

SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
415511	Deep Learning Major(Core) Theory		4
	<p>Course Outcomes: Learners will be able to:</p> <ul style="list-style-type: none"> • Demonstrate the ability to implement a perceptron, understanding the input features, weights, bias, and the activation function. • Understanding Deep Learning, Activation Functions, Forward Propagation • Explore convolution operations, including padding, stride, and batch processing. Implement a convolution layer and a pooling layer in TensorFlow • Explore different RNN architectures, including one-to-one, one-to-many, many-to-one, and many-to-many. Implement and train RNNs. • Understand various types of autoencoders, including standard, sparse, denoising, contractive, and variational autoencoders. 		
Module 1	Introduction to Deep Learning		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Understanding how to build a perceptron involves defining the input features, weights, bias, and the activation function. • Discussing the limitations of a single-layer perceptron, such as its inability to learn non-linear relationships. • Description of the structure of artificial neural networks, including input layer, hidden layers, and output layer. • Overview of activation functions that introduce non-linearity, enabling neural networks to learn complex patterns. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Perceptron: What is a Perceptron? Implementing perceptron, Introducing & Implementing Weights & Bias, Multilayer Perceptron, Limitations of perceptron. • Introduction to Deep Learning: What is deep learning? Biological and artificial neurons, ANN and its layers, Input layer, Hidden layer, Output layer, exploring activation functions, the sigmoid function, the tanh function, The Rectified Linear Unit function, The leaky ReLU function, The Swish function, The softmax function, Forward propagation in ANN, How does ANN learn? 	
Module 2	Convolutional Neural Networks:		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Analyse how TensorFlow represents computations as directed acyclic graphs (DAGs). • Understanding the concept of sessions for executing operations in a TensorFlow graph. • Analyse General architecture of CNN Comprising convolutional layers, pooling layers, and fully connected layers • Implementing a Convolution Layer, Pooling Layer 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Getting to Know TensorFlow • What is TensorFlow? Understanding computational graphs and sessions, Sessions, Variables, constants, and placeholders, Introducing TensorBoard, Creating a name scope. • Back propagation Algorithm, Neural Network Training, • Convolutional Neural Networks: • Overall Architecture, The Convolution Layer, Issues with the Fully Connected Layer, Convolution Operations, Padding, Stride, Batch 	

		Processing, The Pooling Layer, Implementing a Convolution Layer, Implementing a Pooling Layer, Implementing a CNN, Visualizing a CNN.	
Module 3	Optimizers in DL		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Understanding the basic concept of gradient descent as an optimization algorithm for minimizing the loss function during training Introduction to adaptive learning rates based on the historical gradients of parameters. Understanding the challenges of training RNNs and the need for handling sequential dependencies. Explanation of backpropagation through time, the algorithm used to train RNNs by unfolding them into a computational graph over time. Different type of RNN architectures 	<p>Module Contents:</p> <ul style="list-style-type: none"> Optimizers in DL: Gradient Descent, Stochastic Gradient Descent, Mini-Batch Gradient Descent, SGD with Momentum, AdaGrad (Adaptive Gradient Descent), RMS-Prop (Root Mean Square Propagation), AdaDelta, Adam (Adaptive Moment Estimation). Introducing RNNs: RNN implementation and training, Backpropagation through time, Vanishing & exploding gradients, long short-term memory LSTM, Different types of RNN architectures: One-to-one architecture One-to-many architecture Many-to-one architecture Many-to-many architecture. 	
Module 4	Deep Unsupervised Learning		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Understanding autoencoders as neural network architectures designed for unsupervised learning by encoding and decoding input data. Generative Adversarial Networks (GANs) as a framework for training generative models through adversarial training. Understanding scenarios of different models 	<p>Module Contents:</p> <ul style="list-style-type: none"> Deep Unsupervised Learning: Auto encoders (standard, sparse, denoising, contractive, etc), Variational Auto encoders, Deep Generative Models GANS. 	
Assignments/ Activities			
	<p>These assignments aim to apply theoretical concepts to practical application and critical thinking.</p> <ul style="list-style-type: none"> Task students to build a simple neural network from scratch using Python or a framework like TensorFlow/Keras. They should train it on a dataset and analyze its performance. Provide pre-trained neural network models and have students visualize the learned features and activations at different layers to understand how information is processed. Assign students to create a CNN model for image classification using a dataset like CIFAR-10 or MNIST. They should experiment with different 		

	architectures and hyper parameters.	
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- Challenge students to create a GAN model capable of generating realistic images from a given dataset (e.g., faces, digits). They should evaluate the quality of generated images

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Chollet, François. *Deep Learning with Python*. Manning, 2018.

