Bachelor of Technology

(Computer Science and Engineering – Cloud Technology and Information Security)

Program Outcomes (POs)

- **PO1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

- **PO2: Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **PO3: Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- **PO4: Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

- **PO5: Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

- **PO6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- **PO7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **PO9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- **PO12: Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

- **PO13:** Introspect and evolve into dynamic and creative individuals capable of socially productive, constructive actions that positively impact our Nation and the World at large.

Program Specific Outcomes (PSOs)

➢ **PSO1:** To leverage the use of cloud technology against different kinds of software solutions.

➢ **PSO2:** Demonstrate proficiency in using advanced tools and techniques to implement information and cyber security solutions.

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Course Outcomes (COs)

2017-2021 Batch

Semester	SubName	SubCode	Course Outcomes	Course Outcomes
2017 Batch - CTIS -3 SEM	Mathematics for Computer Science		CO1	Solve logical reasoning to verify the correctness of the logical statements and Perform set operations to describe the languages.
			CO2	Apply the concepts of relations, partially ordered sets and lattices in relational data bases and data structures.
			CO3	Analyze the concepts of graphs to understand Mathematical structures and techniques in computer applications.
			CO4	Understand and apply the foundations of probabilistic and statistical analysis mostly used in various applications in engineering and computer sciences.
			CO5	Apply the concept of random variables, Distributions and its properties to analyze the statistical data.
	Economics for Engineers		CO1	Describe the fundamental theories and principles used in Engineering Economics and Management and to some extent are able to compare and evaluate them
			CO2	Learn, compare and apply various cost concepts and analysis techniques
			CO3	Select a business plan for an entrepreneurship project using economics and Management fundamentals
			CO4	Apply the knowledge and techniques, skills and methods to become successful project

			leaders
		CO5	Apply professional ethical principles and corporate social responsibility concepts in personal, financial and economic decisions for sustainable growth and development
		CO6	Analyze and think through basic economic problems of our country
Data Structures and Algorithms		CO1	Describe linear data structures using array and linked list
		CO2	Apply data structures like stacks, queues in linear data structure
		CO3	Discuss non-linear data structures tree and its application
		CO4	Apply various algorithms in graph
		CO5	Solve searching, sorting and hashing techniques in data structures
		CO6	Interpret sorting algorithms for a give problem
Computer Architecture and Organization		CO1	Discuss basic structure of computer and demonstrate the execution of an instructions by CPU.
		CO2	Compute computer arithmetic operations and implement algorithms for fixed point and floating point arithmetic operations.
		CO3	Manipulate the control unit operations and to choose different factors to design central processing unit.
		CO4	Classify different ways of data transfer in computer.
		CO5	CO5 :Contrast the working of different memories by studying memory hierarchy and organization.
Object oriented programming with JAVA		CO1	Implement Object Oriented Programming concepts
		CO2	Design a GUI using Java

				programs and Applets
			CO3	Implement Network based applications using I/O Streams
			CO4	Develop Multithreaded Applications
			CO5	Creating Custom Packages and Interfaces.
	Data Structures and Algorithms Lab		CO1	Compare various kinds of searching and sorting techniques
			CO2	Construct Linear and nonlinear data structures using arrays and linked list
			CO3	Develop Programs employing dynamic memory management
			CO4	Choose appropriate data structure to solve various computing problems
			CO5	Originate hash tables and collision resolution Techniques
			CO6	Identify suitable data structure and algorithm to solve a real world problem
	Object Oriented Programming with JAVA Laboratory		CO1	Apply appropriate OOPS concepts for the given problem
			CO2	Create custom packages and Interfaces.
			CO3	Design GUI using Applets and Java
			CO4	Implement Multithreading applications
	Energy Studies		CO1	Discuss energy scenario and its importance to the society.
			CO2	Recommend few energy management and energy conservation techniques in daily life.
			CO3	interpret energy policies.
			CO4	Discuss emerging technologies importance in today's energy scenario
2017 Batch - CTIS -4 - SEM	Operating Systems Building Blocks		CO1	Analyze the structure of OS and basic architectural components involved in OS design.
			CO2	Analyze and design the applications to run in parallel either using process or

				thread models of different OS.
			CO3	Analyze the various device and resource management techniques for timesharing and distributed systems.
			CO4	Understand the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
			CO5	Interpret the mechanisms adopted for file sharing in distributed Applications.
			CO6	Conceptualize the components involved in designing a contemporary OS
	Relational Data Base Management System		CO1	Understand any commercial database system architecture
			CO2	Design the data and ER model for given problem and apply the normalization techniques to optimize the logical database
			CO3	Develop the relational and SQL queries for the any given application
			CO4	Build the PL/SQL programs to access the database
	Computer Networks		CO1	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
			CO2	Analyse and compare data link, network, and transport layer protocols
			CO3	Design and implement data link or network layer protocols within a simulated networking environment
			CO4	Analyse various related technical, administrative and social aspects of specific computer network protocols from standards documents and other primary materials found through research
	Information		CO1	Understand the basic

