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DEPARTMENT OF MECHANICAL ENGINEERING

MECHTRON 2K24

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MECHANICAL ENGINEERING ASSOCIATION

MECHTRON 2K24

MECHTRON'24

It is an annual magazine, brought out by Rohini College of Engineering & Technology, Kanyakumari. The articles published are copy-righted. If you have any queries or feedback, address them to machtrons2k24@gmail.com

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ABOUT DEPARTMENT

The Department of Mechanical Engineering started in the year 2012 with an initial intake of 60 students to the B.E Program and increased to an intake of 120 students from 2013 and 180 students from 2014. The Department offers ME Thermal Engineering programme from 2015 with an intake of 24 students. The Department is a recognized research centre by Anna University Chennai from the year 2019. The department accomplish outcome Based Education which help the students to learn, develop and serve to the society. The Departmenthas experienced and dedicated faculty with a wide range of specialization namely Thermal Engineering, Engineering Design, Manufacturing Engineering, Energy Engineering, CAD/CAM, Industrial Engineering and Mechatronics.

The faculty members have published more than 100 papers National/Internationaljournals/Conference and had written books, filed patterns during the last 3 years and receivedmany awards. The students were motivated by providing lot of opportunities like technical presentation in Symposium, conferences for skill development. The department provide value added knowledge to under graduates and post graduate students. Apart from curriculum students were motivated to participate in sports. The department has well established laboratory facilities to conduct research work on different specialized areas like Material Science, Renewable Energy, Thermal Science. The students of the department have received external research funding from Tamil Nadu State council for Science and technology in recent years. The students of the departments have joined in reputed industries through placements and some of them are turned to be an entrepreneur. The department has a good network of alumni.

VISION

To inculcate competence in the field of mechanical engineering for the students by providing quality education and learning opportunities to become ethically strong engineers for the development of society.

MISSION

To provide fundamentals and technical skills in Mechanical Engineering through effective teaching-learning methodologies.

To provide an ambience for research through collaborations with industry and academia.

To inculcate the students' leadership quality through employability skills with ethical

PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S)

PEO: 1

Graduates will apply the knowledge of Mechanical Engineering concepts and innovative methods to solve real world Engineering problems

PEO: 2

Graduates will have the required qualities for a successful carrier in Mechanical Engineering and related fields.

PEO: 3

Graduates will exhibit the professional skills with ethical values, Communication skills and team spirit.

PROGRAMME SPECIFIC OBJECTIVES (PSO'S)

PSO: 1

Graduates of the program will achieve optimized design by utilizing their knowledge in thermalengineering, material science, manufacturing, fluid

PSO: 2

Graduates will be able to analyse and interpret by using modern tools and provide solutions toreal time mechanical engineering and related problems.

PSO: 3

Graduates will learn managerial skills to work effectively in a team and are aware of the impact of professional engineering solutions in human community, environmental context, ethics and be able to communicate effectively.

Chairman's Message

"Education is for improving the lives of others and for leaving your community and world"

I deem it to be a matter of immense pleasure and honour for me to address you all through the website of ROHINI College of Engineering & Technology. It is indeed very heartening to witnessthat the college has carved a name for itself in the academicscenario of the region. Education is the mostpowerful tool to bring desirable changes in ourpersonality and also to bring positive changes in oursociety. It is the only medium which enables you to move from darkness to brightness.

Dear friends, I strongly believe that, there can be no better way to drive and improve our nation's prosperity and social economic well-being than through its education system. I also believe that, technocrats are the key to continued economic and technological advancement of our country.

I would take this opportunity to urge you all to focus on all round development. You should always have your education laced with morality and ethics. This task has to be taken over by the academicians to provide value and ethic based education. You should all remember that, "honesty is the first chapter in the book of wisdom" and we should inculcate honesty and integrity in all what we do.

I earnestly hope and trust that, my esteemed academicians and budding technocrats will work with sincerity, honesty and dedication and thereby contribute to make this world a better place to live in.

Best Wishes,

Shri.K.NEELA MARTHANDAN

Chairman

ROHINI Groups.

Principal's Message

'We make technocrats, who proudly say 'I am an Engineer; I serve mankind, by making dreams come true.'

The major challenge for today'S engineering educational institutions is to accommodate the evervarying aspirations of the younger generation because of increasingly changing demand and development in industries. We constantly put efforts to accommodate these aspirations by fine tuning the academics of college with innovative and practical oriented teaching learning practices along with other developmental activities.

idealistic, but this is precisely our long term goal. It is what motivates the work of everyone at the ROHINI College of Engineering and Technology from faculty and staff, to students and alumni. It inspires our teaching and research. It is this goal which fuels the faculty to excel

Our approach reflects the educational needs of the 21st century. We focus on our students by providing them with a world-class outcome based education and hands-on experience through resear research, training, and student forum activities activities etc. The success of our undergraduate, postgraduate & research programs is supervised by our eminent faculty, who continue to set the standard for excellence. There is continuous check on the implementation of planned academic activities with desired results in grooming our future generation for employment and for higher studies in India and abroad. A research culture has taken shape in the institute through enhanced IR & D activities. We believe in continuous development and strive to carry on the best efforts and endeavours towards the benefibfstudents.