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SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
415512	NATURAL LANGUAGE PROCESSING Major (Core) Theory		4
	Course Outcomes: Learners will be able to: <ul style="list-style-type: none"> Understand different building blocks of NLP Design algorithms for NLP problems. Understand machine translation and its techniques Learn and use different tools for NLP. 		
Module 1	Introduction		1
	LOs: Learners will be able to <ul style="list-style-type: none"> Define the significance and necessity of natural language processing (NLP) in modern computing and communication systems. Differentiate between various levels of language processing (phonetics, syntax, semantics) and comprehend their role in NLP. Identify and analyze the key issues, challenges, and limitations in natural language processing. Analyze and discuss diverse applications of NLP across various domains such as machine translation, sentiment analysis, information retrieval, chatbots, and more. 	Module Contents: <ul style="list-style-type: none"> Need for processing of natural languages, Language processing levels, Issues and challenges in NLP, History, Classical approaches to NLP with knowledge bases and linguistic rules. Introduction to formal languages, finite state automata and regular expressions. Applications of NLP. 	
Module 2	Morphology and Phonology		1
	LOs: Learners will be able to <ul style="list-style-type: none"> Define and differentiate between inflectional and derivational morphology, recognizing their significance in understanding word formation and structure. Explain the fundamentals of phonetics, including phonemes and phonological rules, to analyze the sound 	Module Contents: <ul style="list-style-type: none"> Morphology fundamentals, Inflectional and Derivational morphology, Morphological parsing, Finite State transducers, N- gram language models, phonetics fundamentals, phoneme and phonological rules, machine learning of phonology, phonological aspects of prosody and speech synthesis. 	

	structure of languages.		
Module 3	Part-of-Speech Tagging and Parsing:		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Define and categorize word classes, recognizing their significance in linguistic analysis and natural language understanding. Analyse basic parsing strategies such as top-down and bottom-up parsing, recognizing their advantages and limitations in syntactic analysis. Demonstrate an understanding of finite state parsing methods, applying them to analyse and process sequential structures in language. 	<p>Module Contents:</p> <ul style="list-style-type: none"> Word Classes, Part of speech tagging, Tagsets, Rule based, Stochastic and Transformation based POS tagging. Basic parsing strategies, top-down parsing, bottom up parsing, parsing with context free grammars, a basic top down parser, Earley parser, CYK parser, Finite state parsing methods, Unification of feature structures. 	
Module 4	Semantic Analysis and Pragmatics:		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Define and differentiate between lexemes, understanding their internal structures and the relationships among different senses of words. Demonstrate proficiency in word sense disambiguation techniques, employing computational methods to determine the correct meaning of words within a given context. Apply lexical semantic analysis techniques and WordNet in computational models for tasks such as information retrieval, text summarization, and sentiment analysis. 	<p>Module Contents:</p> <ul style="list-style-type: none"> Lexical Semantics, Lexemes, Relations among lexemes and their senses, WordNet, Internal structure of words, metaphor and metonymy & their computational approaches, Word Sense Disambiguation. Discourse, Reference resolution, syntactic and semantic constraints on coreference, pronoun resolution reference, text coherence, discourse structure, Dialogue- Acts, structure, conversational agents, Introduction to language generation, architecture, discourse planning. 	
Assignments/ Activities			
	<p>These assignments aim to apply theoretical concepts to practical application and critical thinking:</p> <ul style="list-style-type: none"> Organize a workshop where students collaboratively annotate a text corpus with POS tags, discussing ambiguities and challenging cases. 		