Security - Kidiyppa sir			concepts and importance of information Security for an individual and to organization/Enterprise
		CO2	Analyze the security threats and attacks information assets and enterprise networks face
		CO3	Interpret the risks involved using various risk assessment techniques.
		CO4	Analyze the use of network security devices like firewalls, IDS and IPS to build the defense in depth
Software Engineering		CO1	Apply software engineering principles and techniques to build software.
		CO2	Develop, maintain and evaluate large-scale software systems, and produce efficient, reliable, robust and cost-effective software solutions.
		CO3	Use metrics for software quality and risk management.
		CO4	Able to understand and meet ethical standards and legal responsibilities in software development.
Business Communication and Presentation skills		CO1	Overcome common obstacles in public speaking
		CO2	Demonstrate critical and innovative thinking.
		CO3	Display complete in oral, written and visualization
		CO4	Understand the importance of research in developing your topic.
		CO5	Use resources to gather information effectively
Relational Data Base Management Systems – Lab		CO1	Apply Data Definition Language, Data Manipulation Language, Data Control Language and Transaction Control Language commands on sample database.
		CO2	Create a Student database with necessary constraints and to get it populated with the data.

			CO3	Execute simple and complex queries on Student Database.
			CO4	Create Employee database with necessary constraints, populate it with the data and to execute queries on the database.
			CO5	Create Library database with necessary constraints, populate it with the data and to execute queries on the database.
			CO6	Demonstrate the learned concepts through exhibiting a mini project
	Operating Systems Building Block - Lab		CO1	Use basic UNIX/Linux commands from the command line.
			CO2	Use files and processes on a Linux machine
2017 Batch - CTIS -5 SEM	Principles of Virtualization		CO1	Installing and configuring the SDDC using VMware products.
			CO2	Implementing Fault tolerance and High availability for the Virtual machines
			CO3	Securing the Virtual environment.
			CO4	Resource Optimization and monitoring
	Storage Management		CO1	Recognize the storage devices and network level components for storage management
			CO2	Understand and Build the storage in infrastructure.
			CO3	Compare and contrast Storage Technologies such as SAN NAS and CAS
			CO4	Provide the solutions for backup and recovery of data, manage and monitor a data storage infrastructure
	Network Security		CO1	Understand the need of networks and hence network security
			CO2	Understand and analyze standard security implementations at various network layers

		CO3	Analyze and validate solutions to computer network security challenges using common network security tools and formal methods.
		CO4	Design and Implement security controls for network.
Cryptography		CO1	Build secure communications/ storage of information using encryption/decryption algorithms.
		CO2	Analyze which cryptographic technique/algorithm to use for certain scenarios
		CO3	Use the learnt algorithms in securing information assets while in storage or transit.
Installation and configuration of Server		CO1	Recognize and explore various services provided by windows server
		CO2	Analyze and apply centralized services with client nodes of the network
		CO3	Recognize the importance of Domain Name services in the server network infrastructure
		CO4	Justify the minimal management and attain improved performance with Hyper v client
Data Center		CO1	Understand a datacenter, its architecture and various component associated with it.
		CO2	Analyze and identify requirements for setting up a Data center based on business needs
		CO3	Design a Datacenter based on various guidelines which can be maintained effectively
		CO4	Understand and implement the disaster recovery model for datacenters
Principles of Virtualization		CO1	CO1: Install and configure VMware ESXi server and vCenter

