



**Bhagat Ram Labana**  
**Electrical Engineering**  
**Indian Institute of Technology Bombay**  
**Specialization: Control And Computing**

**22M1083**  
**M.Tech**  
**Gender: Male**  
**DOB: 20-03-1998**

Examination	University	Institute	Year	CPI/%
Post Graduation	IIT Bombay	IIT Bombay	2022-24	
Graduation	IIT Goa	IIT Goa	2016-20	7.13
Intermediate/+2	CBSE	JNV Chittorgarh	2015	91
Matriculation	CBSE	JNV Chittorgarh	2013	91.2

#### SCHOLASTIC ACHIEVEMENTS

- 99 % percentile in GATE 2022 among 54,292 candidates.
- Received Gold Medal for international mathematics olympiad.

#### M.TECH THESIS & SEMINAR

##### Model Predictive Control

(M.Tech Project | Guide: Prof. Harish Pillai, Department of Electrical Engineering, IIT Bombay)

[June'23-Present]

##### Current work:

- Studied **Linear MPC Regulation, Optimal State Estimation** with set-point tracking and disturbance rejection.
- Conducted study on Regulation to the origin for nonlinear and constrained systems.
- Studied **Robust MPC design**, emphasizing tube/bundle-based trajectories over single nominal trajectories.
- Conducted Study on State Estimation Technique's for nonlinear constrained systems.

##### Centrality Of One Or More Node In Graph Theory

(M.Tech Seminar | Guide: Prof. Madhu Belur, Department of Electrical Engineering, IIT Bombay)

[Aug'22-Nov'22]

- Analyzed the top-K important nodes for various conventional centralities based on the ranking of their respective centrality scores.
- Identified the key shortcomings of the existing centrality-finding techniques through a comprehensive analysis of an 8-node graph.
- Implemented a community centrality-based greedy approach to effectively identify the top-K most crucial nodes.

#### KEY PROJECTS & ASSIGNMENTS

##### Path Following and Obstacle avoidance of Robot

[Jan'23-Feb'23]

(Course Assignment | Instructor: Prof. Depasattam Paul, Department of Electrical Engineering, IIT Bombay)

- Implemented the **Pure Pursuit Algorithm** for the robot to track a path given by a set of points in a 2-coordinate system.
- Implemented the **Vector Field Histogram** for obstacle detection, collision avoidance, and steering the robot towards target.
- Tested and verified both algorithms on a robot in the ROS environment using MATLAB and Simulink.

##### Swing up and stabilization of rotary inverted pendulum

(Feb'23-Mar'23)

(Course Assignment | Instructor: Prof. Depasattam Paul, Department of Electrical Engineering, IIT Bombay)

- Designed a controller that facilitates the pendulum's upward swing to attain an upright position through **energy control**.
- Devised controller to **stabilize** the pendulum in upright position using **Linear Quadratic Regulator** optimization method.
- Integrated both the stabilization and swing-up controllers by implementation of **switching control** in simulink model.

##### Attitude Estimation Of IMU Sensor

(Mar'23-April'23)

(Course Assignment | Instructor: Prof. Depasattam Paul, Department of Electrical Engineering, IIT Bombay)

- Designed **Complementary Filter** for the Sensor fusion to perform the Attitude Estimation of IMU Sensor.
- Interfaced IMU sensor with arduino to get the readings and communicated arduino with matlab.
- Conducted a study on the design of Kalman Filters for sensor fusion to estimate the attitude of an IMU sensor.

##### Dual Axis Solar Tracking System

(May'21-May'21)

(Course Project | Instructor: Prof. Nandakumar Nambath, School of electrical science, IIT Goa)

- Conducted a literature survey on solar energy, the types of existing solar trackers, and the corresponding technologies used.
- Computed the position of the sun in Goa using astronomical equations based on its latitude and longitude at any given time.
- Designed a dual-axis solar tracking system utilizing two servo motors controlled by an Arduino Mega 2560 microcontroller.

##### Clustering And Dimensionality Reduction On an Image Data set

(July'21-Sep'21)

(Assignment | Instructor: Prof. Amit Sethi, IIT Bombay)

- Loaded, visualized, and **centered** Fashion-MNIST dataset for improved data interpretation and processing.
- Reduced the dimension of images using **PCA technique** & visualized the impact by comparing original and reconstructed images.
- Performed **cluster analysis** using **K-means** on reduced data set to group similar type of data in single group

## Linear Regression from scratch

(Jan'22-Jan'22)

(Assignment | Instructor: Prof. Amit Sethi, IIT Bombay)

- Calculated the weights using **pseudo inverse** method and also using **gradient descent** method.
- Computed the Gradient of MSE assuming the **L1 and L2 regularization** And Estimated the weights and the updated MSE.
- Analyzed the trends and relationships between training and validation **NRMSE** using **Box-Plots**.