Our University results and placement speaks about our excellence with many of our students bringing laurel to the college by getting highest ranking in university exams and huge number of students are placed in national & multinational companies, moreover our students' creativity and determination is evident by this continuous success in various fields. Our institute stands by its core values, mission of churning out well-rounded individuals and thorough professionals.

Best Wishes,

Dr.R.RAJESH, M.E., Ph.D.

Principal

Rohini College of Engineering & Technology

HOD's Message

Mechanical engineering is one of the oldest and broadest engineering discipline, and plays a significant role in enhancing safety, economic vitality, enjoyment and overall quality of life throughout the world. Aprerequisite for development is growth and that is directly related to production or output of a country. A warm and Green Greetings from the Department of Mechanical Engineering at RCET

A warm and Green Greetings from the Department of Mechanical Engineering at RCET. The college has been simply unstoppable in its progress asit has been actively involved in various activities that have brought to light the hidden talents of the college students and staff. Mechanical Engineering is a professional Core engineering discipline that deals with the design, production and maintenance of any produce of any industry

Our department has a team of highly qualified and experienced faculty, good infra structure and lab facilities. We are striving hard continuously to improve upon the quality of education and to maintain its position of leadership in engineering and technology. We always work withthe motto "Nothing can be achieved without genuine effort." The core values of the departmenthelp the students to develop their overall personality and make them worthy to compete and work at global level. Our faculty are continuously attending various training programs, publishing research papers, books and filing patents. Many are pursuing research. Our department has been conducting seminar / conferences to keep the faculty and students abreast with the latest developments in the field of technical education. We are happy to share that many students are pursuing higher studies in leading universities in India and abroad. I am certain that our students will prove to be an invaluable asset to an organization. We, Mechanical engineers to build the nation

Best Wishes,

Dr.kailainathan M.E, Ph.D
HOD of Mechanical Engineering,
RCET.

Dean's Message

As we reflect on another dynamic year in our Mechanical Engineering Department, I am filled with pride and gratitude for the remarkable achievements and innovations that have emerged from our community. Our commitment to excellence in education, research, and collaboration continues to shape the future of engineering.

This year has been particularly exciting, with our students showcasing their talents in various competitions, from robotics to sustainable design. Their hard work and creativity are a testament to the strong foundation we provide, nurturing not only technical skills but also critical thinking and problem-solving abilities.

Our faculty remain at the forefront of research, pushing boundaries in areas such as renewable energy, advanced materials, and robotics. Their dedication to mentorship and innovation inspires our students to strive for greatness and contribute to impactful projects that address real-world challenges.

As we look forward, we must embrace the opportunities and responsibilities that come with being engineers in a rapidly evolving world. I encourage you all to stay engaged, collaborate across disciplines, and continue to explore the limitless possibilities that lie ahead.

Thank you for being an integral part of our community. Together, we will continue to advance the field of mechanical engineering and make a difference in the world.

Warm regards,

Best Wishes,

Dr.D.Prince Sahaya Sudharsan M.E, Ph.D
Dean,
(Industry Institute Interface)
RCET.

Editor's Message

It gives us great pleasure to bring you issue of MECHTRON 2024,the Mechanical department technical magazine of Rohini College of Engineering and Technology, Kanyakumari

The objective of the magazine is to mainly focus on Achievementof the students from the Mechanical Engineering department in the Co-curricular and Extra-Curricular Activities

The name and fame of an institute depends on the caliber and achievements of the students and teachers. The role of a teacher is to be a facilitator in nurturing the skills and talents ofstudents. This magazine is a platform to exhibit the literary skills and innovative ideas of teachers and students MECHTRON 2024 presents the skills and innovative thinking of students and contributions of teachers

We are also thankful to our Management and Principal for their support and encouragement.. Last but not the least we are thankful to all the authors who have sent their articles. We truly hope that the pages that follow will make an interesting read.

Dr.M.EZHILAN
Prof. / MECH
Editor of Department Magazine
ROHINI College of Engg. And Technology

FACULTY ARTICLES

1. Soft Robotics

INTRODUCTION

Soft robotics is a growing field which relies on mimicking locomotion mechanisms of soft bodies existing in nature to achieve smooth and complex motion. Soft robots are primarily composed of easily deformable matter such as fluids, gels, and elastomers that can match certain materials, in a process called compliance matching. Many soft robots are inspired by biological organisms, leveraging natural movement mechanisms to achieve complex locomotion. This includes designs that mimic creatures like octopuses, which use their soft bodies for efficient movement. Soft robots utilize unique actuation systems that do not rely on rigid components. Instead, they often employ fluidic actuators made from elastomeric materials which can bend, twist, or contract in response to changes in pressure. This allows for smooth and adaptable movements.

COMPLIANCE MATCHING

Compliance matching is the principle that materials that encounter each other should share similar mechanical rigidity to evenly distribute internal load and minimize interfacial stress concentrations. However, this principle does not apply to rigid robots (Young's Modulus of order 109 Pa) interacting with soft materials (Young's Modulus of order 102-106 Pa), causing damage or mechanical immobilization. These types of interactions with soft materials are widely spread, as for instance with natural skin, muscle tissue, delicate internal organs, but also organisms, artificial replications of biological functionalities, etc. Due to this dramatic mismatch in mechanical compliance, it is easy to conclude that rigid robots are not adapted and even dangerous for intimate human interaction. Therefore, there is a need of robots that match the elastic and rheological properties of materials and organisms found in nature, and this is where soft robots could bring the solution. Soft robots are designed to be safer for human interaction due to their flexible materials, which reduce the risk of injury during contact. Their soft bodies allow them to squeeze into tight spaces, making them particularly useful in applications such as search and rescue operations or minimally invasive surgeries.

