b>Course Outcomes</b>	<b>Knowledge Level (K)#</b>
<b>CO1</b>	Acquire the basic concepts of security & Authentication	K3
<b>CO2</b>	How to detect Malicious Code in software applications	K1
<b>CO3</b>	Analyze and apply Access Control & Physical Protection to the UNIX and Windows operating system	K4
<b>CO4</b>	Brief explain the concepts of OSI Model, Sockets	K2
<b>CO5</b>	Ability to Acquire the concepts of Counter Measures	K1

**UNIT-I:**

**Introduction to security & Authentication-** Software Security Dealing with Widespread Security Failures, Bugtraq, CERT Advisories, RISKS Digest, Technical Trends Affecting Software Security, The ileitis, Beyond Reliability, Penetrate and Patch, On Art and Engineering, Security Goals, Prevention, Traceability and Auditing, Monitoring, Privacy and Confidentiality, Multilevel Security.

**UNIT-II:**

**Security & Malicious Code-**Managing Software Security Risk: An Overview Of Software Risk Management For Security, The Role Of Security Personnel, Software Security Personnel In The Life Cycle, Deriving Requirements, Risk Assessment, Software Risk Management, Architectural Risk Analysis, Risk-Based Security Testing, Security Requirements, Security Operations.

**UNIT-III:**

**Access Control & Physical Protection-**The UNIX Access Control Model, How UNIX and Windows Exploits, Modifying File Attributes, Modifying Ownership, The unmask, The Programmatic Interface, Setuid Programming, Access Control In Windows NT, Compartmentalization, Fine-Grained Privileges. Buffer Overflow & Root kits: Buffer Overflows As Security Problems, Defending Against Buffer Overflow.



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**UNIT-IV:**

**Network Security & Intrusion-** OSI Model, Sockets-Functions, Addresses, Network Byte Order, Internet Address Conversion, Simple Server and Web Clients, Tiny web Server. Peeling Back the Lower Layers, Network Sniffing, Raw Socket Sniffer, libpcap Sniffer, Decoding the Layers, Active Sniffing, Denial of Service, SYN Flooding, The Ping of Death, Teardrop, Ping Flooding, Amplification Attacks, Distributed DoS Flooding.

**UNIT-V:**

**Counter Measures-** Detection of System Daemons, Crash Course in Signals, Tiny web Daemon, Tools of the Trade, tiny web Exploit Tool, Log Files, Log less Exploitation, Socket Reuse, Payload Smuggling, String Encoding, Buffer Restrictions, Polymorphic Printable ASCII Shell code. Hardening Countermeasures, Non executable Stack, ret2libc, Returning into system() Randomized Stack Space, Investigations with BASH and GDB, Bouncing Off Linux gate, Applied Knowledge, First Attempts, Paying the Odds.

**Text Books:**

1. John Viega & Gary McGraw: Building Secure Software: How to Avoid Security Problems the Right Way (Addison-Wesley Professional Computing Series), 2001.
2. Gary McGraw: Software Security: Building Security In (Addison-Wesley Professional Computing Series), 2008.

**Reference Books:**

1. Michael Howard, David LeBlanc, John Viega: 19 Deadly Sins of Software Security: Programming Flaws and How to Fix Them (Security One-off) (Addison-Wesley Professional Computing Series), 2001.
2. Jon Erickson: Hacking: The Art of Exploitation, 2nd Edition (No Starch Press, San Fransico), 2005.
3. Richard Sinn “Software Security, Theory Programming and Practice” Cengage Learning, 2004.



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<b>III Year II Semester</b>	<b>DevOps</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The main objectives of this course are to:

- Describe the agile relationship between development and IT operations.
- Understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
- Implement automated system update and DevOps lifecycle.

**UNIT-I**

**Introduction to DevOps:** Introduction to SDLC, Agile Model. Introduction to DevOps. DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, Automation of CI/ CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

**UNIT-II**

**Source Code Management (GIT):** The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration. **UNIT TESTING - CODE COVERAGE:** Junit, NUnit & Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.

**UNIT-III**

**Build Automation - Continuous Integration (CI):** Build Automation, What is CI Why CI is Required, CI tools, Introduction to Jenkins (With Architecture), jenkins workflow, jenkins master slave architecture, Jenkins Pipelines, PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects & Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.



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**UNIT-IV**

**Continuous Delivery (CD):** Importance of Continuous Delivery, CONTINUOUS DEPLOYMENT CD Flow, Containerization with Docker: Introduction to Docker, Docker installation, Docker commands, Images & Containers, DockerFile, Running containers, Working with containers and publish to Docker Hub.

**Testing Tools:** Introduction to Selenium and its features, JavaScript testing.

**UNIT-V**

**Configuration Management - ANSIBLE:** Introduction to Ansible, Ansible tasks, Roles, Jinjatemplating, Vaults, Deployments using Ansible.

**CONTAINERIZATION USING KUBERNETES(OPENSIFT):** Introduction to Kubernetes Namespace & Resources, CI/CD - On OCP, BC, DC &ConfigMaps, Deploying Apps on Openshift Container Pods. Introduction to Puppet master and Chef.

**Text Books:**

1. Joyner, Joseph., Devops for Beginners: Devops Software Development Method Guide for Software Developers and It Professionals, 1<sup>st</sup> Edition MihailsKonoplows, 2015.
2. Alisson Machado de Menezes., Hands-on DevOps with Linux, 1<sup>st</sup> Edition, BPB Publications, India, 2021.

**Reference Books:**

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10
2. Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016.
3. Verona, Joakim Practical DevOps, 1<sup>st</sup> Edition, Packt Publishing, 2016.
4. Joakim Verona. Practical Devops, Ingram short title; 2<sup>nd</sup> edition (2018). ISBN10: 1788392574
5. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952



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<b>III Year II Semester</b>	<b>APPLIED CRYPTOGRAPHY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

Knowledge on significance of cryptographic protocols and symmetric and public key algorithms

**Course Outcomes:**

1. Understand the various cryptographic protocols
2. Analyze key length and algorithm types and modes
3. Illustrate different public key algorithms in cryptosystems
4. Understand special algorithms for protocols and usage in the real world.