	Lab		CO2	CO2: Create and Manage Virtual Machines connected with Virtual Networks
			CO3	CO3: Manage the Storage requirements in Virtual environments
			CO4	CO4: Design and Manage Cloud applications
			CO5	CO5: Deploy a private cloud with help of open source cloud management software.
	Installation and configuration of Server Lab		CO1	CO1: Installation of wirndoes server
			CO2	CO2: Configuration of windos server
			CO3	CO3: Manage the Storage requirements in server
			CO4	CO4: Filesharing in server
			CO5	CO5: Creating and cofiuring virtual machine/servers.
2017 Batch - CTIS -6 SEM	Cloud Technology		CO1	Compare various services and deployment models of cloud computing
			CO2	Distinguish the services offered by various cloud service providers and find the feasible /optimal solution for a given business scenario
			CO3	Recognize the cloud governance solution and legal issues of cloud
			CO4	Interpret how the cloud management strategies helps in achieving business goals
	Enterprise Network Engineering		CO1	Understand the Networking basics and Architecture
			CO2	Configuring networking devices such as switches, routers, VLAN etc.,
			CO3	Analyze and configure networking protocols
			CO4	Design, build and troubleshoot enterprise level network infrastructure
	Database Security		CO1	Understand database technologies and their security needs

			CO2	Understand applying permissions and encryption on databases.
			CO3	Understand authentication and authorization on databases.
			CO4	Analyze and design security for databases.
			CO5	Apply all security concepts for securing databases.
			CO6	Audit and trace user events and manage the polices in SQL server.
	Ethical Hacking		CO1	To understand the ethical hacking methodology.
			CO2	Learn different tools and techniques to be used in the different hacking stages.
			CO3	Perform Foot-printing, scanning and enumeration using tools to identify vulnerabilities.
			CO4	Analyze and use different exploitation techniques to hack into target systems and networks.
			CO5	Hack, gain and maintain access into a compromised network or system.
			CO6	Understand the legal implications of hacking in India.
	Elective 1 - Big Data Analytics		CO1	Understand the concept of BigData and Hadoop
			CO2	Understand the internals of MapReduce and YARN
			CO3	Write MapReduce job for word count
			CO4	Create one node Hadoop cluster
	Elective 1 - Machine learning		CO1	Understand the different machine learning techniques and its application.
			CO2	Understand the importance of simple linear regression in predicting new observations.
			CO3	Understand the importance of assumptions in estimating the parameters in simple linear regression analysis.

			CO4	Understand the important multiple linear regression in predictive techniques and its assumptions.
			CO5	Understand the effect of model assumptions in estimating the coefficients in multiple linear regression analysis.
			CO6	Predict the binary class variable using decision tree and random forest.
			CO7	Understand the importance of Logistic regression over decision tree and random forest.
			CO8	Differentiate the importance of SVM over SVR and its application situations.
			CO9	Understand the important concepts of neural networks and its prediction techniques.
			CO10	Apply the assessment method to find the better fit model for classification techniques.
	Elective-1 Data Mining		CO1	Know the important concepts on data types and data quality measures.
			CO2	Know the important data pre-processing techniques for data mining process.
			CO3	Know the decision tree and ensemble methods and their business application.
			CO4	Know the concepts of neural network and SVM for binary class and continuous variable.
			CO5	Know the algorithm related to association analysis and cluster analysis.
	Elective-II Information Security Governence		CO1	Understand governance, IT governance and information security governance.
			CO2	Learn and understand various industry standards for IT and Information security governance.

			CO3	Use these industry standards to create governance frameworks for organizations.
			CO4	Analyze and Apply risk management principles to handle security incidents.
			CO5	Apply the principles and concepts learnt to develop security architecture and security governance frameworks.
			CO6	Analyze and apply the concepts of ISG on new age IT technologies like cloud, mobile and AI.
	Elective 2 - Applcation web security - Archana		CO1	explain how security is integrated into software development
			CO2	articulate the importance of security principles in protecting web applications from vulnerabilities, exploits and attacks
	Elective-II Disaster Recovery & Business Continuity Management		CO1	Understand the need of Business Continuity Plan and Disaster Recovery Plan.
			CO2	Learn industry standards for creating contingency strategies.
			CO3	Analyze incidents, plan and develop Recovery Strategies.
			CO4	Plan testing and training exercises for business continuity
			CO5	Create information systems contingency plan with BCP and DRP for different incident scenario's
			CO6	Maintain and manage BCP's and DRP's.
	Enterprise Network Engineering Lab		CO1	Analyze the differences between switches and routers and their configurations.
			CO2	Execute various network protocols DHCP, OSPF, EIGRP, Static and Dynamic Routing protocols.