COMMON MATERIALS USED IN SOFT ROBOTICS

Silicone Elastomers:

Silicone is one of the primary materials used for soft robots due to its excellent flexibility and durability. It can be easily moulded into complex shapes and provides good mechanical properties, making it suitable for various applications, including pneumatic actuators.

Hydrogels: Hydrogels are water-swollen polymer networks that exhibit significant elasticity and can change their properties in response to environmental stimuli. They are often used in applications requiring biocompatibility, such as medical devices.

Fluids:

Pneumatic and hydraulic systems often utilize fluids to create motion within soft robots. These systems can generate significant forces through controlled pressure changes, enabling various movements like bending and twisting.

Dielectric Elastomers:

These electroactive polymers deform when subjected to an electric field, allowing for actuation without mechanical components. They are lightweight and can be integrated into soft robotic designs for precise control of movement.

Shape-Memory Alloys (SMAs):

Although primarily metallic, SMAs can be incorporated into soft robotic systems to provide actuation through thermal changes. They exhibit shape memory effects, allowing them to return to a predetermined shape upon heating.

Liquid Crystalline Elastomers (LCEs):

LCEs are smart materials that can undergo large shape changes when exposed to light, making them suitable for applications requiring responsive movement.

Reinforcement Materials:

Soft robots often include reinforcement layers made from materials like fabrics or fibres to enhance structural integrity while maintaining flexibility. These reinforcements help distribute stress and improve overall performance during operation.

Challenges

The challenges in soft robots span across multiple aspects, including materials, design, control, actuation, and integration with other systems. The inherent flexibility of soft robots complicates control strategies, as traditional robotic control methods often do not apply effectively. While soft materials offer many benefits, they also pose difficulties in terms of durability and performance under various conditions.

Conclusion

Soft robotics represents a promising frontier in robotic technology, with the potential to revolutionize industries ranging from healthcare to agriculture to exploration. While there are still challenges to overcome, advancements in materials science, actuation technologies, and control algorithms are rapidly improving the capabilities of soft robots. As these challenges are addressed, the applications of soft robotics will continue to expand, offering solutions that are safer, more adaptable, and more efficient in complex and dynamic environments.

BINY R. WISTON
ASSISTENT PROFFRSOR
MECHANICAL DEPARTMENT

Analysis of Wire Electrical Discharge Machining of Inconel 718 Alloy using Grey Relation method

ABSTRACT

The objective of the present work is to optimize Wire Electrical Discharge Machining (WEDM) process parameters of Inconel 718 alloy with multiple performance characteristics such as Material Removal Rate (MRR) and Surface roughness based on the Taguchi – Grey Relational Analysis. The process parameters considered in this work are Pulse On-time, Pulse Off-time, Wire Feed and Gap Voltage. The experimental results were analysed with Analysis of Variance (ANOVA) to find the relative contribution of machining parameters in controlling the responses. Response tables and graphs were used to find the optimal levels of parameters in WEDM process. The confirmation experiments were carried out to validate the optimal results.

Keywords: Wire Electrical Discharge Machining, Taguchi method, Orthogonal Array, Analysis of Variance, Grey Relational Analysis

1. INTRODUCTION

Wire electrical discharge machining process is a highly complex, time varying & stochastic process. This is used in the fields of dies, molds; precision manufacturing and contour cutting etc. Any complex shape can be generated with high grade of accuracy and surface finish using CNC WEDM. The output of the process is affected by large no of input variables. Hence a suitable selection of input variables for the wire electrical discharge machining (WEDM) process depends heavily on the operator's technology & experience. WEDM is extensively used in machining of conductive materials when precision is of prime importance. Rough cutting operation in WEDM is treated as a challenging one because improvement of more than one machining performance measures viz. metal removal rate (MRR) and surface finish (SF) are sought to obtain a precision work (1).

). WEDM is an electro-thermal process where the material removal mechanism is achieved by electrical discharges occurring between an anode (usually the tool electrode) and a cathode (the work piece) submerged in a fluid dielectric. These electric discharges melt and vaporize minute amounts of the work material, which are then ejected and flushed away by the dielectric fluid (2). i.e., the tool and the work piece are electrically conductive. There is no contact between the tool and the work piece. On the other hand, the wire is continuously moving at a constant speed.

In order to generate a discharge, the WEDM machine power supply applies a voltage between work piece and wire during the ignition delay time. The ignition delay time is the time period between the application of the voltage and the ignition. Before

applying the voltage for the next discharge, the dielectric cools the gap and removes the erosion debris during a period of time known as off-time. One of the main research fields in WEDM is related to the improvement of the process productivity by avoiding wire breakage. Different factors can lead to wire breakage such as a decrease in flushing pressure, inefficient removal of erosion debris as well as other types of stochastic phenomena that appear during the cutting process. In such a case, the cutting process is stopped and the wire has to be threaded again, involving an undesired waste of time. Therefore, it would be desirable to diagnose in advance low quality cutting regimes and, consequently, predict wire breakage, in order to perform an on-line readjust of the machine parameters before it happens (3).