**UNIT - I**

Foundations: Terminology, Steganography, Substitution Ciphers and Transposition Ciphers, Simple XOR, One-Time Pads, Computer Algorithms, Large Numbers, Cryptographic Protocols: Protocol Building Blocks: Introduction to Protocols, Communications Using Symmetric Cryptography, One-Way Functions, One-Way Hash Functions, Communications Using Public-Key Cryptography, Digital Signatures, Digital Signatures with Encryption, Random and Pseudo-Random-Sequence Generation

**UNIT - II**

Cryptographic Techniques: Key length: Symmetric Key length, Public key length, comparing symmetric and public key length. Algorithm types and modes: Electronic Codebook Mode, Block Replay, Cipher Block Chaining Mode, Stream Cipher, Self-Synchronizing Stream Ciphers, Cipher-Feedback Mode, Synchronous Stream Ciphers, Output-Feedback Mod, Counter Mode, Other Block-Cipher Modes.

**UNIT - III**

Public-Key Algorithms: Background, Knapsack Algorithms, RSA, Pohlig-Hellman, Rabin, ElGamal, McEliece, Elliptic Curve Cryptosystems, LUC, Finite Automaton Public-Key Cryptosystems Public-Key Digital Signature Algorithms: Digital Signature Algorithm (DSA), DSA Variants, Gost Digital Signature Algorithm, Discrete Logarithm Signature Schemes, Ong-Schnorr-Shamir, ESIGN



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**UNIT - IV**

Special Algorithms for Protocols: Multiple-Key Public-Key Cryptography, Secret-Sharing Algorithms, Subliminal Channel, Undeniable Digital Signatures, Designated Confirmer Signatures, Computing with Encrypted Data, Fair Coin Flips, One-Way Accumulators, All-or-Nothing Disclosure of Secrets, Fair and Failsafe Cryptosystems, Zero-Knowledge Proofs of Knowledge, Blind Signatures, Oblivious Transfer, Secure Multiparty Computation, Probabilistic Encryption, Quantum Cryptography

**UNIT - V**

Real World Approaches: IBM Secret key management protocol, ISDN, Kerberos, KryptoKnight, Privacy enhanced mail (PEM), Message security protocol (MSP), PGP, Public-Key Cryptography Standards (PKCS), Universal Electronic Payment System (UEPS).

**Text books:**

1. Bruce Schneier, Applied Cryptography, Second Edition: Protocols, Algorithms, and Source Code in C (cloth)



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<b>III Year II Semester</b>	<b>INTERNET OF THINGS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

From the course the student will learn

- the application areas of IOT
- the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- building blocks of Internet of Things and characteristics

**UNIT I:**

Predecessors of IoT: Introduction, Wireless Sensor Networks, Machine-to-Machine Communications, Cyber Physical Systems. Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT

**UNIT II:**

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics. IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

**UNIT III:**

IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IT, Wi-Fi, Bluetooth. IoT Communication Technologies: Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols.

**UNIT IV:**

IoT Interoperability: Introduction, Standards, Frameworks. Fog Computing and Its Applications: Introduction, View of Fog Computing Architecture, Fog Computing in IoT, Selected Applications of Fog Computing

**UNIT V:**

Paradigms, Challenges, and the Future: Introduction, Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT. IoT Case Studies: Agricultural IoT, Vehicular IoT



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**Text Books:**

1. Introduction to IoT, SudipMisra, AnandarupMukhaerjee, Arjit Roy, Cambridge University Press, 2021
2. Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education

**Reference Books:**

1. Fog and Edge Computing: Principles and Paradigms, [RajkumarBuyya \(Editor\)](#), [Satish narayanaSrirama \(Editor\)](#) , ISBN: 978-1-119-52498-4, January 2019
2. Getting Started with the Internet of Things, CunoPfister ,Oreilly



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<b>III Year II Semester</b>	<b>DESIGN OF SECURE PROTOCOLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Courseobjectives:**

The main objective of this course is that to explore various protocols and design of various protocols with deeper security.

**Course Outcomes:**

- Get the exposure to various protocols.
- Gain knowledge on various secure mechanisms through set of protocols.
- Apply different data link layer protocols
- Efficiently design new set of protocols.
- Learn Security issues and over comemeans with protocols.

**UNIT–I**

OSI: ISO Layer Protocols:- Application Layer Protocols-TCP/IP, HTTP, SHTTP, LDAP, MIME, - POP & POP3 - RMON-SNTP-SNMP. Presentation Layer Protocols –Light Weight Presentation Protocol Session layer protocols.

**UNIT–II**

RPC protocols transport layer protocols ITOT,RDP,RUDP,TALI,TCP/UDP, compressed TCP. Network layer Protocols – routing protocols-border gateway protocol-exterior gateway protocol-internet protocol IPv4- IPv6- Internet Message Control Protocol- IRDP- Transport Layer Security-TSL-SSL-DTLS

**UNIT–III**

Data Link layer Protocol – ARP – In ARP – IPCP – IPv6CP – RARP – SLIP .Wide Area and NetworkProtocols- ATM protocols – Broadband Protocols – Point to Point Protocols – Other WAN Protocols-securityissues.

**UNIT–IV**

Local Area Network and LAN Protocols – ETHERNET Protocols–VLAN protocols–Wireless LAN Protocols–Metropolitan Area Network Protocol–Storage Area Network and SAN



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**UNIT-V**

Protocols - FDMA, WIFI and WIMAX Protocols - security issues. Mobile IP – Mobile Support Protocol for IPv4 and IPv6 – Resource Reservation Protocol. Multi – casting Protocol–VGMP, IGMPMSDP. Network Security and Technologies and Protocols–AAA Protocols–Tunneling Protocols– Secured Routing Protocols– GRE-Generic Routing Encapsulation– IPSEC–Security.

**TEXTBOOKS:**

1. Jawin: “Networks Protocols Handbook”, 3<sup>rd</sup> Edition, Jawin Technologies Inc., 2005.
2. Bruce Potter and Bob Fleck: “802.11 Security”, 1<sup>st</sup> Edition, O’Reilly Publications, 2002.

**REFERENCES:**

1. Ralph Oppliger: “SSL and TLS: Theory and Practice”, 1<sup>st</sup> Edition, Arttech House, 2009.
2. Lawrence Harte: “Introduction to CDMA-Network services Technologies and Operations”, 1<sup>st</sup> Edition, Althos Publishing, 004.
3. Lawrence Harte: “Introduction to WIMAX”, 1<sup>st</sup> Edition, Althos Publishing, 2005.