	<ul style="list-style-type: none"> • Task students to build and evaluate a part-of-speech tagging system using a dataset. They should measure accuracy, precision, and recall of their model. • Assign students to create an NER system to identify entities (e.g., persons, organizations) in text data, assessing its precision and recall. • Task students to perform sentiment analysis on social media posts or reviews, identifying sentiments and evaluating the effectiveness of the analysis. • Assign groups to explore and compare different machine translation systems, evaluating their translations and discussing strengths and weaknesses. • Task students to build a text generation model (e.g., using recurrent neural networks) and generate coherent text based on a given prompt or theme. • Provide case studies involving ethical issues in NLP and ask students to analyze and propose solutions considering ethical considerations. 	
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SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
415513	Mobile Application Development using Android Programming: Practical Major (Core)		2
	<p>Course Outcomes: Learners will be able to:</p> <ul style="list-style-type: none"> • Demonstrate knowledge of the Android platform architecture. • Set up the Android development environment, including the Android Studio IDE. • Write and understand Java code relevant to Android app development. • Implement object-oriented programming concepts in Android applications. • Implement responsive and adaptive layouts for different screen sizes and orientations. • Create and manage activities as the building blocks of Android applications. • Utilize intents to enable communication between different components of an Android app. 		
Module 1	Fundamentals of Android Development		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Define what Android is and explain its evolution through different versions. • List the system requirements for setting up the Android Development Environment. • Analyse the directory structure of an Android project. • Describe the role of XML in Android application development. • Develop a basic Android application using the Android Studio IDE. • Define Android application components and their roles. • Understand the role of Android Services in processing tasks in the background. • Describe the role of Content Providers in Android for data 	<p>Module Contents:</p> <ul style="list-style-type: none"> • What is Android, Android versions and its feature set The various Android devices on the market, The Android Market application store, Android Development Environment-System Requirements, Creating Android Virtual Devices (AVDs) • Android Software Development Platform, The Directory Structure of an Android Project , Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes , Launching Your Application: The Android Manifest.xml File, Creating Your First Android Application • Android Application Components, Android Activities: Defining the UI, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications Content Providers: Data Management, Android Intent Objects: Messaging for Components. 	

	management.		
Module 2	Android Manifest XML		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Declare Android components in the Manifest XML file. • Design user interfaces for different Android devices. • Utilize Views, View Groups, and Android Layout Managers for effective UI design. • Retrieve data from users through various input mechanisms. • Implement buttons, check boxes, and radio groups in user interfaces. • Utilize Gallery, Image Switcher, GridView, and ImageView views for image display. • Explore multithreading in Android, including the main application thread and creating new threads. • Explore sending and receiving emails programmatically. • Configure the Android Emulator for simulating location-based services. • Play audio and video in Android applications. • Record audio and video using the device. • Utilize the camera to take and process pictures within the application. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Android Manifest XML: Declaring Your Components, Designing for Different Android Devices, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool • Displaying Text with Text View, Retrieving Data from Users, Using Buttons, Check Boxes and Radio Groups, Getting Dates and Times from Users, Using Indicators to Display Data to Users, Adjusting Progress with Seek Bar, Working with Menus using views, Gallery, Image Switcher, GridView, and ImageView views to display images, Creating Animation • Intent Overview, Implicit Intents, Creating the Implicit Intent Example Project, Explicit Intents, Creating the Explicit Intent Example Application, Intents with Activities, Intents with Broadcast Receivers, An Overview of Threads, The Application Main Thread, Thread Handlers, A Basic Threading Example, Creating a New Thread, Implementing a Thread Handler, Passing a Message to the Handler. • Sending SMS Messages Programmatically, Getting Feedback after Sending the Message Sending SMS Messages Using Intent Receiving, sending email, Introduction to location-based service, configuring the Android Emulator for Location-Based Services, Map-Based Activities • Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures. 	
Assignments/ Activities towards Comprehensive Continuous Evaluation			
	These assignments aim to apply theoretical concepts to practical application and critical thinking:		