To evaluate the effects of machining parameters on performance characteristics (MRR and surface roughness), and to identify the performance characteristics under the optimal machining parameters, a specially designed experimental procedure is required. Classical experimental design methods are too complex and difficult to use. Additionally, large number of experiments has to be carried out when number of machining parameters increases.

Taguchi method, a powerful tool for parameter design of performance characteristics, was used to determine optimal machining parameters for maximum MRR and minimum surface roughness in WEDM. In Taguchi method, process parameters which influence the products are separated into two main groups: control factors and noise factors

. The control factors are used to select the best conditions for stability in design of manufacturing process, whereas the noise factors denote all factors that cause variation. Taguchi proposed to acquire the characteristic data by using orthogonal arrays, and to analyze the performance measure from the data to decide the optimal process parameters. This method uses a special design of orthogonal arrays to study the entire parameter space with small number of experiments only (4).

1. EXPERIMENTAL DESIGN

2.1 MATERIAL SELECTION

Inconel 718 has been considered in this present work. It is a Nickel-Chromium alloy being precipitation hardenable and having high creep-rupture strength at high temperatures to about 700°C. These alloys might be used in any environment that requires resistance to heat and corrosion but where the mechanical properties of the metal must be retained. it is very difficult to machine Inconel 718 alloy by conventional machining processes and moreover by conventionally used tool materials. Of late, modern machining techniques such as WEDM are increasingly being used for machining such hard materials. Hence, this study focused on machining of Inconel 718 using WEDM in order to satisfy production and quality requirement.

The compositional range for Inconel 718 alloy is provided in Table 1 and typical properties are shown in Table 2. These alloys found applications in Aerospace, gas turbines, rocket motors, spacecraft, space shuttles, nuclear reactors, pumps, turbo pump seals, and tooling.

Table 1. Chemical composition of Inconel 718

Element	Nickel	Iron	Chromium	Niobium	Molybdenum	Others
composition (%)	52.29	19.18	17.9	5.1	3.06	2.47

Table 2. Properties of Inconel 718

Property	Density	Melting Point	Coefficient of Expansion	Modulous of Rigidity	Modulous of Elasticity
Metric	8.19 g/cm^3	1336°C	13 µm/m °C	77.2 KN/mm^2	204.9 KN/mm^2

2.1 Selection of WEDM process parameters

The WED machine used in this investigation was EZEECUT PLUS EZ-01 and the dielectric used was de-ionized water. A brass wire of 0.25mm diameter was used as tool electrode for experimentation. The selection of the machining parameters was presented in Table 3. Specimens of 5 mm x 7 mm x 10 mm were machined from a plate of size 120 mm x 100 mm x 10 mm.

Surface roughness (Ra) of the machined specimen was measured by Mitutoyo surftest SJ-201P surf tester. Material removal rate (MRR) of the work piece can be calculated using the formula (1):

MRR = VC b t (mm3/min) (1)

Where,

VC = Cutting speed, (mm/min)

b = Width of cut (kerf), mm

t = Thickness of the work piece, mm

Width of cut is directly measured by using video measuring system.

Table 3. WEDM Process Parameters and levels

Level	Machining Parameters			
	Pulse on time T_{on} (µs)	Pulse off time T_{off} (µs)	Wire feed (m/min)	Gap voltage (Volts)
Level 1	4	4	60	70
Level 2	6	5	70	80
Level 3	8	6	80	90

2.1 GREY RELATIONAL ANALYSIS

The grey theory provides an efficient management upon the uncertainty, multi-input and discrete data (5,7). In grey relational analysis, black represents no information where as white represents all information. A grey system has a level of information between black and white (6). The grey relational analysis is actually a measurement of the absolute value of the data difference between sequences, and is also used to measure an approximate correlation between sequences. It is an effective means of analyzing the relationship between the sequences with less data and can analyze many factors (8). In this work, the grey relational analysis is used to investigate the multiple performance characteristics in the optimization of composite machining process. The following steps are used to perform optimization of WEDM parameters.

Step 1: Normalize the measured values of surface roughness and material removal rate ranging from zero to one. This process is also known as Data pre-processing

Step 2: Generate Grey relational values using the required characteristics. Since both surface roughness and material removal rate cannot be optimized for minimum value, lower the better and higher the better characteristics are used to get the minimum surface roughness and maximum material removal rate respectively.

Step 3: Calculate Grey relational co-efficient (GRC) to represent the relationship between the desired and actual data.

Step 4: Calculate Grey relational grade (GRG) by averaging the grey relational co-efficient values.

Step 5: Perform statistical analysis of variance (ANOVA) for the input parameters with the Grey relational grade and to find which parameter significantly affects the process.

Step 6: Select the optimal levels of process parameters.

Step 7: Conduct confirmation experiment and verify the optimal process parameters setting.

In grey relational analysis, data are first pre-processed to normalize the raw data for analysis. Considering a grey system where a set of variables yi depend on certain independent factors xi, then normalized experimental results xi(k) can be expressed if the performance characteristic is higher the better as:

$x_i(k)=$ (2)

If the performance characteristic is lower the better pattern, then:

$x_i(k)=$ (3)

The grey relational coefficient ξi, is calculated to express the relationship between the ideal (best) and the actual normalized experimental results is given as:

ξi = (4)

The overall evaluation of the multiple variables is based on the grey relational grade, which is computed by averaging the grey relational coefficient corresponding to each performance characteristics.