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<b>III Year II Semester</b>	<b>FIREWALLS &amp; VPN SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- Identify and assess current and anticipated security risks and vulnerabilities
- Develop a network security plan and policies
- Establish a VPN to allow IPSec remote access traffic
- Monitor, evaluate and test security conditions and environment
- Develop critical situation contingency plans and disaster recovery plan
- Implement/test contingency and backup plans and coordinate with stakeholders
- Monitor, report and resolve security problems

**Course Outcomes:** At the end of the course, student will be able to

- To show the fundamental knowledge of Firewalls and its types
- Construct a VPN to allow Remote Access, Hashing, connections with Cryptography and VPN Authorization
- Elaborate the knowledge of depths of Firewalls, Interpreting firewall logs, alerts, Intrusion and Detection
- Infer the design of Control Systems of SCADA, DCS, PLC's and ICS's
- Evaluate the SCADA protocols like RTU, TCP/IP, DNP3, OPC, DA/HAD

**SYLLABUS**

**UNIT–I: Firewall Fundamentals**-Introduction, Types of Firewalls, Ingress and Egress Filtering, Types of Filtering, Network Address Translation (NAT), Application Proxy, Circuit Proxy, Content Filtering, Software versus Hardware Firewalls, IPv4 versus IPv6 Firewalls, Dual-Homed and Triple-Homed Firewalls, Placement of Firewalls.

**UNIT– II: VPN Fundamentals**-VPN Deployment Models and Architecture, Edge Router, Corporate Firewall, VPN Appliance, Remote Access, Site-to-Site, Host-to-Host, Extranet Access, Tunnel versus Transport Mode, The Relationship Between Encryption and VPNs, Establishing VPN Connections with Cryptography, VPN Authorization.

**UNIT–III: Exploring the Depths of Firewalls**-Firewall Rules, Authentication and Authorization, Monitoring and Logging, Understanding and Interpreting Firewall Logs and Alerts, Intrusion Detection, Limitations of Firewalls, Downside of Encryption with Firewalls, Firewall Enhancements and Management Interfaces.



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**UNIT–IV: Overview of Industrial Control Systems**–Overview of SCADA, DCS, and PLCs, ICS Operation, Key ICS Components, Control Components, Network Components, SCADA Systems, Distributed Control Systems, Programmable Logic Controllers, Industrial Sectors and their Interdependencies.

**UNIT–V: SCADA Protocols**–Modbus RTU, Modbus TCP/IP, DNP3, DNP3 TCP/IP, OPC, DA/HAD, SCADA protocol fuzzing. Finding Vulnerabilities in HMI: software- Buffer Overflows, Shell code. Previous attacks Analysis- Stuxnet, Duqu.

**Text Books:**

1. Michael Stewart “Network Security, Firewalls, and VPNs” Jones & Bartlett Learning September 2010.
2. T. Macaulay and B. L. Singer, Cyber security for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS, Auerbach Publications, 2011.

**Reference Books:**

1. J. Lopez, R. Setola, and S. Wolthusen, Critical Infrastructure Protection Information Infrastructure Models, Analysis, and Defense, Springer-Verlag Berlin Heidelberg, 2012.
2. Robert Radvanovsky and Jacob Brodsky, editors. Handbook of SCADA/Control Systems Security. CRC Press, 2013.
3. A.W. Colombo, T. Bangemann, S. Karnouskos, S. Delsing, P. Stluka, R. Harrison, et al. Industrial cloud-based cyber-physical systems Springer International Publishing, 2014.
4. D. Bailey, Practical SCADA for Industry. Burlington, MA: Newnes, 2003.



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<b>III Year II Semester</b>	<b>WEB APPLICATION SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites:** Networking Fundamentals, Web Development Basics and Cyber security Fundamentals

**Course Objectives:** This course aims to provide students with a fundamental understanding of web application security principles, common vulnerabilities, and security best practices.

**Course Outcomes:**

Upon completion of this course, the students will be able to:

**CO1-** Identify and analyze web application security vulnerabilities.

**CO2-** Apply secure coding practices to develop and maintain web applications.

**CO3-** Perform security testing and assessment on web applications.

**CO4-** Configure and manage Web Application Firewalls (WAFs) for protection.

**CO5-** Develop an incident response plan for web application security breaches.

**UNIT I: (9 Hours)**

**Introduction to Web Application Security:** Introduction to web application security concepts, Importance of web application security, Threat landscape and security challenges in web applications, The role of security in the software development lifecycle

**UNIT II: (9 Hours)**

**Web Application Vulnerabilities:** Common web application vulnerabilities (e.g., SQL injection, XSS, CSRF), Understanding attack vectors and exploitation techniques, Real-world examples of web application breaches and their impact, Introduction to the OWASP Top Ten Project

**UNIT III: (10 Hours)**

**Secure Coding Practices:** Principles of secure coding for web applications, Input validation and sanitization, Authentication and authorization mechanisms, Session management and secure communication, Error handling and logging

**UNIT IV: (9 Hours)**

**Web Application Security Testing:** Manual and automated security testing techniques, Vulnerability scanning and assessment tools, Security testing methodologies (e.g., black-box, white-box, gray-box testing), Reporting and remediation of security findings



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**UNIT V: (9 Hours)**

**Web Application Firewall (WAF) and Incident Response:** Introduction to Web Application Firewalls (WAF), Deploying and configuring WAF for web application protection, Incident response and handling security breaches, Web application security monitoring and alerting.

**TEXT BOOKS:**

1. "Web Application Security: A Beginner's Guide" by Bryan Sullivan, Vincent Liu
2. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto
3. "Secure Coding in C and C++" by Robert C. Seacord (For secure coding practices)
4. "OWASP Testing Guide" by The OWASP Foundation (Free online resource for security testing)

**REFERENCE BOOKS:**

1. "Web Application Security: Threats, Countermeasures, and Best Practices" by Lakshmanan Ganapathy and Mike Ware
2. "Hacking Web Apps: Detecting and Preventing Web Application Security Problems" by Mike Shema
3. "Secure Programming with Static Analysis" by Brian Chess and Jacob West



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<b>III Year II Semester</b>	<b>SECURITY ASSESSMENT AND RISK ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES**

1. The course takes a software development perspective to the challenges of engineering software systems that are secure.
2. This course addresses design and implementation issues critical to producing secure software systems.
3. The course deals with the question of how to make the requirements for confidentiality, integrity, and availability integral to the software development process.
4. Secure software requirements gathering to design, development, configuration, deployment, and ongoing maintenance
5. Security of enterprise information systems.

**COURSE OUTCOMES:**

1. Understand various aspects and principles of software security.
2. Devise security models for implementing at the design level.
3. Identify and analyze the risks associated with s/w engineering and use relevant models to mitigate the risks.
4. Understand the various security algorithms to implement for secured computing and computer networks
5. Explain different security frameworks for different types of systems including electronic systems.

**UNIT-I**

Defining computer security, the principles of secure software, trusted computing base, etc, threat modeling, advanced techniques for mapping security requirements into design specifications. Secure software implementation, deployment and ongoing management.