	Ethical hacking Laboratory		CO1	To identify different terminologies of hacking.
			CO2	To differentiate between the types of testing.
			CO3	To illustrate wireless hacking.
			CO4	To understand about the firewall and its types.
			CO5	To illustrate network penetration testing.
2017 Batch - CTIS -7 SEM	Elective 3 - Cloud Deployment Management		CO1	Understand an open source cloud development environment - openstack
			CO2	Realize the services like keystone, neutron etc., provided by openstack
			CO3	Configure the services provided by openstack to implement private cloud.
			CO4	Maintain and manage the openstack services
			CO5	Configure the services and deploy the instances using GUI.
			CO6	Configure the advanced services using Command Line Interface.
	Cloud Deployment Management Lab		CO1	Analyze authentication, confidentiality and privacy issues in cloud computing.
			CO2	Identify security implications in cloud computing.
			CO3	Understand the importance of protocols and standards in management for cloud services
			CO4	applying data security in cloud
	Elective -III Cloud Web Services		CO1	Identify and recognize various cloud services available on a given cloud and provision various IT services at different deployment models.
			CO2	Analyze and suggest the optimal / best web services for the respective service requirements
			CO3	Compare and contrast various cloud web services

			and utilize them to minimize cloud cost for a business organization.
		CO4	Identify and illustrate the steps and techniques to migrate the cloud web services
Cloud Web Services lab		CO1	Creating Amazon cloud front
		CO2	Understand Amazon Dynamo DB
		CO3	Understanding Amazon Machine Learning
		CO4	Creating AWS Database Migration Service
Elective -III Infrastructure Solution on Cloud		CO1	Understand the difference between open source and azure cloud
		CO2	Recognize the various services of azure
		CO3	Deploy the virtual machines and access from RDP
		CO4	Develop and deploy the application using .Net framework in azure
Elective 3 - Infrastructure Solution on Cloud lab		CO1	CO1: Create a Windows Azure Account, Virtual Machines and install Windows server images
		CO2	CO2: Manage website applications on Azure platform
		CO3	CO3: Perform Database migration
		CO4	CO4: Create storage accounts
Elective 4 - Cyber Forensics & Investigation		CO1	Learn and Understand the computer forensics procedures, tools and techniques.
		CO2	Understand the build and working of storage devices and memory types and their forensic implications.
		CO3	Apply the forensics procedure and investigate different kinds of machines, operating systems and computer networks as well.
		CO4	Investigate servers, devices, applications and any communication to collect evidence in case of attacks and data breaches.

		CO5	Prepare evidence collected in a way it can be presented in the court of law.
		CO6	Design and conduct investigative procedures for any kind of cyber-crimes.
Cyber Forensics & Investigation Lab		CO1	Creation of disk and memory images for forensic investigation purposes
		CO2	Recovery of Data with hard drive, pen drive.
		CO3	Analyze the contents of images, windows registry and recovered data to gather evidence.
		CO4	Knowing about password and encryption.
Open Elective IV Security Architecture		CO1	Realize the importance of creating security architecture for an enterprise.
		CO2	Relate fundamental concepts of information and network security in designing security architecture
		CO3	Apply their understanding of security principles in building a sustainable security architecture
		CO4	Use industry recognized frameworks like SABSA to create enterprise security architecture.
		CO5	Articulate the importance of managing the security architecture using policies, processes and framework for effective and efficient security.
		CO6	Manage security architecture using best practices and enforcing compliance.
Security Architecture Lab		CO1	Undertanding the Installation of Check Point security management server
		CO2	Understaning the configuration Check Point security management server
		CO3	Understanding Windows and Linux server hardening with the security configured wizard

		CO4	Understaning how to bypass SQL database server and privilege escalation
		CO5	Applying Webserver security testing using Kali Linux
Elective –IV Server Security Management		CO1	Relate fundamental concepts of information security in securing servers
		CO2	Understand and harden different servers using basic configuration.
		CO3	Identify techniques of securing servers based on risk assessment.
		CO4	Use threat modelling techniques to identify threats to servers.
		CO5	Apply security principles and controls in protecting windows and Linux servers .
		CO6	Secure database servers – SQL server and web servers
Elective –V Security Analytics		CO1	Rationalize the need for and importance of Data Analytics in Security
		CO2	Understand basic statistical methods used in security analytics.
		CO3	Use these analytical methods to analyse security incidents
		CO4	Understand the big data techniques to detect malware and identify threats.
		CO5	Use machine learning concepts detecting attacks and data breaches.
Elective –V Latest Trends in Information Security		CO1	Perform deployment and basic management of Exchange Server
		CO2	Create and manage various recipient objects in Exchange Server.
		CO3	Configure client connectivity to Exchange Server and manage Client Access services.
		CO4	Implement and maintain high availability.