	<ul style="list-style-type: none"> • Introduce students to the Android Studio IDE, project structure, and the basic components of an Android app. • Practice using XML for UI layout, understanding Views and View Groups, and exploring the Graphical Layout Tool. • Implement multimedia features, work with MediaPlayer, and understand handling different media formats. • Understand the concept of intents, explore data passing between activities, and use both types of intents. • Integrate location-based services, use maps, and handle user input for reminder details. • Understand threading in Android, work with background processing, and implement thread handlers. • Develop an app that captures images using the device camera and allows users to apply basic filters. • Prepare and publish a simple app on the Google Play Store. 	
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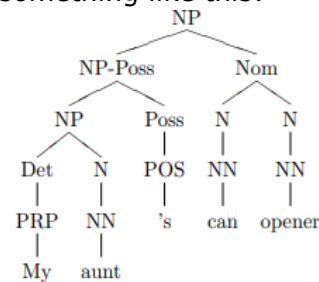
SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
415524	Natural Language Processing Lab: Practical Major (Core)		2
	<p>Course Outcomes: Learners will be able to:</p> <ul style="list-style-type: none"> • Understand and implement the basics of Natural Language Processing • Understand different building blocks of NLP. • Design algorithms for NLP problems. • Understand machine translation and its techniques. • Learn and use different tools for NLP. • To implement NLP task like Names Entity Recognition, Syntactic and Semantic analysis and WordSense disambiguation. 		
Module 1	POS Tagging and Name Entity Recognition		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Identify and tokenize words in sentences. • Assign accurate part-of-speech (POS) tags to each token. • Understand and apply POS tagging rules for different types of words (nouns, verbs, adjectives, etc.). • Construct phrase-structure trees (PSTs) for each identified noun phrase. • Analyze the distributional properties of constituents and invent labels for non-terminals based on linguistic analysis. • Apply named entity recognition (NER) techniques to extract relevant information from text. • Evaluate the importance of named entities in understanding the content and context of a document. • Apply natural language processing (NLP) concepts to real-world tasks, enhancing skills in information extraction 	<p>Module Contents:</p> <ul style="list-style-type: none"> • <u>Experiment 1:</u> Part-of-Speech Tagging Choose 2 sentences from each of the 3 sets below (6 total) and assign part-of-speech (POS) tags to each token of each sentence. Sentences : (1) a. The old car broke down in the car park b. At least two men broke in and stole my TV c. The horses were broken in and ridden in two weeks d Kim and Sandy both broke up with their partners (2) a. The horse which Kim sometimes rides is more bad tempered than mine b. The horse as well as the rabbits which we wanted to eat has escaped c. It was my aunt's car which we sold at auction last year in February d. The only rabbit that I ever liked was eaten by my parents one summer e. The veterans who I thought that we would meet at the reunion were dead (3) a. Natural disasters - storms, flooding, hurricanes - occur infrequently but cause devastation that strains resources to breaking point b. Letters delivered on time by old-fashioned means are 	

and document analysis.

increasingly rare, so it is as well that that is not the only option available

- c. It won't rain but there might be snow on high ground if the temperature stays about the same over the next 24 hours
- d. The long and lonely road to redemption begins with self-reflection: the need to delve inwards to deconstruct layers of psychological obfuscation
- e. My wildest dream is to build a POS tagger which processes 10K words per second and uses only 1MB of RAM, but it may prove too hard

- Experiment 2: Task phrase-structure tree (PST)
Choose 2 sentences from sets below (4 total) and bracket all the noun phrases (NPs) in each sentence. Then for each NP found, draw a phrase-structure tree (PST) using non-terminal labels (NP, AP etc.) You can invent your own labels for constituents motivated by distributional analysis as necessary, and base your PST on the tokenization and PoS tags assigned in the first handout. For instance the PST analysis of the first two NPs in: My aunt's can opener can open a drum should look something like this:



Sentences

(1)

- a. The old car broke down in the car park
- b. At least two men broke in and stole my TV
- c. The horses were broken in and ridden in two weeks
- d. Kim and Sandy both broke up with their partners

(2)

- a. The horse which Kim sometimes rides is worse tempered than mine
- b. The horse as well as the

		<p>rabbits which we wanted to eat have escaped</p> <p>c. It was my aunt's car which we sold at auction last year in February</p> <p>d. The only rabbit that I ever liked was eaten by my parents one summer</p> <p>e. The veterans who I thought that we would meet at the reunion were dead</p> <ul style="list-style-type: none"> • <u>Experiment 3</u>: Named entity recognition (NER), Identifying person, location, and organization names in a given document 	
Module 2	Syntactic and Semantic Analysis		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Construct syntactic trees for sentences in the document. • Identify sentence boundaries, phrases, and grammatical structures. • Construct syntactic trees for sentences in the document. • Apply dependency parsing techniques to represent the syntactic relationships between words. • Analyse the syntactic complexity of sentences in terms of structure and depth. • Identify and label semantic roles of words and phrases in a given document. • Demonstrate an understanding of WordNet and its structure. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • <u>Experiment 4</u>: Syntactic analysis of a given document • <u>Experiment 5</u>: Semantic analysis of a given document • <u>Experiment 6</u>: To implement word Sense Disambiguation for a specific scenario using wordnet. 	
Assignments/ Activities towards Comprehensive Continuous Evaluation			
	<p>These assignments aim to apply theoretical concepts to practical application and critical thinking:</p> <ul style="list-style-type: none"> • Gain hands-on experience with text pre-processing techniques in natural language processing (NLP). • Understand the importance of tokenization in NLP. • Select a dataset containing textual information (e.g., reviews, articles, tweets). • Perform text preprocessing tasks • Apply named entity recognition techniques to extract entities from a given text. • Apply named entity recognition techniques to extract entities from a given text. • Develop a sentiment analysis model to classify text into positive, negative, or neutral sentiments. 		