**UNIT-II**

Software design and an introduction to hierarchical design representations. Difference between high-level and detailed design. Handling security with high-level design. General Design Notions. Security concerns designs at multiple levels of abstraction, Design patterns, quality assurance activities and strategies that support early vulnerability detection, Trust models, security Architecture & design reviews .



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**UNIT-III**

Software Assurance Model: Identify project security risks & selecting risk management strategies, Risk Management Framework, Security Best practices/ Known Security Flaws, Architectural risk analysis, Security Testing & Reliability (Pen testing, Risk- Based Security Testing)

**UNIT-IV**

Security in Enterprise Business: Identification and authentication, Enterprise Information Security, Symmetric and asymmetric cryptography, including public key cryptography, data encryption standard (DES), advanced encryption standard (AES), algorithms for hashes and message digests. Authentication, authentication schemes, access control models, Kerberos protocol, public key infrastructure (PKI), protocols specially designed for e-commerce and web applications, firewalls and VPNs.

**UNIT-V**

Security development frameworks. Security issues associated with the development and deployment of information systems, including Internet-based e-commerce, e-business, and e-service systems.

**TEXT BOOKS:**

1. W. Stallings, Cryptography and network security: Principles and practice, 5 th Edition, Upper Saddle River, NJ: Prentice Hall., 2011
2. C. Kaufman, r. Perlman, & M. Speciner, Network security: Private communication in a public world, 2 nd Edition, Upper Saddle River, NJ:PrenticeHall, 2002
3. C. P. Pfleeger, S. L. Pfleeger, Security in Computing, 4 th Edition, Upper Saddle River, NJ:Prentice Hall, 2007
4. T. M. Merkow, & J. Breithaupt, Information security: Principles and practices. Upper Saddle River, NJ:Prentice Hall, 2005

**REFERENCE BOOKS:**

1. Gary McGraw, Software Security: Building Security In, Addison-Wesley, 2006



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**(R23 – III<sup>rd</sup> YEAR COURSE STRUCTURE & SYLLABUS)**

<b>III Year II Semester</b>	<b>CYBER SECURITY &amp; DIGITAL FORENSICS LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**Course Objectives:**

- Investigate cybercrime and collect evidences
- Able to use knowledge of forensic tools and software
- To understand the preservation of digital evidence.
- To learn about stenography Perceptual models

**Course Outcomes:** At the end of the course, student will be able to

	<b>Course Outcomes</b>	<b>Knowledge Level (K)#</b>
<b>CO1</b>	Identify the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing.	K3
<b>CO2</b>	Construct the file system storage mechanisms of two common desktop operating systems and forensics tools used in data analysis.	K6
<b>CO3</b>	List and Implement all running processes, network connections from a memory image and find whether a firewall is set by analyzing a memory image.	K4
<b>CO4</b>	Define and perform live incident response on a system, View all browser history and List out all established network connections in a computer (Hint: Triage Incident Response).	K1

*#Based on suggested Revised BTL*

**Mapping of course outcomes with program outcomes**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>												
<b>CO2</b>												
<b>CO3</b>												
<b>CO4</b>												

(Please fill the above with Levels of Correlation, viz., L, M, H)



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**Experiment- 1**

Evidence Collection

- a) Linux: Capturing RAM dump using fmem  
<https://github.com/NateBrune/fmem>
  - i) `dcfldd if=/dev/fmem of=memory.dump hash=sha256 sha256log=memory.dump.sha256 bs=1MB count=1000`
- b) Linux: Capturing Disk using dfldd  
<https://www.obsidianforensics.com/blog/imaging-using-dcfldd>
  - i) `dcfldd if=/dev/sdb1 of=/media/disk/test_image.dd hash=md5, sha1 hashlog=/media/disk/hashlog.txt`
- c) Windows: Capture RAM dump of a windows system
  - a. Hint: FTK Imager or RAMCapture
- d) Windows: Capture Disk Image of a windows system

Hint: FTK Imager

**Experiment- 2**

Disk Analysis

- i) List all files in a directory from a disk image
  - a. FTK Imager
- ii) Export a particular file from a disk image
  - a. FTK Imager
- iii) Recover a deleted file from a disk image

FTK Imager

**Experiment- 3**

Memory Analysis

1. List all running processes from a memory image
2. List all network connections from a memory image
3. Find out whether a firewall is set by analyzing a memory image

Hint: volatility

**Experiment- 4**

- 4) Live Incident Response
  1. Perform live incident response on a system
  2. View all browser history in a computer
  3. List out all established network connections in a computer

Hint: Triage Incident Response



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**Exercise- 5**

Implement E-Mail Tracking and Email Investigation

**Exercise- 6**

Implement video Analytics for a live video

**Exercise- 7**

Analysis on different Malware Working

**Exercise- 8**

Work on Mail Bombs &SMS bombs

**Exercise- 9**

Implement a case on windows and Linux forensics

**Exercise- 10**

Implement a case on network Forensic

**Exercise- 11**

Work on different types of vulnerabilities

**Exercise- 12**

Implement a case on Mobile Forensics

**Exercise- 13**

Develop a Evidence and Preparation and Documentation



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<b>III Year II Semester</b>	<b>MALWARE ANALYSIS &amp; REVERSE ENGINEERING LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		0	0	3	1.5

**COURSE OBJECTIVES:**

- This course provides students a foundational knowledge about reverse engineering and malware analysis, through the study of various cases.
- This course provides students a hand-on analysis of malware samples.
- It covers fundamental concepts in malware investigations so as to equip the students with enough background knowledge in handling malicious software attacks.

**COURSE OUTCOMES:**

Upon the completion of the course, the students will be able to:

- CO 1:** Demonstrate the cyber security challenges posed by malicious software attacks. [K2]  
**CO 2:** Analyze security risks, threats and potential vulnerabilities in enterprise networks environment. [K3]  
**CO 3:** Independently to conduct in-depth analysis of modern malware samples using behavioural, code analysis and memory forensic techniques. [K3]  
**CO 4:** Apply the techniques learned to proactively protect computer systems and networks, reduce security risks and mitigate the potential for malicious software attacks. [K5]  
**CO 5:** Apply immunity debugger for reverse engineering [K3]

**EXPERIMENTS:**

**WEEK-1:** Malware analysis lab environment setup

**WEEK-2:** Building malwares using tools

**WEEK-3:** Static Malware Analysis

1. Upload the files to <http://www.VirusTotal.com/> and view the reports. Does either file match any existing antivirus signatures?
2. When were these files compiled?
3. Are there any indications that either of these files is packed or obfuscated? If so, what are these indicators?
4. Do any imports hint at what this malware does? If so, which imports are they?
5. Are there any other files or host-based indicators that you could look for on infected systems?
6. What network-based indicators could be used to find this malware on infected machines?
7. What would you guess is the purpose of these files?



