ANNEXURE: 1 MODULE WISE COURSE CONTENT AND OUTCOME

SL.NO	MODULE NAME	MODULE CONTENT	MODULE LEARNING OUTCOME	DURATION (HRS)
1	Understanding Speech Recognition Basics	- Define speech recognition and its real-world applications (e.g., voice assistants, transcription services). - Describe the components of a speech recognition system (acoustic models, language models, and decoders). - Identify challenges in speech recognition (noise, accents, homophones).	- Understand the core concepts and applications of speech recognition. - Recognize the components of a speech recognition system. - Identify the challenges faced in speech recognition.	5
2	Signal Processing for Speech Recognition	- Apply techniques such as noise reduction and speech enhancement on raw audio signals. - Demonstrate the extraction of features like Mel-frequency cepstral coefficients (MFCCs). - Implement methods for voice activity detection (VAD).	- Learn how to preprocess and extract features from speech signals. - Implement techniques for noise reduction and speech enhancement. - Use VAD for separating speech from background noise.	5
3	Acoustic Modeling in Speech Recognition	- Explain the role of hidden Markov models (HMMs) in acoustic modeling. - Train a simple acoustic model using a	- Understand how acoustic models are trained and used in speech recognition.	5

		speech corpus and evaluate its accuracy. - Discuss deep learning-based models in modern speech recognition.	- Train and evaluate an acoustic model. - Explore the role of deep learning in speech recognition.	
4	Language Models and Speech Recognition	- Define the role of n-gram models in language modeling for speech recognition. - Implement and train a basic language model using a text corpus. - Integrate the language model with an acoustic model.	- Understand the role of language models in improving speech recognition accuracy. - Implement and train basic language models. - Integrate language models with acoustic models.	4
5	Speech Recognition Algorithms	- Compare and contrast traditional speech recognition algorithms (e.g., dynamic time warping, HMM) with modern approaches (e.g., deep learning). - Implement a basic speech-to-text system using a machine learning algorithm. - Evaluate algorithm performance.	- Understand different speech recognition algorithms and their applications. - Implement a basic speech-to-text system. - Evaluate the performance of speech recognition algorithms.	4
6	Deep Learning in Speech Recognition	- Understand the role of CNNs and RNNs in speech recognition tasks. - Train a deep neural network for speech	- Learn how deep learning techniques like CNNs and RNNs are used in speech	5

		recognition using a large-scale dataset. - Fine-tune pre-trained models for specific applications.	recognition. - Train and fine-tune deep learning models for speech recognition tasks.	
7	Speaker Adaptation in Speech Recognition	- Explain the process of speaker adaptation. - Implement a speaker adaptation technique such as Maximum Likelihood Linear Regression (MLLR). - Evaluate the improvement in accuracy after applying speaker adaptation.	- Understand the process of speaker adaptation in speech recognition. - Implement speaker adaptation techniques. - Evaluate accuracy improvements with speaker adaptation methods.	4
8	Handling Accents and Dialects	-Identify challenges caused by accents and dialects in speech recognition. - Use data augmentation techniques to train models for different accents. - Evaluate system performance on multi-accent datasets.	- Explore methods to improve speech recognition for accents and dialects. - Use data augmentation to handle different accents. - Evaluate system performance for multi-accent datasets.	4
9	Real-time Speech Recognition Systems	- Implement a real-time speech-to-text system using libraries like Google Speech API or CMU Sphinx.	- Develop real-time speech-to-text systems. - Optimize systems for low-	5

		- Optimize systems for low-latency processing in real-time applications. - Integrate speech recognition into real-world applications.	latency. - Integrate speech recognition into practical applications like voice assistants and transcription services.	
10	Hands-on Capstone Project	- Define the scope and requirements of a speech recognition project. - Implement signal processing, acoustic modeling, and language modeling. - Build and deploy a real-time or batch speech recognition system.	- Apply concepts from previous modules to develop a complete speech recognition system. - Implement signal processing, acoustic and language modeling. - Deploy a working speech recognition system.	5