1. Results and discussion

The experiments are conducted according to Taguchi's L9 orthogonal array corresponds to 9 different experiments. Grey relational approach converts a multiple response process optimization problem into a single response optimization situation with the objective function of an overall grey relational grade. Table 4 shows the values of Material Removal Rate (MRR), Surface roughness (Ra), grey relation coefficient (GRC) and grey relational grade (GRG) for each experiment.

Table 4. Grey Relational Co-efficient and Grey Relational Grade for MRR and R_a

T_{on} (µs)	T_{off} (µs)	Wire feed (m/min)	Gap Volt (V)	MRR (mm^3/min)	R_a (µm)	GRC		GRG
						MRR	R_a	
4	4	60	70	2.4	2.89	0.366	0.333	0.35
4	5	70	80	2.05	1.49	0.35	1	0.67
4	6	80	90	1.65	2.14	0.333	0.519	0.42
6	4	70	90	7.23	2.02	1	0.569	0.78
6	5	80	70	5.92	2.19	0.682	0.5	0.59
6	6	60	80	3.75	1.99	0.445	0.583	0.51
8	4	80	80	5.6	2.16	0.631	0.511	0.571
8	5	60	90	4.24	2.41	0.483	0.432	0.458
8	6	70	70	3.4	2.73	0.421	0.361	0.391

Figure 1 shows the grey relational grade for maximum Material Removal Rate and minimum surface roughness. It shows that parameter combination A2, B2, C2, D2 i.e., pulse on time 6 µs, pulse off time 5 µs, wire feed 70 m/min and gap voltage 80 V is the exact combination for both MRR and Ra.

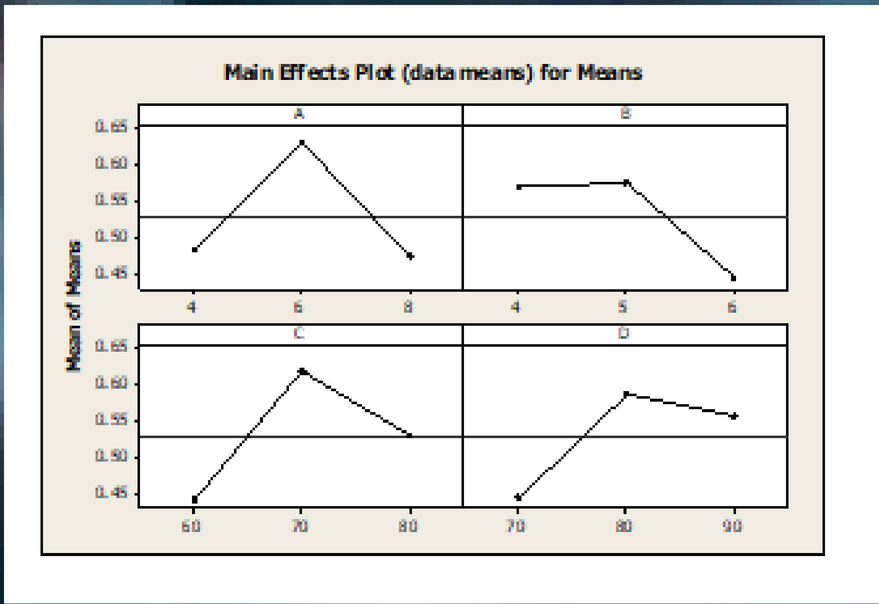


Figure 1. Response Graph for Grey Relational Grades.

The mean of the grey relational grade for each level of the machining parameters on the responses can be calculated and the response table for grey relational grades is given in table 5. It is clear that wire feed is the major factor which plays a vital role in machining Inconel 718 alloy. Factor pulse on time is second and is followed by factors gap voltage and pulse off time.

Table 5. Response Table for Grey Relational Grades

Level	Pulse On Time	Pulse Off Time	Wire Feed	Gap Voltage
1	0.4837	0.5687	0.4407	0.4440
2	0.6300	0.5747	0.6170	0.5867
3	0.4733	0.4437	0.5293	0.5563
Delta	0.1567	0.1310	0.1763	0.1427
Rank	2	4	1	3

Taguchi method cannot judge and determine the effect of individual parameters on entire process while percentage contribution of individual parameters can well be determined using Analysis of Variance (ANOVA). MINITAB15 software of ANOVA module was employed to investigate the effect of process parameters (9). The results obtained from the experiments were analyzed using ANOVA to find the significance of each input factor on the measures of process performances Material Removal Rate and surface roughness. Using the grey relational grade value, ANOVA is formulated for identifying the significant factors. The results of ANOVA are presented in Table 6.

Table 6. ANOVA Table for Grey Relational Grades

Source	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	% contribution
A	2	0.04606	0.02303	28.89%
B	2	0.03282	0.01641	20.58%
C	2	0.04664	0.02332	29.25%
D	2	0.03389	0.01694	21.26%
Total	8	0.15942	---	---

From ANOVA table, it is clear that Wire Feed is the major influencing factor contributing 29.25% to performance measures, followed by pulse-on time contributing 28.89%, gap voltage contributing 21.26% and pulse-off time contributing 20.58%.