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**WEEK-4: Static Malware Analysis**

1. Upload the Lab01-02.exe file to <http://www.VirusTotal.com/>. Does it match any existing antivirus definitions?
2. Are there any indications that this file is packed or obfuscated? If so, what are these indicators? If the file is packed, unpack it if possible.
3. Do any imports hint at this program's functionality? If so, which imports are they and what do they tell you?
4. What host- or network-based indicators could be used to identify this malware on infected machines

**WEEK-5: Dynamic Malware Analysis**

1. How can you get this malware to install itself?
2. What are the command-line options for this program? What is the password requirement?
3. How can you use OllyDbg to permanently patch this malware, so that it doesn't require the special command-line password?
4. What are the host-based indicators of this malware?
5. What are the different actions this malware can be instructed to take via the network?
6. Are there any useful network-based signatures for this malware?

**WEEK-6: Dynamic Malware Analysis**

1. What strings do you see statically in the binary?
2. What happens when you run this binary?
3. How can you get this sample to run its malicious payload?
4. What is happening at 0x00401133?
5. What arguments are being passed to subroutine 0x00401089?
6. What domain name does this malware use?
7. What encoding routine is being used to obfuscate the domain name?
8. What is the significance of the Create Process A call at 0x0040106E?

**WEEK-7: Automated Malware Analysis**

**WEEK-8: Android malware analysis using tools**

**WEEK-9: Malware hunting Techniques using 1.Backdoors 2.Ransomware**

**WEEK-10: Malware hunting Techniques using 1.Credential stealers  
2. Persistence mechanisms**

**WEEK-11: Host exploitation and forensic analysis**

**WEEK-12:**

1. Reverse Engineering with Immunity Debugger
2. Software Cracking with HexEditor Tool
3. Rebuilding the software after cracking



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**Text Books:**

1. Sikorski, M., & Honig, A. (2012). Practical malware analysis: the hands-on guide to dissecting malicious software. No starch press.
2. Eilam, E. (2005). Reversing, Secrets of Reverse Engineering Wiley Publishing.
3. Malin, C. H. (2013). Linux Malware Incident Response: A Practitioner's Guide to Forensic Collection and Examination of Volatile Data: An Excerpt from Malware Forensic FieldGuide for Linux Systems. Elsevier.

**Reference Books:**

1. Sikorski, M., & Honig, A. (2012). Practical malware analysis: the hands-on guide to dissecting malicious software. No starch press.
2. Shashidhar, N., & Cooper, P. (2016, April). Teaching malware analysis: The design philosophy of a model curriculum. In 2016 4th International Symposium on Digital Forensic and Security (ISDFS) (pp. 119-125). IEEE.
3. Singh, A.(Ed.). (2009). Identifying malicious code through reverse engineering (Vol. 4). Springer Science & Business Media.



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**(R23 – III<sup>rd</sup> YEAR COURSE STRUCTURE & SYLLABUS)**

<b>III Year II Semester</b>	<b>SOFT SKILLS or IELTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		0	1	2	2

**Course Objectives:**

- To equip the students with the skills to effectively communicate in English
- To train the students in interview skills, group discussions and presentation skills
- To motivate the students to develop confidence
- To enhance the students' interpersonal skills
- To improve the students' writing skills

**UNIT -I**

Analytical Thinking & Listening Skills: Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self – Analysis, Developing Positive Attitude, Perception. Communication Skills: Verbal Communication; Non Verbal Communication (Body Language)

**UNIT -II**

Self-Management Skills: Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities. Etiquette: Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

**UNIT - III**

Standard Operation Methods: Basic Grammars, Tenses, Prepositions, Pronunciation, Letter Writing; Note Making, Note Taking, Minutes Preparation, Email & Letter Writing

**UNIT-IV**

Job-Oriented Skills: Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

**UNIT-V**

Interpersonal relationships: Introduction, Importance, Types, Uses, Factors affecting interpersonal relationships, Accommodating different styles, Consequences of interpersonal relationships

**Text books:**

1. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.

**Reference books:**

1. R.S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand & Company Ltd., 2018.
2. Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

**E-resources:**

[https://swayam-plus.swyam2.ac.in/courses/course-details?id=P\\_CAMBR\\_01](https://swayam-plus.swyam2.ac.in/courses/course-details?id=P_CAMBR_01)



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<b>III Year II Semester</b>	<b>TECHNICAL PAPER WRITING &amp; IPR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		2	0	0	0

**Course Objective :**

- The course will explain the basic related to writing the technical reports and understanding the concepts related to formatting and structuring the report.
- This will help students to comprehend the concept of proofreading, proposals and practice

**UNIT-I**

**Introduction:** An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing. **Planning and Structuring:** Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing.

**UNIT-II**

**Drafting report and design issues:** The use of drafts, Illustrations and graphics. **Final edits:** Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

**UNIT-III**

**Proofreading and summaries:** Proofreading, summaries, Activities on summaries. **Presenting final reports:** Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

**UNIT-IV Using word processor:**

Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes, Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros,

**UNIT-V**

**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of **Patenting and Development:** technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property



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**Text Books:**

1. Kompal Bansal & Parshit Bansal, “Fundamentals of IPR for Beginner’s”, 1<sup>st</sup> Ed., BS Publications, 2016.
2. William S. Pfeiffer and Kaye A. Adkins, “Technical Communication: A Practical Approach”, Pearson.
3. Ramappa, T., “Intellectual Property Rights Under WTO”, 2<sup>nd</sup> Ed., S Chand, 2015.

**Reference Books:**

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press (2006)

**E-resources:**

1. <https://www.udemy.com/course/reportwriting/>
2. <https://www.udemy.com/course/professional-business-english-and-technical-report-writing/>
3. <https://www.udemy.com/course/betterbusinesswriting/>



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**MINORS**

	<b>COMPUTER NETWORKS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To understand the different types of networks
- To discuss the software and hardware components of a network
- To develop an understanding the principles of computer networks.
- To familiarize with OSI model and the functions of layered structure.
- To explain networking protocols, algorithms and design perspectives.