## Classification and Feature Engineering

(Feb'22-Now)

(Assignment | Instructor: Prof. Amit Sethi, IIT Bombay)

- Developed **classification models** for the mice data for Down's syndrome treatment evaluation.
- Performed **exploratory data analysis** to identify usable variables and developed strategy to handle the missing variables.
- Optimized hyperparameters for **Linear SVM, RBF kernel SVM**, One hidden-layer **Neural Network** with Softmax output.
- Evaluated feature importance using **recursive feature elimination** to improve of the accuracy of the model.

## DC motor rotation by 180 degree (Self Project)

(Apr'21-Apr'21)

- Controlled the Position of DC Motor to some setpoint location using arduino mega Implimenting **PID** feedback controller.
- Constrained the design specifications such as rise time, settling time and overshoot by Tuning PID.

## Line Following Robot (Self Project)

(May'21-May'21)

- Implemented **PID Control** for spark-V robot to follow a continuos track using IR Sensors values as the feedback .
- Tuned the gain values boost the speed of the bot, in-order to traverse the track within 30 seconds.

## Identification Of Pizza Or Not Pizza Images (Natural Language Processing)

(Feb'22-Now)

- Deployed **Neural Network** model on a set of images using Pytorch Library to perform **Binary Classification**.
- Built A Neural Network with single input, two Hidden and single output layer with non-linear **activation functions**.
- Analysed the accuracy of test data.

## Implementing Skip-gram Word Embeddings in PyTorch (Natural Language Processing)

(Feb'22-Now)

- Preprocessed the corpus using word **tokenization, stemming, lemmatization** and using **stop word analysis**.
- Neural Network was trained to predict the **neighbours** of input source word using **skip-gram embedding**.
- Visualized word embeddings graphically and quantitatively with **cosine similarity** for trends and similarities.

## Sentiment Analysis Using LSTM (Natural Language Processing)

(Feb'22-Now)

- Implemented Neural network Model with **LSTM layer** to perform sentiment analysis on movie reviews.
- Computed the accuracy and **binary cross entropy** loss of model & visualized both graphically.

## EXPERIENCE

### Interned at Institute for Plasma Research Gandhinagar

(Guide | Sci. Officer Himanshu Tyagi)

(June'23-Present)

- Familiarized with **feedback control** by designing temperature controller for the Bulb using temperature sensor thermocouple.
- Designed a Microcontroller based **closed-loop Temperature Controller** for laser diode using relay and current as **actuator**.
- Analyzed the system with **P, PI, PD, PID**, and **ON-OFF** controllers to achieve the desired set value temperature for the laser diode.

## TECHNICAL SKILLS

- **Programming & Scripting Languages:** Python,C,C++,MATLAB
- **Tools & Libraries:** Simulink, LaTeX, Pytorch, Numpy, Pandas,NLTK, Matplotlib .

## RELEVANT COURSES

- |                             |                                 |                               |
|-----------------------------|---------------------------------|-------------------------------|
| • Applied Linear Algebra    | • Statistical Signal Analysis   | • Introduction to ML          |
| • Digital Signal Processing | • Multivariable Control Systems | • Optimal Control Systems     |
| • Matrix Computations       | • NonLinear Systems             | • Estimation & Identification |

## POSITION OF RESPONSIBILITIES

- **Teaching Assistant at IITB** for the course, **Control Systems Lab** (Aug'22-Nov'22)
- **Teaching Assistant at IITB** for the course, **Control Systems Course** (Jan'23-April'23)
- **Teaching Assistant at IITB** for the course, **Control Systems Lab** (Aug'23-Present)
- Captained the IIT Goa cricket team in the inter-IIT cricket tournament 2019. Aug'19-Feb'20

## Extra Curricular Activities

- Won gold medal for hostel in cricket in general champion ship 2023 at IIT Bombay.

- Participated in Inter-IIT cricket tournament for IIT Goa for three consecutive years.
- Attended NCC camp held at Eklingarh, Udaipur And achieved A-Grade in Certificate-A.
- Cleaned Versova Beach , Mumbai in a team of 240 in the world's largest beach clean-up campaign.