Parv Goel

Final Year Dual Degree, Department of Mechanical Engineering

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Academic Qualifications

Year	Qualification	Institution	Grade/CPI
2020 - Present	BT-MT Dual Degree	Indian Institute of Technology Kanpur	BT- 8.2 | MT- 9.2
2020	XII	B. C. M. Arya Model School, Ludhiana	93.8%
2018	X	B. C. M. Arya Model School, Ludhiana	96%

Scholastic Achievements

- Secured an **All India Rank** of **1834** in **JEE Advanced 2020** among 1.5 Lakh+ shortlisted candidates nationwide.
- Secured an **All India Rank** of **10955** in **JEE Mains 2020** among 1 million+ applicants across the country.
- Awarded with **Academic Excellence Award** for outstanding academic performance in 2022–23 at IIT Kanpur.
- Presented *Review of Laser Ignition Technology for Sustainable Transportation* at **VIIIth SEEC Conference, 2023**.

Research Experience

Optimization of Methanol Fuelled Compression Ignition Engine | Master's Thesis *July'24 - Present*

Engine Research Laboratory | Supervisor: Prof. P. A. Lakshminarayanan

Objective	Optimize performance and emission characteristics using an **electronic fuel injection** system.
Approach	➢ Modified **piston crown geometry** to attain higher in-cylinder pressure and temperature conditions. ➢ Simulated the modified design on **CONVERGE Studio** to visualize in-cylinder fuel-air interaction. ➢ Designed an **Arduino** based electronic fuel injection system capable of operating upto **90 MPa**. ➢ Investigated the effect of **injection strategies** on combustion, performance and emissions of engine.
Target	Improved **thermal efficiency** of the IC engine while reducing exhaust out hydrocarbon (HC) emissions.

Modeling Losses in Solid Oxide Fuel Cell | Under Graduate Project *May'24 - July'24*

Energy Science and Materials Laboratory | Supervisor: Dr. Abhishek Sarkar

Objective	Parametric investigation of factors influencing performance of a **H_2 Solid Oxide Fuel Cell** (SOFC).
Approach	➢ Simulated **Current Density-Voltage** (C/V) characteristics using a **zero dimensional model**. ➢ Observed effect of cell temperature, current density and hydrogen mole fraction on cell performance. ➢ Calculated **Area Specific Power** and estimated optimal operating parameters for H_2 fuel cell.
Outcome	Developed a python program to calculate operating parameters for efficient functioning of the SOFC.

Key Projects

High Speed High Power LED Driver Circuit | *Mentor: Prof. A. K. Agarwal* *Oct'23 - April'24*

Objective	Design, development and testing of high speed high power LED driver circuit.
Approach	➢ Designed and simulated an equivalent circuit on **LTspice** capable of switching high power LEDs. ➢ Assembled and soldered required **N-MOSFET** and **IC**s on a PCB to fabricate the final prototype. ➢ Measured voltage waveforms across **GATE to SOURCE** and **LED terminal** via oscilloscope. ➢ Tested LED response via **high speed camera** at different switching frequencies and duty cycles.
Outcome	Engineered a circuit capable of switching a **50W** LED up to **100KHz** with adjustable light intensity.

High Pressure Diesel Injector Driver Circuit | *Mentor: Prof. A. K. Agarwal* *May'24 - Present*

Objective	Design, development and testing of a solenoid-based high pressure diesel injector driver circuit.
Approach	➢ Measured solenoid electrical parameters using a **LCR meter** for design and simulation on **LTspice**. ➢ Developed a **current-feedback controlled** injector driver prototype based on simulated design. ➢ Tested output current waveform using **current clamp** and oscilloscope for over **20000+ injections**. ➢ Captured fuel spray using **Diffused Backlit Illumination** (DBI) and calibrated mass flow rate.
Outcome	Engineered an **Arduino UNO** based circuit capable of driving low impedance diesel injector.

Viscometery of Glycerine | *Instructor: Dr. Manjesh Kumar Singh* (Course Project) *Mar'22 - Apr'22*

Objective	Measure the **Dynamic Viscosity** of Glycerine by measuring the terminal velocity of a floating plank.
Approach	➢ Constructed a glycerine filled **static channel** measuring $180 \times 20 \times 1$ cm^3 using PVC foam sheets. ➢ Pulled a floating PVC plank by a freely falling mass using a string and pulley arrangement. ➢ Measured **terminal velocity** of plank and calculated viscosity using **Newton's Law of Viscosity**. ➢ Compared experimental and theoretical values from literature and explained possible sources of error.
Outcome	Measured viscosity of glycerine using Newton's Law of Viscosity within **10**% relative error.