**Course Outcomes (CO):**After completion of the course, students will be able to

- Identify the software and hardware components of a Computer network. (L1)
- Explain the functionality of each layer of a computer network. (L2)
- Identify and analyze flow control, congestion control, and routing issues. (L4)
- Analyze and interpret the functionality and effectiveness of the routing protocols. (L4)
- Choose the appropriate transport protocol based on the application requirements. (L3)

**UNIT-I**

**Introduction:** Types of Computer Networks, Broadband Access Networks, Mobile and Wireless Access Networks, Content Provider Networks, Transit networks, Enterprise Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship of Services to Protocols ,Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

**UNIT-II**

**The Data Link Layer:** Guided Transmission Media, Persistent Storage, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics, Data Link Layer Design Issues, Services Provided To The Network Layer, Framing Error Control, Flow Control, Error Detection And Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission And Receipt, Simplex Link-Layer Protocols, Improving Efficiency, Bidirectional Transmission, Multiple Frames In Flight, Examples Of Full-Duplex, Sliding Window Protocols, The Channel Allocation Problem, Static Channel Allocation, Assumptions For Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet, Classic Ethernet Physical Layer, Classic Ethernet Mac Sublayer Protocol, Ethernet Performance, Switched Ethernet,



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Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, 40- And 100-Gigabit Ethernet, Retrospective On Ethernet.

**UNIT-III**

**The Network Layer:** Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing Within a Network, Broadcast Routing, Multicast Routing, Anycast Routing, Traffic Management at The Network Layer, The Need for Traffic Management: Congestion, Approaches To Traffic Management, Internetworking, Internetworks: An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes: Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF—An Interior Gateway Routing Protocol, BGP—The Exterior Gateway Routing Protocol, Internet Multicasting.

**UNIT-IV**

**The Transport Layer:** The Transport Service, Services Provided To The Upper Layers, Transport Service Primitives, Berkeley Sockets, An Example Of Socket Programming: An Internet File Server, Elements Of Transport Protocols, Addressing, Connection Establishment, Connection Release, Error Control And Flow Control, Multiplexing, Crash Recovery, Congestion Control, Desirable Bandwidth Allocation, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction To UDP, Remote Procedure Call, Real-Time Transport Protocols, The Internet Transport Protocols: TCP, Introduction To TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

**UNIT-V**

**The Application Layer:** Electronic Mail, Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Server Farms and Web Proxies, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.



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**Textbook:**

1. Andrew Tanenbaum, Feamster Wetherall, Computer Networks, 6<sup>th</sup> Edition, Global Edition.

**Reference Books:**

1. Behrouz A. Forouzan, Data Communications and Networking, 5<sup>th</sup> Edition, McGraw Hill Publication, 2017.
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, 6<sup>th</sup> edition, Pearson, 2019.
3. YouluZheng, ShakilAkthar, “Networks for Computer Scientists and Engineers”, Oxford Publishers, 2016.

**Online Learning Resources:**

<https://nptel.ac.in/courses/106105183/25>

<http://www.nptelvideos.in/2012/11/computer-networks.html>

<https://nptel.ac.in/courses/106105183>



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	<b>INTRODUCTION TO CYBER SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- Understand the threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and its applications.

**Course Outcomes:**By the end of the course, the student should be able to:

- Differentiate among different types of security attacks.
- Define computer forensics.
- Identify the process in taking digital evidence.
- Describe how to conduct an investigation using methods of memory, operating system, network and email forensics with different forensic tools.

**UNIT-I**

**Introduction to Information Security Fundamentals and Best Practices:** Protecting Your Computer and its Contents, Securing Computer Networks--Basics of Networking, Compromised Computers, Secure Communications and Information Security Best Practices, Privacy Guidelines, Safe Internet Usage.

**UNIT-II**

**Ethics in Cyber Security & Cyber Law:** Privacy, Intellectual Property, Professional Ethics, Freedom of Speech, Fair User and Ethical Hacking, Trademarks, Internet Fraud, Electronic Evidence, Cybercrimes.

**UNIT-III**

**Penetration Testing:** Overview of the web from a penetration testers perspective, Exploring the various servers and clients, Discussion of the various web architectures, Discussion of the different types of vulnerabilities, defining a web application test scope and process, Defining types of penetration testing.



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**UNIT-IV**

**Web Application Security:** Common Issues in Web Apps, what is XSS, SQL injection, CSRF, Password Vulnerabilities, SSL, CAPTCHA, Session Hijacking, Local and Remote File Inclusion, Audit Trails, Web Server Issues. **Forensics & Network Assurance:** Forensic Technologies, Digital Evidence Collection, Evidentiary Reporting, Layered Defense, Surveillance and Reconnaissance, Outsider Thread Protection

**UNIT-V**

**Information Risk Management:** Asset Evaluation and Business Impact Analysis, Risk Identification, Risk Quantification, Risk Response Development and Control, Security Policy, Compliance, and Business Continuity. Forensic investigation using Access Data FTK, En-Case

**Cyber Incident Analysis and Response:** Incident Preparation, Incident Detection and Analysis. Containment, Eradication, and Recovery. Proactive and Post-Incident Cyber Services, CIA triangle

**Text Books:**

1. Cyber Security & Digital Forensics by Anas Zakir, Clever Fox Publishing, Publication Date- 2022
2. “Beginners Guide To Ethical Hacking and Cyber Security “, by Abhinav Ojha, Khanna Publishers, First Edition, Publication Date-2023

**Reference Books:**

1. The Official CHFI Study Guide for Computer Hacking Forensic Investigator by Dave Kleiman
2. CISSP Study Guide, 6th Edition by James M. Stewart



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	<b>CRYPTOGRAPHY &amp; NETWORK SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand the basic categories of threats to computers and networks
- Discusses the Mathematics of Cryptography
- Discuss the fundamental ideas of Symmetric and Asymmetric cryptographic Algorithms
- Discusses the Network layer, Transport Layer and Application layer Protocols Enhanced security mechanisms

**Course Outcomes:** At the end of the course, student will be able to

<b>CO</b>	<b>Course Outcomes</b>	<b>Knowledge Level (K)#</b>
<b>CO1</b>	Student will be able to understand security issues related to computer networks and learn different symmetric key techniques	<b>K2</b>
<b>CO2</b>	Students will be able learn mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	<b>K3</b>
<b>CO3</b>	Students will be able learn different types of symmetric and Asymmetric algorithms	<b>K3</b>
<b>CO4</b>	Students will be able learn different algorithms of Hash functions, message authentication and digital signature and their importance to the security	<b>K4</b>
<b>CO5</b>	Students will be able learn different Enhanced security protocols of Application Layer, Transport Layer and Network layer	<b>K4</b>

**#Based on suggested Revised BTL**



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**Mapping of course outcomes with program outcomes**

	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
C O1	1	2	1	2	1	1	1	1		1		2	2	2	2
C O2	3	1	1	2	2	2	1	2		3	3	2	3	2	1
C O3	2	2	2	1	2	1	1	1		2		3	1		
C O4	3	2	3	2	3	2	1	1		2	1	2	2	1	
C O5	3	2	3	1	2	2	1	1		2	2	2	1	2	1

(Please fill the above with Levels of Correlation, viz., L-1, M-2, H-3)

**UNIT-I**

**Security Concepts:** Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography. Classical Encryption Techniques-symmetric cipher model, Substitution techniques, Transposition techniques, Rotor Machines, Stenography.

