SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai
Accredited by NAAC-UGC with 'A++' Grade (Cycle III) &
Accredited by NBA (B.E - CSE, EEE, ECE, Mech & B.Tech.IT)
COIMBATORE-641 035, TAMIL NADU

Robotics, natural language processing and computer vision

1. Robotics

Definition:

Robotics is an interdisciplinary field that integrates mechanical engineering, electrical engineering, computer science, and AI to design, build, and operate robots—machines capable of carrying out complex tasks autonomously or semi-autonomously.

Core Components:

Mechanical Structure: The physical frame, actuators, and joints.

Sensors: Devices to perceive the environment (e.g., cameras, LiDAR, touch sensors).

Actuators: Motors and servos enabling movement.

Controller: The brain of the robot, often a microcontroller or onboard computer.

Software/AI: Algorithms for motion planning, control, and task execution.

Types of Robots:

Industrial Robots: Used in manufacturing (e.g., robotic arms in assembly lines).

Service Robots: For customer service, cleaning, and deliveries.

Autonomous Vehicles: Cars, drones, and underwater vehicles.

Medical Robots: Surgical assistants, rehabilitation robots.

Humanoids: Robots with human-like appearance and movement.

Applications:

Manufacturing automation

Warehouse logistics (e.g., Amazon Robotics)

Healthcare (robot-assisted surgeries)

Military and space exploration

Agriculture (robotic harvesting)

Recent Trends

Integration of AI for decision-making

Human-robot interaction

Swarm robotics

Soft robotics

Edge computing in robots

2. Natural Language Processing (NLP)

Definition:

NLP is a subfield of AI that enables computers to understand, interpret, generate, and interact using human language.

Key Tasks in NLP

Text Processing: Tokenization, stemming, lemmatization

Syntactic Analysis: Parsing, POS tagging

Semantic Analysis: Named entity recognition (NER), sentiment analysis

Discourse Integration: Understanding context across sentences

Pragmatic Analysis: Understanding intended meaning in a situation

Major NLP Techniques:

Rule-Based Systems: Based on grammar rules and pattern matching.

Statistical Methods: N-gram models, HMMs.

Machine Learning Approaches: SVM, Naïve Bayes.

Deep Learning Approaches: RNNs, LSTMs, Transformers (e.g., BERT, GPT).

Applications:

Machine Translation (e.g., Google Translate)

Speech Recognition (e.g., Siri, Alexa)

Chatbots and Virtual Assistants

Text Summarization

Sentiment Analysis

Information Retrieval and Question Answering

Recent Trends:

Pre-trained language models (e.g., GPT-4, BERT)

Few-shot and zero-shot learning

Multilingual and cross-lingual models

Conversational AI and emotion-aware NLP

3. Computer Vision

Definition:

Computer vision is the field of study that enables machines to interpret and make decisions based on visual inputs (images and videos).

Core Concepts:

Image Processing: Filtering, enhancement, edge detection

Object Detection: Identifying and locating objects (e.g., YOLO, Faster R-CNN)

Image Classification: Categorizing images (e.g., CNNs)

Image Segmentation: Dividing an image into meaningful regions

Pose Estimation: Determining body/limb positions

Face Recognition: Identifying individuals based on facial features

Key Algorithms & Models:

Traditional: SIFT, SURF, HOG, OpenCV

Deep Learning: Convolutional Neural Networks (CNNs), ResNet, U-Net, Vision Transformers

Applications:

Facial recognition (e.g., security systems)

Autonomous vehicles (lane detection, object tracking)

Medical imaging (e.g., tumor detection)

Surveillance and anomaly detection

Augmented and virtual reality

Retail (inventory management, cashier-less stores)

Recent Trends:

Self-supervised and unsupervised learning

Generative AI (e.g., DALL·E, Stable Diffusion)

Multimodal AI (vision + language)

Real-time vision processing on edge devices

Interconnection Among the Three Domains:

Robotics + Computer Vision: Enables visual perception in robots (e.g., obstacle avoidance, object manipulation).

Robotics + NLP: Allows human-robot communication using speech or text (e.g., voice-controlled robots).

Computer Vision + NLP: Powers multimodal applications (e.g., image captioning, visual question answering).

All Three Combined: Form the foundation for intelligent systems like autonomous vehicles, smart assistants, and service robots.