	<ul style="list-style-type: none">• Understand the application of machine learning in sentiment analysis.• Develop a text classification model to categorize documents into predefined classes.• Explore different classification algorithms in NLP.	
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SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
425511	Information Security Major(Elective) Theory		4
	<p>Course Outcomes: Learners will be able to:</p> <ul style="list-style-type: none"> • Understand the services and mechanisms provided by symmetric ciphers. • Analyse the OSI Security Architecture and its relevance to information security. • Describe classical encryption techniques within the symmetric cipher model. • Explain the principles of public key cryptography. • Understand digital signatures. • Explore authentication applications, including Kerberos and X.500 Authentication Service. • Analyse malicious software, including viruses and related threats, and countermeasures 		
Module 1	Symmetric Ciphers		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Explain the fundamental services provided by symmetric ciphers. • Identify and defend against common attacks on symmetric ciphers. • Analyze the OSI Security Architecture and its role in network security. • Describe classical encryption techniques, including substitution and transposition. • Understand the principles of block ciphers, focusing on the Data Encryption Standard (DES). • Evaluate the strength and weaknesses of DES through differential and linear cryptanalysis. • Apply block cipher design principles to create secure encryption algorithms. • Explain different modes of operation used by block ciphers for secure communication. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Overview – Services, Mechanism and Attacks, The OSI Security Architecture, A model for network security Classical Encryption techniques – Symmetric Cipher model, Substitution. Techniques, Transposition techniques, Rotor Machines, Steganography. Block Cipher and Data Encryption Standard – Simplified DES, Block. Cipher principles, The Data Encryption Standard, The strength of DES, Differential and Linear Cryptanalysis, Block Cipher design principles, Block Cipher mode of Operation 	
Module 2	Asymmetric Ciphers		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Understand the principles of public key cryptography and its applications. • Explain the RSA algorithm, including key management 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Public Key Cryptography and RSA – Principles of Public Key Cryptosystems, The RSA Algorithm Key management ; Other public key cryptosystemsKey 	

	<p>practices.</p> <ul style="list-style-type: none"> • Compare different public key cryptosystems and assess their strengths and weaknesses. • Describe the principles and applications of Diffie-Hellman key exchange and elliptical curve cryptography. • Discuss authentication requirements and functions in secure communication. • Explain the principles of message authentication codes and secure hash functions. • Understand the role of digital signatures and authentication protocols in information security. 	<p>Management, Diffe-Hellman Key Exchange, Elliptical Curve Arithmetic, Elliptical curve Cryptography Message Authentication and HASH Functions – Authentication requirements, Authentication Functions, Message Authentication Codes, Hash Functions, security of Hash Functions and MACS Digital Signatures and Authentication Protocols – Digital Signatures, Authentication Protocols, Digital Signature Standard</p>	
Module 3	Network Security practice		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Implement and configure authentication protocols such as Kerberos and X.500. • Utilize Pretty Good Privacy (PGP) and S/MIME for secure email communication. • Understand the architecture and components of IP Security (IPSec). • Implement IPSec components, including Authentication Header (AH) and Encapsulating Security Payload (ESP). • Demonstrate proficiency in combining Security Associations and key management in IPSec. • Identify and mitigate web security threats and vulnerabilities. • Implement SSL/TLS protocols for securing web communication. • Understand the principles and applications of Secure Electronic Transaction (SET) in e-commerce. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Network Security practice : Authentication Applications – Kerberos, X.500 Authentication Service Electronic Mail Security – Pretty Good Privacy, S/MIME IP Security – IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating security payload, Combining Security Associations, Key Management WEB Security – Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction 	
Module 4	System Security		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Implement and configure intrusion detection systems for proactive threat identification. • Design and enforce effective password management policies and practices. • Implement countermeasures against viruses and related threats. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • System Security : Intruders – Intruders, Intruder detection, Password Management, Malicious Software – Viruses and Related Threats, Virus Countermeasures, Firewall design principles, Trusted system. 	