**UNIT-II**

**Introduction to Symmetric Cryptography: Algebraic Structures-**Groups, Rings, Fields,  $GF(2^n)$  fields, Polynomials. **Mathematics of Asymmetric cryptography:** Primes, Checking For Primness, Eulers phi-functions, Fermat’s Little Theorem, Euler’s Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation And Logarithm.

**UNIT-III**

**Symmetric key Ciphers:** Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5. **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.



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**UNIT-IV**

**Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA). **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S, MAC'S Based on Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC. **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Scheme, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

**UNIT-V**

**Network and Internet Security: Transport-Level Security:** Web Security Considerations, Transport Level Security, HTTPS, SSH. **IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Authentication Header Protocol. **Electronic-Mail Security:** Internet-mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.

**Text Books:**

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
2. Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill, 3rd Edition, 2015

**Reference Books:**

1. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3. Modern Cryptography: Theory and Practice By Wenbo Mao. Pearson



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	<b>BLOCKCHAIN TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

## Course Objectives:

- To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
- To understand public block chain system, Private block chain system and consortium block chain.
- Able to know the security issues of blockchain technology.

## UNIT – I

**Fundamentals of Blockchain:** Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

**Blockchain Types and Consensus Mechanism:** Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. **Cryptocurrency:** Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

## UNIT – II

**Public Blockchain System:** Introduction, Public Blockchain, Popular Public Blockchains,

The Bitcoin Blockchain, Ethereum Blockchain. **Smart Contracts:** Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

## UNIT – III

**Private Blockchain System:** Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. **Consortium Blockchain:** Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. **Initial Coin Offering:** Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.



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**UNIT – IV**

**Security in Blockchain:** Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

**Applications of Blockchain:** Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

**UNIT – V:**

Blockchain Case Studies:

Case Study 1 – Retail,

Case Study 2 – Banking and Financial Services,

Case Study 3 – Healthcare,

Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

**Text book:**

1. “Block chain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

**Reference Books:**

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley



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	<b>CLOUD COMPUTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To explain the evolving utility computing model called cloud computing.
- To introduce the various levels of services offered by cloud.
- To discuss the fundamentals of cloud enabling technologies such as distributed computing, service-oriented architecture and virtualization.
- To emphasize the security and other challenges in cloud computing.
- To introduce the advanced concepts such as containers, serverless computing and cloud-centric Internet of Things.

**UNIT -I**

Introduction to Cloud Computing Fundamentals, Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

**UNIT-II**

Cloud Enabling Technologies, Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

**UNIT-III**

Virtualization and Containers, Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.



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**UNIT-IV**

Cloud computing challenges, Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

**UNIT -V**

Advanced concepts in cloud computing, Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

**Text Books:**

1. Mastering Cloud Computing, 2<sup>nd</sup> edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, McGraw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

**Reference Books:**

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2<sup>nd</sup> edition, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)



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	<b>CYBER SECURITY LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**Course Objective:** To get practical exposure to Cybersecurity threats and Forensics tools.

**Course Outcome:**

- Get the skill to identify cyber threats/attacks.
- Get the knowledge to solve security issues in day-to-day life.
- Able to use Autopsy tools
- Perform Memory capture and analysis
- Demonstrate Network analysis using Network miner tools

**List of Experiments:**

1. Perform an Experiment for port scanning with nmap
2. Set up a honeypot and monitor the honeypot on the network
3. Install Jscript/Cryptool tool (or any other equivalent) and demonstrate Asymmetric, Symmetric crypto algorithm, Hash and Digital/PKI signatures.
4. Generate minimum 10 passwords of length 12 characters using openssl command
5. Perform practical approach to implement Footprinting - Gathering target information using Dmitry-Dmagic, UA tester
6. Work with sniffers for monitoring network communication (Wireshark).
7. Using Snort, perform real-time traffic analysis and packet logging.
8. Perform email analysis using the Autopsy tool.
9. Perform Registry analysis and get boot time logging using process monitor tool
10. Perform File type detection using Autopsy tool
11. Perform Memory capture and analysis using FTK imager tool
12. Perform Network analysis using the Network Miner tool

**Text Books:**

1. Real Digital Forensics for Handheld Devices, E.P. Dorothy, Auerback Publications, 2013.
2. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, J. Sammons, Syngress Publishing, 2012.

**Reference Books:**

1. Handbook of Digital Forensics and Investigation, E. Casey, Academic Press, 2010.
2. Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides, C.H. Malin, E. Casey and J.M. Aquilina, Syngress, 2012.
3. The Best Damn Cybercrime and Digital Forensics Book Period, J. Wiles and A. Reyes, Syngress, 2007.



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	<b>CRYPTOGRAPHY &amp; NETWORK SECURITY LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>

**Course Objectives:**

- To learn basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
- To understand and implement encryption and decryption using Ceaser Cipher, Substitution Cipher, Hill Cipher.

**List of Experiments:**

1. Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should AND or and XOR each character in this string with 127 and display the result
3. Write a Java program to perform encryption and decryption using the following algorithms:
  - a) Ceaser Cipher
  - b) Substitution Cipher
  - c) Hill Cipher
4. Write a Java program to implement the DES algorithm logic
5. Write a C/JAVA program to implement the BlowFish algorithm logic
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Using Java Cryptography, encrypt the text "Hello world" using BlowFish. Create your own key using Java key tool.
8. Write a Java program to implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.



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## OPEN ELECTIVES

	<b>JAVA PROGRAMMING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### Course Objectives:

The learning objectives of this course are to:

- Identify language components and how they work to get her in applications
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with in heritance and dynamic binding and how to use exception handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java APIs for program development

### UNIT I

**Object Oriented Programming:** Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

**Data Types, Variables, and Operators :**Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final,**Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement ( - - ) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators. **Control Statements:** Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator ?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

### UNIT II

**Classes and Objects:** Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded ConstructorMethods, NestedClasses, FinalClassandMethods, Passing ArgumentsbyValue and by Reference, Keyword this. **Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.



