

Raj Verma

Pre-final year Undergraduate | Indian Institute of Technology, Kanpur

Majors : Mechanical Engineering | Electrical Engineering

Minors : Industrial and Management Engineering

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📄 Profile Specific Resumes

Academic Qualifications			
Year	Degree/Certificate	Institute	CPI/%
2025 (Exp.)	B.Tech. (Double Major)	Indian Institute of Technology, Kanpur	8.4/10
2020	CBSE (XII)	M.G. Convent School, Lucknow	93.6%
2018	ICSE (X)	St. Ann's Convent School, Lucknow	92.6%

Achievements

🌟 Credentials

- Granted **SURGE fellowship** for research in SURGE 2022, awarded to most accomplishing **599 students nationwide**
- Received **Academic Excellence Award 2020-21**, among **top 50 students** in IIT-K for performance in 1st semester
- Secured **All India Rank 4297** in Joint Entrance Examination Advanced 2020 among **2.5 Lakhs** shortlisted candidates
- Secured an **All India Rank 6024** in Joint Entrance Examination Mains, among **1.1 million** candidates
- Qualified Kishore Vaigyanik Protsahan Yojana(KVPY)** SA Exam Round 1, among top 4000 students nationwide
- Qualified Stage 1 of NTSE** (National Talent Search Examination), among 7500 selected for Stage 2 nationwide

Work Experience

Engine Research Laboratory, IIT-K | Research Intern 🌐 🌟Certificate (October'22 - March'23)

- Conducted advanced research in internal combustion engines, specializing in **combustion optimization, emission analysis, and alternative fuels involving imaging of flames and Motec™ - M41 E.C.U. tuning** for better engine efficiency
- Proficient in utilizing state-of-the-art instruments, including engine test beds, **dynamometers(DYNOMERK™)**, and **exhaust gas analyzers(HORIBA™)**, to analyze engine performance, vehicle vibrations and efficiency of combustion processes
- Developed expertise in **MATLAB coding and MATLAB G.U.I. development** for data analysis and visualization in engine research making code for **fuel spray imaging** data from various methods like **Schlieren, P.I.V. and thermal camera images**
- Collaborated with **industry and research partners** to address challenges in engine technology for improved efficiency and reduced emissions such as **India's first D.M.E. tractor with Tafe Motors And Tractors Ltd. (T.M.T.L., Alwar)**
- Operated various types of engines such as **Gasoline Compression Ignition (G.C.I.) engine, Gasoline Direct Injection (G.D.I.) engine and Single Cylinder Optical Research Engine (S.C.O.R.E)** using various alternative fuels
- Worked on **Laser Ignition Engine working on Hydrogen & C.N.G. blends** and performed various **Constant Volume Compression Chamber (C.V.C.C.) experiments with P.I.V. and P.D.I.** to find out complete spray characteristics
- Utilized simulation software like **Converge™** to simulate the effects of intake manifolds and injection positioning on fuel spray, enhancing understanding of engine behaviour, learned basics of **OpenFoam for modelling multi-phase flows**
- Learned about **various sensors and their integration with E.C.U.** to calibrate **Motec™ E.C.U.** for engine optimisation

Projects

► Conversion of Mechanical Direct injection single cylinder Diesel engine to dual fuel C.R.D.I. and P.F.I. engine

Mentor: Prof. Avinash K Agarwal(Dept. of ME, I.I.T.K.) | Co-Mentor: Lt. Cdr. Tushar Jain 🌟 LOR (May'23 - present)

