ROBOTICS
ALLAHABAD

TSAW
Transforming Humanity

# Jigyasa

## BUILDING ON IMAGINATION

## INTRODUCTION TO KINEMATICS IN ROBOTICS USING PyBullet

# ABOUT US

**Robotics Club MNNIT** is a diverse group of robotics enthusiasts from all the college departments, which runs under the umbrella of the Student Activity Centre of MNNIT Allahabad.

Established in 2016, we are mainly concerned with building robots for academic purposes, competing at national events, or even building just out of imagination. This puts us in frequent contact with a plethora of software, hardware, and technologies, like Computer Vision, Simulation Softwares (Gazebo, Pybullet, etc.), CAD Softwares, ROS, devising algorithms, path planning, Machine Learning, Microcontrollers, Kinematics to name just a few of many. Since its creation, this club has seen the completion of hundreds of projects,

participated and won accolades in multiple national-level events, and organized various workshops with a decent footfall.

Working closely with the industries, our people regularly acquire lucrative tech giants packages, internships in IITs, and various tech companies.

Our club has also been the birthplace of a startup TSAW in the drone sector, gaining ground in the field and as a company.

We have a team of friendly experts equipped with all kinds of tutorials and workshops along with a compelling workspace to make you an integral part of this rapidly expanding world.

## Jigyasa

"Tell me and I forget, teach me and I may remember, involve me and I learn."
-Benjamin Franklin

Jigyasa is the workshop venture of the Technical clubs of MNNIT, namely Robotics, Aeroclub, and Astrowing, in collaboration with TSAW, a fully functional drone startup that emerged from our clubs. We are motivated by the desire to supplement education with the present-day industry requirements, making the participants future-ready with their skills and a problem-solving mindset.

The workshops under Jigyasa comprise various projects, activities, and interactive sessions, which will help you understand the most difficult concepts in the most comfortable manner. Hence, by emphasizing innovation and imagination, these workshops will instill in your minds a profound scientific temperament and fascination towards technology.

# OVERVIEW

*"Homo Sapiens are the best Robot ever made"*

Ever thought how the coolest looking robots of Boston Dynamics dance? Or how do those industrial robotic arms execute complex maneuvers? Here, we will teach you the math behind the movement of those legs and arms: the whole lot of simple and sophisticated calculations and concepts. We will also be discussing PyBullet: a state-of-the-art robot simulator where you will be simulating your own kinematic systems.

We will conclude with a discussion on the mathematics behind walking and balancing centre of gravity, thus making you capable to build and code your own kinematic systems, like robot arm, quadrupeds, humanoid robots,etc.

**Prerequisties:**

None

**Target Audience:**

Anyone Interested

# WORKSHOP
# SCHEDULE

## DAY 1:

- INTRODUCTION TO ROBOTICS SYSTEMS AND MANIPULATORS, GENERAL INTRODUCTION
- UNDERSTANDING THE USES AND APPLICATIONS.
- INTRODUCTION TO KINEMATICS
- UNDERSTANDING FORWARD AND INVERSE KINEMATICS
- GETTING STARTED WITH MECHANISM AND MODELS OF ARM
- ANALYSING VARIOUS ROBOTS FROM A KINEMATICS POINT OF VIEW
- ROTATION MATRICES AND DISPLACEMENT VECTORS
- UNDERSTANDING UNIFORM TRANSFORMATION MATRIX
- FORWARD KINEMATICS OF 3 DOF ARM

## DAY 2:

- INVERSE KINEMATICS OF 3 DOF ARM
- CODING FORWARD AND INVERSE KINEMATICS OF 3 DOF ARM
- DENAVIT-HARTENBERG METHOD
- INTRODUCTION TO PyBullet
- SPAWNING AN ARM IN PyBullet
- UNDERSTANDING 6 DOF ARM
- A SMALL TASK FOR NEXT DAY IN PyBullet

## DAY 3:

- FORWARD AND INVERSE KINEMATICS OF 6 DOF ARM
- SPAWNING AND CONTROLLING 6 DOF ARM IN PyBullet
- SPAWNING AND CONTROLLING HUSKY IN PyBullet
- INTRODUCTION TO HUMANOID ROBOTS
- CG BALANCING OF HUMANOID ROBOTS
- THEORY OF ZERO MOMENT POINT
- HOW TO DEVELOP ON SKILLS GAINED: PROJECTS AND RESOURCES

# OUR OTHER WORKSHOPS

## ASTRONOMY

- Beginner's walkthrough of Astronomy
- Diving Deeper into the Cosmos
- Astronomy from an Engineer's Perspective
- Establishing an Astronomy Club

## AEROSPACE

- Introduction to Flight
- A peek into the Aerospace Sector
- Getting Started with Drones
- Drone Automation
- Establishing an Aeroclub in your College
- First step to Aerodynamics with OpenVSP, F360 and Ansys

## ROBOTICS

- Kickstart your journey into Robotics
- Introduction to Artificial Intelligence
- Introduction to Kinematics in Robotics using PyBullet
- Kit-up to Set-up: To Establish a Robotics Club
- Build your own Robot
- Introduction to Simulation Software in Robotics
- Stepping into Electronics and Arduino
- Introduction to Computer Vision with Raspberry Pi
- Introduction to Autonomous Vehicles with CARLA and Imitation Learning
- Internet of Things (IoT)

## GENERAL

- Rise and Program
- Think3D: Fundamental of 3D Modelling and 3D Printing
- Learn3D: Introduction to CAD and 3D Printing