1. CONfirmation experiment

The confirmation test for the optimal parameter setting with its selected levels was conducted to evaluate the quality characteristics for WEDM of Inconel 718 alloy. Optimal process parameter set of A2B2C2D2 has the best multiple performance characteristics among the nine experiments. If the optimal setting with a pulse on time of 6 µs, pulse off time of 5 µs, wire feed of 70 m/min and gap voltage of 80 V is used, the final work piece gives the maximum Material Removal Rate of 5.55 mm3/min and average surface roughness of 1.39 µm.

1. CONCLUSION

Taguchi's Grey Relational Analysis was applied in this work to improve the multi-response characteristics such as Material Removal Rate (MRR) and Surface Roughness (Ra) of Inconel 718 alloy during WEDM process. The conclusions of this work are summarized as follows:

The optimal parameters combination was determined as A2B2C2D2 i.e., pulse on time of 6 μs, pulse off time of 5 μs, wire feed of 70 m/min and gap voltage of 80 V.

The Analysis of Variance resulted that wire feed and pulse on time have major influence on the responses.

This work demonstrates the method of using Taguchi methods for optimizing the EDM parameters for multiple response characteristics

S.T.ARJUN

ASSISTENT PROFFRSOR

MECHANICAL DEPARTMENT

STUDENT ARTICLES

1. Hydraulic Flood Protection System

Flooding is one of the very common and critical natural events that disrupts human lives globally. Around 2.2% which makes up almost 2.9% of the worlds population live in regions that have 10% flood probability in every 50 years. Moreover increase in global warming is said to further increase flooding events in near future. Though flooding leads to loss of life, it leads to even more loss of property as property is immovable unlike humans that can go to higher places. There is absolutely no way to save a house in case of flood hits the area.

Well we here attempt to solve this problem by designing a mechanism that can save houses in flooding events. The system uses hydraulics to actually lift a house as per water level to escape flood water in such events. This is a futuristic concept that has to be done before construction of the house n order to work. We develop a small model with a model house to demonstrate the concept. It involves firstly developing the house on a thick steel frame platform.

The concept involves 3 steel rods buried atleast 3 meters below the ground and 3 meters above ground for withstanding flood impacts. The supporting rods are used to keep the house steady in case of strong winds/storm in flood prone region. The steel platform is attached with 4 hydraulic cylinders mounted on 4 corners of the house. The cylinders are used to create the lift needed to lift the house in an upright manner without any jerking when needed.

We hereby use a high torque motor to operate the hydraulics. The motor is a 2 way motor that is used to drive fluid into and out of 4 cylinders as and when needed. Whenever the water level rises the user can choose to lift the house. We hereby use the same flood water to operate hydraulic cylinders instead of costly hydraulic fluid which is prone to leakage. In order to lift the motor drives water into all 4 cylinders thereby causing the cylinder pistons to rise higher gradually. This leads to lifting of the platform of the house. The 3 support rods mounted around the platform are used to keep the house stable and upright in the process.

Thus driving water up the cylinders creates a lift which can be used to raise houses by 6 – 10 feet in order to protect them from flood water. When the flood water recedes, the owner may choose to lower the house, in which case the motor will start pulling water from cylinders, thus lowering the house gradually without any jerks. The hydraulics along with the support rods are designed to life house without causing any critical jerks or angular change which may damage house structure or interiors. This system provides an alternative to a low cost flood proof housing system in flood prone areas.

Base Frame
Supporting Frame
Nuts and Bolts
Screws and Joints
Front View
Hydraulic Flood Protection System for Homes
3D Views
Hydraulic Flood Protection System for Homes

SHAFIN.M
4th YEAR
MECHANICAL - C

2. TRANSFORMING PROTOTYPING AND MANUFACTURING IN MECHANICAL DESIGN

The world of mechanical engineering is undergoing a revolution, thanks to the groundbreaking technology of 3D printing. Once considered a futuristic novelty, 3D printing has now become an integral tool in prototyping and manufacturing, offering unparalleled advantages in speed, cost-efficiency, and design freedom.

What is 3D Printing?

Also known as additive manufacturing, 3D printing is a process that creates physical objects from digital models by layering material, such as plastic, metal, or composites. This contrasts with traditional subtractive manufacturing methods, which remove material to achieve the desired shape.

Impact on Prototyping

Prototyping is a critical stage in the design process, and 3D printing has revolutionized how mechanical engineers approach this phase.

- Speed: Engineers can now create functional prototypes within hours instead of weeks. This rapid iteration allows for quicker testing and refinement of designs.
- Cost-Effectiveness: Traditional prototyping often involves expensive molds or specialized tools. With 3D printing, prototypes can be produced directly from digital files, significantly reducing costs.
- Complexity: Designs with intricate geometries or internal structures that were previously impossible to fabricate are now achievable. This enables engineers to test more innovative and efficient designs.

Applications in Mechanical Engineering

- Aerospace: Lightweight, high-strength components are critical in the aerospace industry. 3D printing enables engineers to create optimized designs that reduce weight without compromising durability.
- Automotive: From custom parts to performance testing, 3D printing supports faster innovation in vehicle design.
- Medical Devices: Engineers are designing patient-specific prosthetics and implants, enhancing both comfort and functionality.