ANNEXURE : 2 Industry Use Cases/Final Projects

LEARNING OUTCOME	ASSESSMENT CRITERIA	PERFORMANCE CRITERIA	USECASES
Use speech recognition to enable hands-free interaction with digital devices, allowing users to control their phones, smart speakers, and other smart devices using voice commands.	Understand the core concepts of speech recognition in real-world applications such as voice assistants. Explain the role of acoustic modeling in recognizing voice commands. Implement a machine learning algorithm for speech-to-text conversion. Integrate speech recognition into real-world applications, such as virtual assistants	-Define speech recognition and its real-world applications (e.g., voice assistants, transcription services). -Explain the role of hidden Markov models (HMMs) in acoustic modeling. -Implement a basic speech-to-text system using a machine learning algorithm. -Integrate speech recognition into a real-world application, such as a voice assistant or transcription service.	Voice Assistants (e.g., Siri, Alexa): Enable hands-free interaction with devices. Voice-controlled Smart Homes: Control home devices such as lights, thermostats, and security systems. Voice Commands for Gaming: Enhance user interaction in games by using voice commands. Voice-enabled Appliances: Control household appliances like smart TVs or ovens.
Automate the transcription of spoken content from meetings or conferences into text, making it easier to create records of discussions for later reference.	Apply signal processing techniques for noise reduction and speech enhancement. Extract features like Mel-frequency cepstral coefficients (MFCCs) from speech signals. Integrate acoustic and language models to improve transcription accuracy.	Apply techniques such as noise reduction and speech enhancement on raw audio signals. Demonstrate the extraction of features like Mel-frequency cepstral coefficients (MFCCs) from speech signals. Integrate the language model with an acoustic model to improve transcription accuracy. Implement a real-time speech-to-text system using popular libraries like Google Speech API	Transcription Services for Meetings and Conferences: Automate transcription of spoken content for records. Real-time Subtitling for Live Events: Provide transcription of live webinars, lectures, or broadcasts. Speech Recognition for Accessibility (e.g., for the Hearing Impaired): Provide spoken-to-text conversion for individuals with hearing impairments.

		or CMU Sphinx.	
Develop systems that allow users to control home devices through voice commands, enhancing convenience and accessibility.	Understand how to integrate speech recognition with IoT devices. Compare traditional and modern approaches to speech recognition. Implement low-latency processing in real-time applications.	-Define speech recognition and its real-world applications. -Compare traditional speech recognition algorithms with modern approaches. - Integrate speech recognition into a real-world application, such as a voice assistant or smart home system.	Voice-controlled Smart Homes: Control home devices like lights, thermostats, and security systems using voice commands. Voice-enabled Navigation Systems for Vehicles: Control navigation and GPS using voice commands.
Use speech recognition to verify or identify users based on their voice, adding an extra layer of security.	Understand speaker adaptation techniques for improving authentication accuracy. Implement speaker recognition methods such as Maximum Likelihood Linear Regression (MLLR).	-Explain the process of speaker adaptation in speech recognition. -Implement a speaker adaptation technique such as MLLR. -Optimize speech recognition systems for low-latency processing in real-time applications.	Voice-based Authentication (Speaker Recognition): Use voice recognition for secure authentication in devices or applications. Personalized Voice Assistants for Elderly: Tailor voice-enabled systems to assist elderly users.
Provide real-time transcription during live events, improving accessibility for people with hearing impairments.	Implement signal processing for background noise reduction and voice activity detection. Apply language models to enhance transcription accuracy in real-time scenarios.	-Apply techniques such as noise reduction and speech enhancement on raw audio signals. -Integrate the language model with an acoustic model to improve transcription accuracy. -Implement a real-time speech-to-text system using popular libraries like Google Speech API.	Real-time Subtitling for Live Events: Provide live transcription during webinars, lectures, or news broadcasts.
Develop systems that	Understand the integration of	-Discuss the use of deep learning-based	Language Translation via

transcribe spoken words and then translate them into another language, enabling seamless communication.	speech recognition with translation systems. Implement a multilingual speech recognition system.	models in modern speech recognition. -Implement and train a basic language model using a text corpus. -Integrate speech recognition into real-world applications like translation systems.	Speech: Transcribe and translate spoken words into another language. Real-time Speech-to-Speech Translators: Facilitate seamless communication between people speaking different languages.
Enable users to dictate text without using hands, useful for multitasking or driving.	Implement a speech-to-text system for hands-free text entry. Evaluate the accuracy of a speech recognition algorithm in real-world tasks.	-Define speech recognition and its real-world applications. -Implement a basic speech-to-text system using a machine learning algorithm. -Integrate speech recognition into real-world applications like voice-based writing systems.	Voice-to-Text for Hands-Free Writing: Enable hands-free writing of documents, emails, or notes.
Automate customer support services using voice recognition to handle customer queries and requests.	Use deep learning models for efficient voice recognition in customer service. Integrate a virtual assistant into customer support systems.	-Define the role of n-gram models in language modeling. -Fine-tune pre-trained models for specific speech recognition applications. -Integrate speech recognition into a real-world application, such as a virtual customer support system.	Virtual Customer Support Systems: Automate customer queries and requests.
Convert spoken medical notes and patient interactions into structured text to reduce administrative workload in healthcare.	Implement voice activity detection and background noise reduction in medical settings. Integrate language models for accurate medical	-Implement methods for voice activity detection (VAD) to separate speech from background noise. -Train an acoustic model using a medical speech corpus.	Speech Recognition for Medical Transcriptions: Convert spoken medical notes into structured text for patient records.