- Converted **Kirloskar DM10** engine from mechanical direct injection to dual fuel electronic **Common Rail Direct Injection (C.R.D.I.)** for injecting Diesel as well as **Port Fuel Injection (P.F.I.)** enhancing its fuel delivery efficiency using alternate fuels
- Conducted engine inspection to address potential wall impingement issues and ensure smooth integration of new components
- Replaced mechanical injector with a **BOSCH™** solenoid injector connected to a common rail and **DELPHI™** high-pressure pump for precise and efficient Diesel delivery and **Royal Enfield (RE™) RE500** injector for port fuel delivery
- Developed electronic injector control system inspired by **Motec-M41** for simultaneous control of Diesel and Methanol injector control and integrated it with **DYNOMERK™** dynamometer for accurate engine control and performance analysis capabilities
- Multiple iterations of the fuel injection circuit were evaluated, with each subsequent iteration demonstrating superior performance and the **final circuit to be manufactured industrially** 🌐









► Design and Implementation of a custom built Dynamometer for U.A.V. Engine testing and performance analysis

Mentor: Prof. Avinash Kumar Agarwal(Department of Mechanical Engineering, I.I.T.K.) (May'23 - present)

- The project was aimed at creating a dedicated small test bed with a custom dynamometer with a **3-phase induction motor** and **in-house made motor controller** for **U.A.V. engine** testing and evaluation
- Tested a small U.A.V. engine on a **MAGTROL™** industry-standard dynamometer for the validation of the new dynamometer
- Built an in-house **Variable Frequency Driver(V.F.D.)** for precise torque and speed control enabling advanced testing capabilities allowing for precise adjustments in **torque and speed**, ensuring the dynamometer could accurately simulate various operating conditions as stated as standards for U.A.V. Engine testing 🌐

► Reinforcement learning-based design of H.V.A.C. Systems | A.M.E., I.I.T. Kanpur 🌐 (Jan'23 - March'23)

- Employed reinforcement learning, a subfield of machine learning, to optimize the design of the **Heat Ventilation And Cooling (HVAC) system**, enabling intelligent decision-making based on environmental feedback
- Incorporated techniques to develop adaptable models that learn from data and adjust system parameters for enhanced efficiency
- Demonstrated **the potential of reinforcement learning in HVAC systems**, showcasing its ability to create intelligent and autonomous control strategies that adapt to changing conditions and optimize energy consumption