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### **UNIT III**

**Arrays:** Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. **Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. **Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

### **UNIT IV**

**Packages and Java Library:** Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, RandomClass, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. **Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

**Java I/O and File:** Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

### **UNIT V**

**String Handling in Java:** Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer. **Multithreaded Programming:** Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication-Suspending, Resuming, and Stopping of Threads. **Java Database Connectivity:** Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface. **Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)



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**TextBooks:**

1. JAVAonestepahead, AnithaSeth, B.L.Juneja,Oxford.
2. Joy with JAVA,Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA9forProgrammers,PaulDeitel,HarveyDeitel,4<sup>th</sup>Edition,Pearson.

**ReferencesBooks:**

1. ThecompleteReferenceJava,11<sup>th</sup>edition,HerbertSchildt,TMH
2. IntroductiontoJavaprogramming, 7<sup>th</sup>Edition, YDanielLiang, Pearson

**Online Resources:**

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012880464547618816347\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview)



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	<b>OPERATING SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for dead lock and their possible solutions.

**UNIT-I**

**Operating Systems Overview:** Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

**UNIT-II**

**Processes:** Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

**UNIT– III**

**Synchronization Tools:** The Critical Section Problem, Peterson’s Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

**UNIT-IV**

**Memory-Management Strategies:** Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.



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**UNIT-V**

**File System:** File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File- System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

**TextBooks:**

1. Operating System Concepts, Silberschatz A, Galvin P B, Gagne G, 10<sup>th</sup> Edition, Wiley, 2018.
2. Modern Operating Systems, Tanenbaum AS, 4<sup>th</sup> Edition, Pearson, 2016

**ReferenceBooks:**

1. Operating Systems-Internals and Design Principles, Stallings W, 9<sup>th</sup> edition, Pearson, 2018
2. Operating Systems: A Concept Based Approach, D.MDhamdhere, 3<sup>rd</sup> Edition, McGraw- Hill, 2013

**Online Learning Resources:**

1. <https://nptel.ac.in/courses/106/106/106106144/>  
<http://peterindia.net/OperatingSystems.html>



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	<b>DATABASE MANAGEMENT SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Data base language
- Demonstrate the principles behind systematic data base design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

**UNIT-I**

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Threetier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

**UNIT-II**

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASICSQL: Simple Databaseschema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

**UNIT-III**

SQL: Basic SQL querying (select andproject) using where clause, arithmetic& logical operations, SQL functions (Date and Time, Numeric, String conversion). Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(uptable andnon-uptable), relational set operations.



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**UNIT-IV**

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Loss less join and dependency preserving decomposition, (1NF, 2NF and 3NF), concept of surrogate key, Boyce-Codd normal form (BCNF), MVD, Fourth normal form (4NF), Fifth Normal Form (5NF).

**UNIT-V**

Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Introduction to Indexing Techniques: B+ Trees, operations on B+ Trees, Hash Based Indexing:

**Text Books:**

- 1) Database Management Systems, 3<sup>rd</sup> edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
- 2) Database System Concepts, 5<sup>th</sup> edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

**Reference Books:**

- 1) Introduction to Data base Systems, 8<sup>th</sup> edition, CJ Date, Pearson.
- 2) Database Management System, 6<sup>th</sup> edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
- 3) Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

**Web-Resources:**

- 1) <https://nptel.ac.in/courses/106/105/106105175/>
- 2) [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01275806667282022456\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview)



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	<b>COMPUTER NETWORKS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course Objectives:**

- To understand the different types of networks
- To discuss the software and hardware components of a network
- To develop an understanding the principles of computer networks.
- To familiarize with OS Model and the function so layered structure.
- To explain networking protocols, algorithms and design perspectives.

**Course Outcomes(CO):**

After completion of the course, students will be able to

- Identify the software and hardware components of a Computer network.(L1)
- Explain the functionality of each layer of a computer network.(L2)
- Identify and analyze flow control, congestion control, and routing issues.(L4)
- Analyze and interpret the functionality and effectiveness of the routing protocols. (L4)
- Choose the appropriate transport protocol based on the application requirements.(L3)

**UNIT-I**

**Introduction:** Types of Computer Networks, Broadband Access Networks, Mobile and Wireless Access Networks, Content Provider Networks, Transit networks, Enterprise Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship of Services to Protocols, Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

**UNIT-II**

**The Data Link Layer:** Guided Transmission Media, Persistent Storage, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics, Data Link Layer Design Issues, Services Provided To The Network Layer, Framing Error Control, Flow Control, Error Detection And Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission And Receipt, Simplex Link-Layer Protocols, Improving Efficiency, Bidirectional Transmission, Multiple Frames In Flight, Examples Of Full-Duplex, Sliding Window Protocols, The Channel Allocation Problem, Static Channel Allocation, Assumptions For Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet, Classic Ethernet Physical Layer, Classic Ethernet Mac Sublayer Protocol, Ethernet Performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, 40- And 100-Gigabit Ethernet, Retrospective On Ethernet.



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**R23 B.Tech Cyber Security**  
**(R23 – III<sup>rd</sup> YEAR COURSE STRUCTURE & SYLLABUS)**

**UNIT-III**

**The Network Layer:** Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing Within a Network, Broadcast Routing, Multicast Routing, Anycast Routing, Traffic Management at The Network Layer, The Need for Traffic Management: Congestion, Approaches To Traffic Management, Internetworking, Internetworks: An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes: Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF—An Interior Gateway Routing Protocol, BGP—The Exterior Gateway Routing Protocol, Internet Multicasting.

**UNIT-IV**

**The Transport Layer:** The Transport Service, Services Provided To The Upper Layers, Transport Service Primitives, Berkeley Sockets, An Example Of Socket Programming: An Internet File Server, Elements Of Transport Protocols, Addressing, Connection Establishment, Connection Release, Error Control And Flow Control, Multiplexing, Crash Recovery, Congestion Control, Desirable Band width Allocation, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction To UDP, Remote Procedure Call, Real-Time Transport Protocols, The Internet Transport Protocols: TCP, Introduction To TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

**UNIT-V**

**The Application Layer:** Electronic Mail, Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Server Farms and Web Proxies, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.



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**KAKINADA –533003(A.P)INDIA**

**Textbook:**

1. Andrew Tanenbaum, Feamster Wetherall, Computer Networks, 6<sup>th</sup> Edition, Global Edition.

**Reference Books:**

1. Behrouz A. Forouzan, Data Communications and Networking, 5<sup>th</sup> Edition, McGraw Hill Publication, 2017.
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, 6<sup>th</sup> edition, Pearson, 2019.
3. Youlu Zheng, Shakil Akthar, “Networks for Computer Scientists and Engineers”, Oxford Publishers, 2016.

**Online Learning Resources:**

<https://nptel.ac.in/courses/106105183/25>  
<http://www.nptelvideos.in/2012/11/computer-networks.html> <https://nptel.ac.in/courses/106105183/>