	<ul style="list-style-type: none"> • Design and configure firewalls based on security requirements. • Understand and implement different types of firewalls for network security. • Recognize the concept of trusted systems and implement mechanisms to build and maintain trust in computing environments 		
Assignments/ Activities			
	<p>These assignments aim to apply theoretical concepts to practical application and critical thinking.</p> <ul style="list-style-type: none"> • In groups, analyse the case studies to identify the type of malware involved, the attack vectors, and the impact on the affected systems. • Set up a simulated network environment with a variety of devices and services. • Research and identify characteristics that contribute to the trustworthiness of a computing system. • Apply the checklist to evaluate a given computing environment and provide recommendations for enhancing trust. • In pairs or small groups, task students with configuring a firewall to secure the network 		

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SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
425512	Digital Forensics Major (Elective) Theory		4
	<p>Course Outcomes: Learners will be able to:</p> <ul style="list-style-type: none"> • Understand the need of digital forensics. • Acquire different methodologies for incident response. • Grasp the knowledge of forensic duplication and implement it. • Evaluate the forensic analysis in file system and its fundamentals. • Understand the different attacks in network system and way to analysis its. • Illustrate the analysis techniques by investigate live system. • Acquire knowledge of Cyber law. • Proficient in different hacker tools. 		
Module 1	Introduction to Digital Forensics		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Understand and define basic concepts of Cybercrime. • Illustrate different types of cybercrime and differentiate it. • Grasp the fundamental concepts of Digital Forensics. • Aware about Incident and incident response methodology. • Analyse the process after detection of incident. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Introduction of Cybercrime: Types, The Internet spawns crime, Worms versus viruses, Computers' roles in crimes, Introduction to digital forensics, Introduction to Incident - Incident Response Methodology – Steps - Activities in Initial Response, Phase after detection of an incident. 	
Module 2	Initial Response and forensic duplication		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Synthesized the concept of initial response. • Understand core concepts of Forensic duplication. • Analyse the tools for forensic duplicates. • Demonstrate forensic duplicate of hard drive. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Initial Response & Volatile Data Collection from Windows system - Initial Response & Volatile Data Collection from Unix system – Forensic Duplication: Forensic duplication: Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic Duplicate/Qualified Forensic Duplicate of a Hard Drive. 	

Module 3	Preserving ,Recovering Digital Evidence and Network forensic		1	
	<p>LOs:</p> <ul style="list-style-type: none"> • Illustrate the concept of File systems and perform forensic analysis of file system. • Understand the storage fundamentals. • Explore the concept of evidence handling. • Grasp the knowledge of Intrusion detection and different attacks in network. • Analyse the attacks in networks. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • File Systems: FAT, NTFS - Forensic Analysis of File Systems – Storage, Fundamentals: Storage Layer, Hard Drives Evidence Handling: Types of Evidence, Challenges in evidence handling, Overview of evidence handling procedure. • Intrusion detection; Different Attacks in network, analysis Collecting Network Based Evidence - Investigating Routers - Network Protocols - Email Tracing- Internet Fraud. 		
Module 4	System Investigation and Law		1	
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Explore the data analysis techniques for windows and Unix. • Grasp the knowledge of different Hacker tools and ethical issues for cybercrime. • Enhance the knowledge of bodies of law related to digital forensic. • Illustrate the different levels of law and differentiate it. • Understand the laws related to computers. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Data Analysis Techniques - Investigating Live Systems (Windows & 08 Unix) Investigating • Hacker Tools - Ethical Issues – Cybercrime. • Bodies of law: Constitutional law, Criminal law, Civil law, Administrative regulations, Levels of law: Local laws, State laws, Federal laws, International laws , Levels of culpability: Intent, Knowledge, Recklessness, Negligence Level and burden of proof : Criminal versus civil cases ,Vicarious liability, Laws related to computers: CFAA, DMCA, CAN Spam, etc. 		
Assignments/ Activities towards CCE				
	<ul style="list-style-type: none"> • Explore the history and evolution of Digital Forensic. • Provide information about different cybercrimes and differentiate between them. • Illustrate different file system concept and their structure. • Demonstrate and explore different attacks in network. • Explore different data analysis techniques for digital forensic using real or given scenario. • Represent demonstration of different hacking tool in real-time. • Synthesized the different digital forensic laws. 			