- **Introduction to Image Processing** | *Course Project (EE-604)*  (Aug'22 - Nov'22)
Mentor: **Prof. Tushar Sandhan** | *Professor, Department of Electrical Engineering, I.I.T.K.*
- Learned Image Processing basics using **OpenCV** including **filters, hough transform, edge and contour detection**
 - Used basic **OpenCV** tools for making plots and image manipulation to solve a **Jigsaw puzzle** and **analyze whether two cyclones would collide in the future given their current positions**
 - Incorporated the use of **Bilateral filter** for denoising an image, further implementing **bilateral up-sampling** for colourizing an image when provided with its **downsampled colour map**
- **C.N.C. Milling Simulation** | *Course Project (ME-361)*  (Oct'22 - Nov'22)
Mentor: **Prof. Mohit Law** | *Professor, Department of Mechanical Engineering, I.I.T.K.*
- Conducted a comprehensive literature review to gain insights into force characteristics specific to **half-milling and full-milling operations**, ensuring the accuracy and reliability of the simulated results with that present in the literature
 - Used **MATLAB** to model and analyze the load characteristics on a tool during **half-milling and full-milling C.N.C. operations**, enabling a better understanding of the machining process
- **Dual Lathe Machine** | **S.U.R.G.E. 2022**  (April'22 - August'22)
Mentor: **Prof. Ishan Sharma** | *Professor, Department of Mechanical Engineering, I.I.T.K.*
- Designed a **user-friendly versatile dual (horizontal and vertical) Lathe Machine** prototype for wood turning, enabling the simultaneous production of **4 nested dolls** allowing even unskilled individuals to operate the machine
 - Employed rigorous stress analysis techniques of stress-concentrated regions using **ABAQUS** and **Fusion in-built ANSYS support** for enhancing the **machine's structural integrity and optimising performance**
 - Secured a patent for the **chuck design**, a crucial component of the Lathe Machine, which exhibited innovative features to **enhance clamping precision and facilitate swift material changes** making it far better than conventional chucks 
 - The project culminated in the creation of a comprehensive final **C.A.D. design for the Dual Lathe Machine**. This integrated design encompassed all components, ensuring seamless functionality, high efficiency, and scalability 
- **Designing of a cheap Micro-Manipulator** (July'22 - Sept'22)
Mentor: **Prof. Manjesh Singh** | *Assistant Professor, Department of Mechanical Engineering, I.I.T.K.*
- Designed a **low-cost Micro-Manipulator** controlled by **servo motors** using Arduino and an **Arduino-based G.U.I.**
 - Conducted **literature review on Micro-Manipulators** and their **working mechanisms realisation** using servo motors
 - Unfortunately, the project was halted due to budget approval challenges and inefficiency of servo motor precision and challenging costs of making the device resulting in the **non-manufacturing of the Micro-Manipulator**
- **Probe station for Micro-Manipulators**  (July'22 - Sept'22)
Mentor: **Prof. Manjesh Singh** | *Assistant Professor, Department of Mechanical Engineering, I.I.T.K.*
- Developed a **cheap alternative Probe station** for attaching colloidal particles to **Atomic Force Microscope (A.F.M.) tips**
 - Conducted literature review on **Stereo microscopes** to select an appropriate model for integration in probe station
 - Utilized **Fusion 360** to design the probe station, incorporating insights from analyzing various pre-existing probe station designs
 - Leveraged **3D printing technology** to efficiently manufacture various parts of the probe station
 - Integrated the stereo microscope into the probe station for precise positioning of **colloidal particles on A.F.M. tips**.
- **Portable Tribometer** | *Course project (ME-222)*  May'22
Mentor: **Prof. Chanraprakash Chindam** | *Professor, Department of Mechanical Engineering, I.I.T.K.*
- Developed a **portable pin-on-disc Tribometer** to measure the wearing coefficient of various material systems
 - Built the Tribometer from scratch, incorporating a **small weighing machine** to accurately calculate **friction force**
 - Conducted experiments using different **metal pins(e.g., Aluminium, Mild Steel)** to measure wear rate and wear coefficient
 - Measured the wear coefficient of soft metals like **Aluminium** and **failed for Mild-Steel** using the pin-on-disc Tribometer
- **Rotating Expanding table** | *Course project (TA-201)*  Nov'21
Mentor: **Prof. Vivek Verma** | *Professor, Department of Material Science & Engineering, I.I.T.K.*
- Conducted an extensive literature review on various expanding table designs to gather inspiration and working mechanisms
 - **Utilized Fusion 360** to design a functional CAD model of a rotating expanding table, incorporating innovative features
 - Optimized part designs and performed a thorough analysis to ensure structural integrity under different load cases
 - Created a **C.A.D. model of an expanding table** that exhibits a significant increase in surface area when fully expanded

Mentored Projects

- **Image Processing in MATLAB** | *A.M.E., IIT Kanpur* Jan'23 - April'23
 - Teaching **40 students about fundamentals of MATLAB** and **Image processing concepts** using various examples
 - Teaching students to gather data such as penetration length and plume area from a set of Fuel injection sprays
 - Teaching students about **Image Processing Toolbox and application development in MATLAB**
- **Last Mile Transporter (LMiT 22)** | *Robotics Club, IIT Kanpur* May'22 - July'22
 - LMiT is a delivery robot originally designed to deliver small loads within hostels
 - Responsible for teaching students about design and simulation software such as **Fusion 360 and Abaqus**
 - Responsible for design and manufacturing of the complete robot and a non-pneumatic tyre used in the delivery robot
- **Holonomic Advanced Mechatronic Droid (HAM-D)** | *Robotics Club, IIT Kanpur* May'22 - July'22
 - Designed a small robot inspired by BB-8, HAM-D using the mechanism of a **2 wheel self-balancing robot**
 - Responsible for teaching students about design, simulation and CAM softwares such as **Fusion 360 and Abaqus**
 - Designed the complete structure of the robot in Fusion 360 and manufactured the complete robot