Challenges and Future Prospects

Despite its advantages, 3D printing faces challenges such as limited material options, slower production speeds for mass manufacturing, and high initial equipment costs. However, ongoing research and development promise to address these limitations. Emerging technologies, such as multi-material printing and hybrid manufacturing, are expected to further expand the capabilities of 3D printing.

Conclusion

3D printing is reshaping the landscape of mechanical engineering, bridging the gap between imagination and reality. As the technology continues to advance, it will undoubtedly drive innovation, reduce barriers to creativity, and set new standards in prototyping and manufacturing. For mechanical engineers, the future of design and production has never been more exciting.

ASHUMA FAISA
4th year
MECHANICAL - A

3..Open-source softwares for mechanical applications

INTRODUCTION:

This article is an analysis about the Open-source softwares which are freely available in the market which can be utilized effectively for mechanical applications. However, most of us are using the student license of some commercial softwares like AutoCAD, Solidworks, Fusion360 etc for 3D modelling and Ansys, Simul8, Simio etc for stimulations; we can't use those softwares for long term after the student license get expire. And using the crack version of such paid softwares is totally illegal. So after parcticing the commands, tools and adopting the virtual environment of those paid softwares, the users will stuck at a point to pay or drop out the software after the student license get expire.

Need of softwares in Mechanical engineering:

Nowadays, an engineer is not forced to lie down on a table with large sheet A3 paper and draft the models as it was in the past. The new technologies in the field of Mechanical engineering have made such difficult tasks very easy for us and put them at our fingertips. Not only for drafting or 30 modelling but also for facilitating many mechanical engineering techniques there are many other softwares that are used widely

1. Computer-Aided Design (CAD)

CAD software allows engineers to create detailed 2D and 3D models of mechanical components and assemblies. It helps visualize, modify, and optimize designs before manufacturing.

Examples:

AutoCAD-Widely used for creating 2D and 3D drawings.
SolidWorks - Popular for 3D modeling and assembly design.
CATIA-Used in complex designs and automotive/aerospace industries.
Creo-Known for parametric design and solid modeling.
Inventor-Autodesk software for 3D mechanical design.

2. Computer-Aided Engineering (CAE)

CAE software focuses on the analysis and simulation of mechanical systems. This includes stress analysis, thermal simulations, fluid dynamics, and more.

Finite Element Analysis (FEA):
ANSYS-Used for structural, thermal, and fluid analysis.
ABAQUS-Known for complex simulations, including non-linear analysis.
COMSOL Multiphysics-Offers multi-physics simulations for various engineering problems.

Computational Fluid Dynamics (CFD):
ANSYS Fluent -Used for fluid flow and heat transfer simulations.
CFX-A powerful tool for simulating fluid dynamics and heat transfer.

3. Simulation Softwares

Simulation tools allow engineers to replicate real-world physical conditions to test how components or systems will perform without physical prototypes.

Examples:

MATLAB/Simulink-Used for modeling, simulating, and analyzing dynamic systems.
Simulß-Used for simulating manufacturing processes and logistics.
Simulink (for control systems) - Used for modeling control systems in mechanical engineering.

As I've mentioned above; Although we have so many softwares available for our mechanical engineering applications, all these are paid software by which we may face the consequences what I have mentioned in the introduction.

So, Practically we can overcome all the above mentioned issues easily with the Open-source softwares available in market.

What is Open-source software?

Open-source software (OSS) is a software that is released under a license in which the creater grants users the rights to use, study, change. and distribute the software and its source code to anyone and for any purpose. Open-source software may be developed in a collaborative, public manner. It is a prominent example of open collaboration, meaning any capable user is able to participate online in development, making the number of possible contributors indefinite. The ability to modify and making it available for anyone facilitates the public trust in the software.

Why open source softwares can be used instead of other softwares?

1. Cost-Effectiveness

Open-source software is generally free to use, which eliminates the high licensing fees associated with proprietary software. This is especially helpful in mechanical engineering, where software like CAD, FEA (Finite Element Analysis), and CFD (Computational Fluid Dynamics) tools can be more expensive.

2. Customization and Flexibility

Open-source software provides access to source code, allowing engineers to taäor the software to specific needs, which can be crucial for mechanical applications that require specialized functionality. Users can modify features, integrate custom tools, or optimize algorithms for better performance and handling,

3. Collaborative Development and Innovation

Open-source projects often involve collaborative contributions from a global community of developers and users, leading to rapid innovation and sharing of knowledge. For mechanical engineers, this means quicker access to new tools, methods, and updates that can Improve their workflows and results

4. Transparency and Reliability

Since open-source code is available for review, it's easier to verify its reliability, identify bugs, and ensure it meets industry standards. Mechanical engineering often requires high precision and reliability, so being able to scrutinize the software's internal workings is a significant advantage.

5. Educational Value

Open-source software allows engineers, researchers, and students to experiment, learn, and develop their skills without financial barriers. This exposure can lead to a better understanding of software internals, ultimately enhancing their proficiency with tools that they may use professionally.

6. Community Support and Resources

Many open-source mechanical engineering software projects have large user communities that provide forums, tutorials, and documentation. Users can leverage community-driven resources and seek support from others facing simillar challenges, often leading to faster solutions.