Modelling Ohmic Losses in PEM Fuel Cell | *Instructor: Dr. Abhishek Sarkar* (Course Project) *Mar'24 - Apr'24*

- Executed literature review to understand working principle of **Polymer Electrolyte Membrane** (PEM) Fuel Cell.
- Developed **MATLAB** program to calculate ohmic losses using emperical relations of conductivity and water content.
- Documented the effect of membrane thickness and temperature on overpotential loss due to **ionic resistance**.

System Identification using Machine Learning | *Instructor: Prof. Malay K. Das* (Course Project) *Oct'23*

Objective	Identify governing equation of a simple pendulum using **1000+** experimentally obtained data points.
Approach	➢ Sorted input data into $\boldsymbol{\theta}$, $\dot{\boldsymbol{\theta}}$, $\ddot{\boldsymbol{\theta}}$, $\mathbf{sin(\boldsymbol{\theta})}$ and $\dot{\boldsymbol{\theta}}^{\mathbf{2}}$ to create a **Pandas** dataframe for data processing. ➢ Calculated the **Correlation matrix** to obtain **Heatmap** and propose possible hypothesis space. ➢ Estimated optimal **Hyperparameter** for **Linear Ridge Regression** model to fit the data points. ➢ Compared **mean-squared error** for each of the fitted hypothesis to identify the governing equation.
Outcome	Determined best possible governing equation for the system based on lowest MSE score of **0.02**.

Function Approximation using ANN | (Self Project) *June'24*

Objective	Approximate a non-linear function in an interval using **Artificial Neural Network** (ANN).
Approach	➢ Programmed a **Python** script to implement an ANN with a **hidden layer** and **ReLU activation**. ➢ Generated **500** randomly selected data points using **Numpy** Library to train and test the model. ➢ Trained the network over **1 Lakh epochs** through **forward** and **back propagation** algorithms. ➢ Evaluated performance through **Test Cost Function** and visualized predictions using **Matplotlib**.
Outcome	Achieved an MSE score of **132** using model and validated results against **Tensorflow** package output.

Data Oriented Analysis of Laser Ignition System | *Mentor: Prof. A. K. Agarwal* *Dec'22 - Mar'23*

Objective	Comparative performance study of Laser Ignition (LI) and Spark Ignition (SI) systems.
Approach	➢ Pre-processed the experimental data using **Weighted Moving Average** (WMA) to reduce **noise**. ➢ Estimated temperature at each point using **Redlich-Kwong** equation through **MATLAB** function. ➢ Generated MATLAB plots to qualitatively compare the temperature data for different experiments.
Outcome	Developed a computer program to pre-process, analyze and visualize data from LI and SI systems.

Two-Stroke Unmanned Aerial Vehicle Engine | *Mentor: Prof. P. A. Laxminarayanan* *April'24*

Objective	Design and manufacturing of a high-power-to-weight ratio propulsion powerplant.
Approach	➢ Explored available state-of-the-art solutions to power a small size Unmanned Aerial Vehicle. ➢ Disassembled a **two-stroke** engine to understand purpose and functioning of different components. ➢ Generated detailed CAD models and engineering drawings for individual components and assembly. ➢ Drafted a detailed document for various testing and manufacturing procedure of the product.
Outcome	Prepared 3D models and detailed documentation for testing and manufacturing of a UAV engine.

Design Anti-Vibrational Mount | *Instructor: Prof. Anindya Chatterjee* (Course Project) *Oct'21 - Nov'21*

➢ Acquired knowledge about various components of an **Anti-Vibrational Mount** utilized for damping purposes.
➢ Studied its possible applications in various domains of mechanical engineering and machine components.
➢ Prepared CAD models and engineering drawing of indivisual parts as well as assembly using **Autodesk Fusion 360**.

Technical Skills

Programming Languages	Software	Libraries
C, C++, Python, LaTeX	MATLAB, Simulink, Fusion 360, CONVERGE Studio, LTspice	Numpy, Matplotlib, Pandas, SQL, Tensorflow, Scikit-Learn

Relevant Courses

Introduction to IC Engine **(A*)**	Advances in IC engine **(A*)**	Engine Design **(A*)**
Electrical Power Engineering **(A*)**	Energy Systems-I **(A*)**	Fluid Mechanics **(A*)**
Mechanics of Solid **(A)**	Refrigeration Systems **(A)**	Machine Learning for Engineers **(A)**
Fundamentals of Electric Drives	Vibration and Control	Applied Numerical Methods
Fundamentals of Computing	Linear Algebra	Partial Differential Equations
Real Analysis	Complex Analysis	Ordinary Differemtial Equation

Extra Curricular Activities

➢ Presented **Connecting-Rod** design at **Bajaj Campus Torq Challenge 2024** during campus simulation round.
➢ Volunteered at VIIth and VIIIth Sustainable Energy & Environmental Challenges conference organised by ISEES.
➢ Participated in **Rifle Shooting Workshop** *(organised by Games and Sports Council)* and shot with 60% accuracy.