	transcription.	-Integrate language models to enhance transcription accuracy.	
Create voice-enabled systems that offer tailored assistance to elderly users, helping with tasks like setting reminders and controlling home devices.	Implement speaker recognition and adaptation techniques. Develop real-time, personalized voice assistants for elderly users.	-Define speech recognition and its real-world applications. -Integrate speech recognition into real-world applications, such as a voice assistant. -Explain the process of speaker adaptation in speech recognition.	Personalized Voice Assistants for Elderly: Assist elderly users with tasks using voice commands.
Allow drivers to control navigation and GPS systems using voice commands, providing hands-free functionality while driving.	Understand the integration of speech recognition with GPS systems. Apply signal processing techniques for feature extraction and noise reduction. Implement a real-time speech-to-text system for voice-controlled navigation.	-Describe the components of a speech recognition system, including acoustic models, language models, and decoders. -Demonstrate the extraction of features like Mel-frequency cepstral coefficients (MFCCs) from speech signals. -Implement a real-time speech-to-text system using popular libraries like Google Speech API or CMU Sphinx.	Voice-enabled Navigation Systems for Vehicles: Control navigation and GPS systems using voice commands while driving. Voice-controlled Appliances: Use speech recognition to control household appliances like smart TVs, ovens, or air conditioners.
Develop systems that can recognize and transcribe speech in multiple languages, providing greater accessibility and ease of communication in global contexts.	Understand the challenges in recognizing and transcribing speech across different languages and accents. Apply data augmentation techniques to train models for multilingual speech recognition.	-Discuss the use of deep learning-based models in modern speech recognition. -Use data augmentation techniques to train models that can handle different accents. -Optimize speech recognition systems for multilingual applications.	Multilingual Speech Recognition System: Recognize and transcribe speech in multiple languages. Real-time Speech-to-Speech Translators: Facilitate seamless communication between people who speak different languages.

	Evaluate system performance on multilingual datasets.		
Create systems that enable searching within audio or video content by transcribing speech into text, making it easier to find relevant information within large audio files.	Apply signal processing techniques to convert audio content into text. Implement and evaluate search and indexing algorithms for audio or video content. Integrate language models to improve the relevance of search results.	-Apply techniques such as noise reduction and speech enhancement on raw audio signals. -Implement and train a basic language model using a text corpus. -Evaluate the performance of a speech recognition algorithm on a test dataset.	Audio Content Search and Indexing: Enable searching within audio or video content by transcribing speech into text for better indexing. Speech-based Search Engines: Implement voice search functionality in search engines.
Use voice recognition to input data into databases or applications without manual typing, improving efficiency in tasks such as inventory management or CRM updates.	Implement a voice-based data entry system to automate information input. Evaluate the accuracy and speed of speech recognition in practical data entry tasks.	-Implement a basic speech-to-text system using a machine learning algorithm. -Implement a real-time speech-to-text system using popular libraries like Google Speech API.	Speech-based Data Entry Systems: Automate data entry in applications like inventory management or CRM systems. Voice Commands for Gaming: Use speech commands in games for better interaction.
Integrate voice commands into games to enhance user interaction, providing a more immersive gaming experience where players can control in-game actions using their voice	Apply speech recognition techniques for real-time voice commands in gaming applications. Integrate voice control into gaming interfaces.	-Define speech recognition and its real-world applications, including in gaming. -Integrate speech recognition into real-world applications like video games.	Voice Commands for Gaming: Enhance user interaction in games with voice commands. Voice-based Notes and Memo Systems: Use voice recognition for dictating and organizing notes.
Allow users to dictate and organize notes	Implement a speech recognition	-Demonstrate the extraction of features like Mel-	Voice-based Notes and Memo Systems: Allow users to