- **Rover Base** | *Robotics Club, IIT Kanpur* May'22 - July'22
 - Base of the Mars rover was designed as a summer project to compete in **U.R.C.(University Rover Championship)**
 - Responsible for teaching students about design, **simulation and CAM softwares such as Fusion 360 and Abaqus**
 - Performed an extensive analysis and simulation of each and every part to be used in the base of the rover

Positions of Responsibility

- **Career Department Mentor(C.D.M.)** | *Mechanical Department (Academics and Career council)* July'23-present
 - Worked in collaboration with the research wing and career development wings of the **Academics and Career council**
 - Organized regular formal and informal sessions for the entire department or their batches of assigned mentees regarding sem-exchange, research scholarships, international opportunities, internships, industrial scope, etc
 - Acted as a link between intern core team, companies and Students during intern process.
- **Problem Statement Lead (I.S.R.O. Moon mapping challenge)** | *Inter I.I.T. Tech 11.0* February '23
 - Secured the **Bronze Medal** in the competition among the **21 participating I.I.T.s** 🏆
Certificate
 - Led the team for the development of an **AI/ML model** to generate a high-resolution map of the moon using **Chandrayaan-1, Chandrayaan-2** Orbiter's imaging payloads considering only **OHRC** and **TMC** images
 - Created alternative viewing method of the **LSB2 images** using **MATLAB** apart from the **pre-existing PDS4 viewer** as every image was nearly **10 Gigabytes in size with a pixel depth of 16 bits**
 - Generated a **global lunar atlas (digital) with the help of MATLAB**, based on the medium/low-resolution data available by creating an **effective image stitching method** and creating data store for such large-size images
 - Developed an innovative AI/ML model utilizing overlapping data from the **Orbiter Higher Resolution Camera (OHRC) and Terrain Mapping Camera-2 (TMC-2)** payloads to generate high-resolution lunar terrain images
- **Organizer 8th Sustainable Energy and Environmental Challenges Conference** | *I.S.E.E.S.* Dec'22 🏆
Certificate
 - Responsible for **managing hospitality of guests at I.I.T. B.H.U. and nearby available hotels**
 - Simultaneously managed **3 tracks for various posters and research thesis presentation**
 - Responsible for managing **High tea** for the guest during **mid-conference breaks**
 - Responsible for **distribution of certificates and bill receipts** for the non-invited speakers
- **Senior Academic Mentor (S.A.M.)** | *Dynamics(ESO209)* July'22 - Jan'23
 - Voluntarily helping students academically with **Counselling Service Core team members (CTMs)**
 - Responsible for teaching and helping students about various concepts in **ESO209(dynamics)**
 - Providing academic help to students unable to perform well academically

Technical Skills

- **Computer Aided Design software:** Fusion 360, Autodesk Inventor, Solidworks, KiCAD, Autodesk EAGLE
- **Analysis and Simulation software:** OpenFoam, Abaqus, Lotus-Shark, GIM, Autodesk C.F.D., Fusion 360(inbuilt simulation)
- **Computer Aided Manufacturing software:** Fusion 360(inbuilt manufacturing), MasterCam
- **Programming Languages:** C/C++, Python, Java, MATLAB, Simulink, Arduino framework
- **Video editing:** Adobe After Effects, iMovie, Adobe Premier rush

Relevant Courses

Alternative fuels & advancement in I.C. engines* Microelectronics Manufacturing Science & Technology Multivariate Calculus* Dynamics * Engineering Design and Graphics * Linear Algebra and Differential Equations Fundamentals of Computing	Image Processing Power Electronics Energy system-I* Nature and properties of Materials** Introduction to manufacturing processes* Partial Differential Equation Thermodynamics Introduction to Electrical Engineering	Energy Systems* Vibration & Controls Advance Mechanics of Solids Mechanics of Solids Engineering Graphics* Introduction to Complex Analysis Fluids Introduction to Electronics
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* : Awarded A grade ** : Awarded A* grade ° : online course