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SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
425513	Agile Methodology Major(Elective) Theory		4
	<p>Course Outcomes: Learners will be able to:</p> <ul style="list-style-type: none"> • Apply the Agile requirement techniques for Software Development. • Analyze different Agile software methodologies to facilitate the Project. • Analyze different Agile Estimation Techniques. • Illustrate Agile Testing approach. 		
Module 1	Introduction to Agile Methodologies		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> • Explain the traditional approach to software development methodology. • Identify the limitations and challenges of traditional software development. • Define the concept of Agile in the context of software development. • Introduce the Class Responsibility Collaborator (CRC) method for collaborative requirements analysis. 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Traditional approach of Software Development Methodology, Need of Agile software Development, Defining Agile, Agile Manifesto Principles of Agile , Values of Agile ,Business Benefits of Agile Software Development • Traditional Requirements Development , Principle of Agile Requirements Development ,Agile Requirements : Epics and User stories ,Difference between Epics and User stories ,Backlog Management, Class Responsibility Collaborator. 	
Module 2	Scrum and Kanban Methodologies		1
	<p>LOs:Learners will be able to</p> <ul style="list-style-type: none"> • Define the Scrum framework and its role in Agile software development. • Identify and analyze the advantages and benefits of adopting the Scrum framework. • Understand the underlying principles that guide the Scrum framework. • Define and differentiate between key artifacts in Scrum, including the Product Backlog, Sprint Backlog, and Increments. • Define the Kanban framework and its principles. • Understand the concept of workflow in Kanban. • Explain the importance of limiting work 	<p>Module Contents:</p> <ul style="list-style-type: none"> • Introduction to Scrum framework, Advantages of Scrum Framework. Phases of Scrum, Principles of Scrum, Roles: Product owner, team members and scrum master, Scrum Ceremonies :Sprint, sprint planning, daily scrum, sprint review, and sprint retrospective, Artifacts: Product backlog, sprint backlog and increments. • Introduction to Kanban framework, Workflow, Limit the amount of work in progress, pulling work from column to column, Kanban board, Adding policies to the 	

	<p>in progress in Kanban.</p> <ul style="list-style-type: none"> Understand the concept of work item age in Kanban. 	<p>board, Cards and their optimization. Kanban Practices , Kanban Flow practices. Work Item Age. Kanban vs Scrum.</p>	
Module 3	Extreme Programming and Agile Estimation Techniques		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Gain a foundational understanding of the basic values and principles that underpin Extreme Programming (XP). Learn and apply the twelve practices of Extreme Programming (XP), including pair programming, continuous integration, and test-driven development (TDD). Explore the life cycle of an XP project, from planning to release. Gain an understanding of the Agile Maturity Model and its levels, ranging from initial to optimized. Learn and apply Agile estimation techniques, including Planning Poker, Shirt Sizes, Dot Voting, and the Bucket System. Explore ways to optimize planning processes using Agile estimation techniques. 	<p>Module Contents:</p> <ul style="list-style-type: none"> Basic values and principles, Roles, Twelve practices of XP, Pair programming, XP team, Life cycle and tools for XP., Good practices need to be practiced in extreme programming, Advantages of Extreme Programming Agile Maturity Model and Agile Estimation Techniques - Planning Poker- Shirt Sizes. Dot Voting, Bucket System. 	
Module 4	Agile Testing		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Understand the Agile Testing Quadrants model and its classification of testing activities into four quadrants. Gain a comprehensive understanding of the Agile Testing Life Cycle and its iterative nature within Agile development. Learn the principles and practices of Behavior Driven Development (BDD) as an Agile testing technique. Gain an understanding of Agile test metrics and their role in measuring and improving the testing process. Learn how to effectively use metrics to assess project progress and identify areas for improvement. Identify common pitfalls associated with Agile test metrics and learn strategies to avoid them. 	<p>Module Contents:</p> <ul style="list-style-type: none"> Agile Testing Life Cycle, Agile Testing Quadrants, Agile Testing Techniques: Behavior Driven Development, Test Driven Development Acceptance Test Driven Development Testing. Role of Agile Tester. User stories approach in Acceptance Test Driven Development Testing. Other Techniques - Exploratory Testing , Session Based testing. Agile Test Metrics. 	

Assignments/ Activities	
	<p>These assignments aim to apply theoretical concepts to practical application and critical thinking.</p> <ul style="list-style-type: none"> • Prepare a Product Backlog ,Epics and User Stories for a given scenario. • Write a Class Responsibility Collaborator for a given scenario. • Importance of Scrum Ceremonies in Scrum Framework. • Importance of Scrum Team Roles and Responsibilities. • Problems on Work Item Age. • Depict Kanban workflow. • Use various Agile Estimation Techniques. • Case study on AMM • Prepare Agile Test cases using Behavior Driven Development. • Prepare Agile Test cases using Acceptance Test Driven Development.