		CO5	Monitor and troubleshoot Exchange Server.	
		CO6	Secure and maintain Exchange Server.	
Elective –VI Hybrid Cloud Computing		CO1	Understand and identify the various services of Hybrid Cloud and its Management	
		CO2	Manage and Integrate Data, Workloads and deployment of application on Cloud.	
		CO3	Execute the Hybrid Cloud computing techniques in Azure cloud.	
		CO4	Plan for Hybrid cloud strategy and manage resources following the best practices.	
		CO5	Implement Azure virtual network and contrast supporting services relate to networking.	
		CO6	Recognize the importance of Disaster Management in cloud computing and integration of On-Premises Services with Cloud Services.	
Open Elective-I Information Security		CO1	Understand the basic concepts and importance of information Security for an individual and to organization/Enterprise.	
		CO2	Analyze the security threats and attacks information assets and enterprise networks face.	
		CO3	Interpret the risks involved using various risk assessment techniques.	
		CO4	Analyze the use of network security devices like firewalls, IDS and IPS to build the defense in depth.	
Open Elective-I Cryptography		CO1	Build secure communications/ storage of information using encryption/decryption algorithms.	
		CO2	Analyze which cryptographic technique/algorithm to use for certain scenarios	

			CO3	Use the learnt algorithms in securing information assets while in storage or transit.
	Open Elective-II Cloud Technology		CO1	Compare various services and deployment models of cloud computing
			CO2	Distinguish the services offered by various cloud service providers and find the feasible /optimal solution for a given business scenario
			CO3	Recognize the cloud governance solution and legal issues of cloud
			CO4	Interpret how the cloud management strategies helps in achieving business goals
	Open Elective-II Basics of Virtualization		CO1	Explain Virtualization concepts and identify various challenges in typical data center.
			CO2	Understand need for Virtualization and Virtualization Technologies
			CO3	Deploy and manage an Enterprise Desktop Virtualization Environment
			CO4	Configure and manage virtual networks, virtual storage and virtual machine management
			CO5	Understand various parameters required to design the virtual infrastructure and adopt security techniques to protect the infrastructure
	Internship /Project Work-II		CO1	CO1 :Apply knowledge to identify, gather information to analyze and formulate the problem definition for project through detailed investigation.
			CO2	CO2 :Implement and demonstrate the defined project using appropriate tools
			CO3	CO3 :Recommend sustainable solution/system for the betterment of the society, with scope for enhancement and

				continue life-long learning.
			CO4	CO4 :Defend the project through effective presentation with professional ethics as an individual or a member of a team
			Co5	CO5 :Make the implemented work to be published in reputed journals
2017 Batch - CTIS -8 SEM	Open elective – III Network Security		CO1	Understand the need of networks and hence network security
			CO2	Understand and analyze standard security implementations at various network layers
			CO3	Analyze and validate solutions to computer network security challenges using common network security tools and formal methods.
			CO4	Design and Implement security controls for network
	Open elective – III Cloud Security		CO1	To understand common security threats to the cloud environment.
			CO2	To Understand legal, regulatory and compliance aspects concerning cloud
			CO3	To Analyse security issues in cloud data, platforms, operations and virtualization.
			CO4	To secure cloud-based applications and mitigate risk.
			CO5	To design and develop security controls for data and infrastructure services on cloud
			CO6	To recommend cloud service providers based on security, legal and compliance issues
	Open elective IV Storage Management and Datacenter		CO1	Recognize the storage devices
			CO2	Explain data center architecture and its requirements
			CO3	Illustrate the storage at network level

			CO4	List and explain types of storage in infrastructure
			CO5	Compare and contrast SAN NAS and CAS
			CO6	Explain Server Farms and Services associated with it.
			CO7	Explain business continuity and disaster recovery fundamentals.
	Open Elective – IV Cloud Web Services		CO1	Identify and recognize various cloud services available on a given cloud and provision various IT services at different deployment models.
			CO2	Analyze and suggest the optimal / best web services for the respective service requirements
			CO3	Compare and contrast various cloud web services and utilize them to minimize cloud cost for a business organization.
			CO4	Identify and illustrate the steps and techniques to migrate the cloud web services