or memos using speech recognition, making it easier to capture ideas and to-do lists without needing to type.	system for dictating and organizing notes. Evaluate the effectiveness and accuracy of the system in real-world applications.	frequency cepstral coefficients (MFCCs) from speech signals. -Compare traditional speech recognition algorithms with modern approaches. -Implement a real-time speech-to-text system for dictating notes or memos.	dictate and organize their notes. Voice-controlled Appliances: Control household appliances using voice commands.
Implement voice search functionality in search engines, allowing users to search the web hands-free by speaking their queries.	Develop a voice-based search engine. Evaluate the accuracy and efficiency of speech-to-text search systems.	-Describe the components of a speech recognition system, including language models and decoders. -Implement a basic speech-to-text system using a machine learning algorithm. -Implement a real-time speech-to-text system for web-based searches.	Speech-based Search Engines: Enable users to search the web by speaking their queries. Voice-enabled Navigation Systems for Vehicles: Control GPS and navigation via voice commands.
Use speech recognition to control various household appliances such as smart TVs, ovens, or air conditioners, making it easier to operate devices without manual intervention.	Implement a voice recognition system to control household appliances. Evaluate the accuracy and responsiveness of voice-controlled appliances.	-Define speech recognition and its real-world applications, such as controlling appliances. -Implement a speech-to-text system for voice-controlled appliance interactions. -Integrate speech recognition into real-world applications like home automation.	Voice-controlled Appliances: Control smart devices such as TVs, ovens, or air conditioners using voice commands. Voice-enabled Navigation Systems for Vehicles: Voice-control for GPS systems.
Convert spoken language in real-time into another language using both speech recognition and	Understand the integration of speech recognition and synthesis for real-time translation.	-Integrate the language model with an acoustic model to improve transcription accuracy. -Train deep learning	Real-time Speech-to-Speech Translators: Enable seamless communication between people speaking different

synthesis, facilitating seamless communication between people who speak different languages.	Evaluate the performance of real-time translation systems.	models for real-time speech recognition and translation. -Integrate speech recognition into real-world applications like translation systems.	languages. Multilingual Speech Recognition System: Transcribe and translate speech in multiple languages.
Create systems that provide spoken-to-text conversion for individuals with hearing impairments, helping them follow conversations or presentations in real time.	Implement a real-time speech-to-text system for accessibility applications. Evaluate system performance for accessibility in live environments.	-Implement methods for voice activity detection (VAD) to separate speech from background noise. - Implement a real-time speech-to-text system using popular libraries. -Build and deploy a real-time or batch speech recognition system for accessibility.	Speech Recognition for Accessibility (e.g., for the Hearing Impaired): Convert spoken language to text for people with hearing impairments. Real-time Subtitling for Live Events: Provide real-time transcription of speech during live events for accessibility.

LIST OF FINAL PROJECTS	
SL.NO	**FINAL PROJECT**
1	Voice Assistants (e.g., Siri, Alexa)
2	Transcription Services for Meetings and Conferences
3	Voice-controlled Smart Homes
4	Voice-based Authentication (Speaker Recognition)
5	Real-time Subtitling for Live Events
6	Language Translation via Speech
7	Voice-to-Text for Hands-Free Writing:
8	Virtual Customer Support Systems
9	*Speech Recognition for Medical Transcriptions*
10	*Personalized Voice Assistants for Elderly*
11	*Voice-enabled Navigation Systems for Vehicles:*
12	*Multilingual Speech Recognition System:*
13	*Audio Content Search and Indexing*

14	*Speech-based Data Entry Systems*
15	*Voice Commands for Gaming*
16	*Voice-based Notes and Memo Systems*
17	*Speech-based Search Engines*
18	*Voice-controlled Appliances:*
19	*Real-time Speech-to-Speech Translators*
20	*Speech Recognition for Accessibility (e.g., for the Hearing Impaired)*

ANNEXURE 3 – COURSE ASSESSMENT

ASSESSMENT CRITERIA	DESCRIBE THE CRITERIA OF THE BELOW CATEGORY PERFORMANCE			TOTAL MARKS
	FAIR	**GOOD**	**EXCELLENT**	
MCQ/ Programming /Project Submission Round	Above 40	Above 55	Above 65	70

Category	Assessment Criteria	Performance Levels	Weightage (Marks)
Practical Skills Proficiency	Demonstrates ability to perform job-specific tasks effectively, using relevant tools, techniques, or methodologies (e.g., Tally for accounting, consignment tracking).	Fair, Good, Excellent	20
Technical Knowledge Application	Applies theoretical concepts to practical scenarios with accuracy and relevance (e.g., compliance with GST laws, financial planning, or logistics protocols).	Fair, Good, Excellent	15
Project Execution	Completes assigned projects or use cases demonstrating innovation, thoroughness, and skill application relevant to industry standards.	Fair, Good, Excellent	25
Communication and Reporting	Clearly presents findings, solutions, or project outcomes using professional communication and documentation standards (e.g., reports, presentations).	Fair, Good, Excellent	10