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SN	Courses, Modules and Outcomes	Course Contents	Cr
	Semester IV		
425514	Cloud Computing Major(Elective) Theory		4
	Course Outcomes: Learners will be able to: <ul style="list-style-type: none"> • After completion of course, students would be able to: • Identify security aspects of each cloud model • Develop a risk-management strategy for moving to the Cloud • Implement a public cloud instance using a public cloud service provider • Apply trust-based security model to different layer 		
Module 1	Introduction to Cloud Computing:		1
	LOs: Learners will be able to <ul style="list-style-type: none"> • Define and explain the concept of cloud computing. Identify the key characteristics, service models (IaaS, PaaS, SaaS), and deployment models (public, private, hybrid) of cloud computing. • Provide an overview of the historical development of cloud computing. Explain the evolution from traditional computing models to cloud computing. • Compare and contrast major cloud service providers such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP). • Identify and analyze potential security risks and challenges associated with cloud computing. 	Module Contents: <ul style="list-style-type: none"> • Introduction to Cloud Computing • Online Social Networks and Applications • Cloud introduction and overview • Different clouds, Risks, Novel applications of cloud computing 	
Module 2	Cloud Computing Architecture, Cloud Deployment Models		1
	LOs: Learners will be able to: <ul style="list-style-type: none"> • Define the requirements that led to the emergence of cloud computing. • Provide an overview of the basic principles and concepts underlying cloud computing. • Explain CPU virtualization and its role in cloud architectures. • Discuss different hypervisors and their features. • Define and explain the SPI (Software as a Service, Platform as a Service, Infrastructure as a Service) framework. • Identify the key drivers motivating organizations to adopt cloud computing. • Evaluate the impact of cloud 	Module Contents: <ul style="list-style-type: none"> • Cloud Computing Architecture: Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model • Cloud Deployment Models: 	

	<p>computing on end-users and businesses.</p> <ul style="list-style-type: none"> Explore best practices for establishing effective governance structures in cloud environments 	<p>Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise</p>	
Module 3	Security Issues in Cloud Computing and Access management		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Understand the importance of infrastructure security in cloud computing and identify key components involved. Explain network-level security measures and protocols relevant to cloud environments. describe application-level security practices and challenges specific to cloud-based applications. Understand the significance of data security and storage in cloud computing environments. Assess the security considerations related to data managed by cloud service providers. Define trust boundaries and explain their significance in Identity and Access Management Familiarize with key standards and protocols used for Identity and Access Management in cloud services. Understand the concept of authorization management in the cloud and its role in ensuring secure access. 	<p>Module Contents:</p> <ul style="list-style-type: none"> Security Issues in Cloud Computing: Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security. Identity and Access Management: Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management. 	
Module 4	Security Management in the Cloud, Privacy Issues		1
	<p>LOs: Learners will be able to</p> <ul style="list-style-type: none"> Understand and apply security management standards relevant to cloud computing. Differentiate availability management practices for Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Conduct risk assessments specific to cloud security and propose effective mitigation strategies. Develop and implement incident response plans tailored to cloud computing scenarios. 	<p>Module Contents:</p> <ul style="list-style-type: none"> Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS. Privacy Issues: Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to 	

	<ul style="list-style-type: none"> Analyse the data life cycle and identify key points for addressing privacy concerns in each phase. Identify and prioritize key privacy concerns that arise in cloud computing environments. Propose and evaluate measures for protecting privacy in the cloud, including encryption and access controls. Understand the legal and regulatory landscape related to privacy in cloud computing. Summarize and interpret relevant U.S. laws and regulations pertaining to privacy in cloud computing. 	<p>Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations.</p>	
Assignments/ Activities			
	<p>These assignments aim to apply theoretical concepts to practical application and critical thinking.</p> <ul style="list-style-type: none"> Research and compare three major cloud service providers (e.g., AWS, Azure, Google Cloud) based on their service offerings, pricing models, and customer reviews. Design a hypothetical cloud infrastructure for a given business scenario. Consider factors such as scalability, security, and cost-effectiveness. Conduct a security risk assessment for a given cloud-based application. Identify potential vulnerabilities and propose mitigation strategies. Develop a comprehensive security policy for a fictional organization migrating to the cloud. Address key security management standards and practices. 		

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