7. Interoperability and Integration

Open-source software often uses open standards, making it easier to integrate with other tools or systems. In mechanical engineering, this enables smoother data exchanges across different software solutions, reducing errors and increasing efficiency.

Open source softwares in industrial aspects:

Yes, industries in mechanical engineering are increasingly adopting open-source software for specific applications. Small and medium-sized companies uses the open-source software for initial designs and prototypes for the cost reduction. Tools like FreeCAD (CAD) and OpenFOAM (CFD) allow engineers to perform detailed analysis without needing to invest in costly licenses, especially during early development phases.

Open source softwares available for mechanical applications:

There are several open-source software packages available for a wide range of mechanical engineering applications. Here's a list categorized by specific engineering tasks and applications.

1. 3D CAD (Computer-Aided Design)

FreeCAD: A parametric 3D CAD modeler widely used for 3D modeling, product design, and small-scale prototyping.

LibreCAD: Focuses on 2D CAD and is useful for creating detailed technical drawings, sketches, and schematics. precise 30 models through code, commonly used for parametric and

OpenSCAD: A script-based CAD modeler suited for creating custom designs, Blender: Although primarily a graphics tool. Blender with engineering add-ons can be used for CAD, particularly for modeling complex

shapes and prototyping. SolveSpace: A parametric 3D CAD program with constraints-based modeling, suitable for creating 3D parts, assemblies, and mechanism analysis.

2. Finite Element Analysis (FEA)

CalculiX: Used for structural, thermal, and multiphysics simulations, it has an interface similar to Abaqus.

Elmer FEM: Multiphysical simulation software ideal for structural, thermal, and fluid dynamics problems. Code Aster: Developed by EDF, it is a powerfull FEA tool for structural analysis, thermal simulations, and multiphysics problems.

288: Offers linear and nonlinear FEA and supports thermal analysis, commonly used for educational purposes and small simulations,

3. Computational Fluid Dynamics (CFD)

OpenFOAM: One of the most popular open-source CFD tools, used for complex fluid dynamics, heat transfer, and multiphase flow
simulations. SU2: A CFD code used for aerodynamic simulationis, such as optimizing fluid flows around shapes, commonly used in aerospace and
automotive.and fluid-structure interaction,
Palabos. An open-source library for lattice Boltzmann-based fluid flow simulations, used for complex flow modeling in porous media

4. 3D Printing and Additive Manufacturing

OctoPrint: A tool for managing and monitoring 3D printers, especially useful for additive manufacturing workflows. Slic3r: A slicing software used to prepare 3D models for printing by converting them into instructions for the printer. PrusaSlicer: An advanced slicer based on Slic3r, optimized for Prusa printers but used more widely due to its customization features.

5. Thermal and Energy Simulation

EnergyPlus: Primarily used in HVAC and building energy simullations, but it has some applications in thermall modelling of industrial environments.
ThermoPower (for Modelica): A library for Modelica specifically for modelling thermal power generation systems.
OpenModelica (Thermal Modules): Provides modules for thermal simulation, often used in conjunction with other physics for complex thermall systems.

6. Control Systems and Simulation

OpenModelica: An open-source modeling and simulation environment for complex dynamic systems, used in control systems,
OpenTURNS: An performance under varying conditions.
thermodynamics, and power systems. ScicosLab: A simulation platform similar to Simulink, used for modeling and simulating control systems and dynamic systems. open-source tool for uncertainty quantification in simulations, often used to evaluate system reliability and

Similar to these softwares, More other Open source softwares are available in free of charge for many Mechnical engineering applications.

In conclusion, open-source software offers a valuable alternative for mechanical engineering applications, providing significant benefits in cost savings, flexibility, customization, and community support. With a variety of tools available for CAD, FEA, CFD, data analysis, and project

management, open-source solutions are becoming viable options for professionals and organizations.

These tools empower engineers to innovate, adapt, and integrate their workflows without the limitations of licensing fees or copyrights.

However, they may lack some advanced features found in paid softwares, open-source options are constantly evolving through community contributions and collaborations, making them a sustainable and forward-looking choice.

By embracing open-source software, engineers can foster an environment of transparency, continuous improvement, and shared knowledge for advancing both individual skills and the broader engineering field.

Infant Berlin B
3rd year
MECHANICAL - A

AI in Modern Generation

The Rise of AI in the Modern Generation: Revolutionizing the Future

Artificial Intelligence (AI) has become an integral part of our daily lives, transforming the way we interact, work, and live. The modern generation has grown up with AI-powered technologies, from virtual assistants like Siri and Alexa to self-driving cars and personalized recommendations on Netflix.

The Evolution of AI

AI has come a long way since its inception in the 1950s. The early days of AI focused on rule-based systems, which were limited in their capabilities. However, with the advent of machine learning and deep learning, AI has become increasingly sophisticated.

Applications of AI

1. Virtual Assistants: AI-powered virtual assistants, such as Siri, Alexa, and Google Assistant, have revolutionized the way we interact with technology.
2. Image and Speech Recognition: AI-powered image and speech recognition technologies have enabled applications such as facial recognition, voice assistants, and language translation.

Benefits of AI

1. Increased Efficiency: AI automates repetitive tasks, freeing up humans to focus on creative and strategic work.
2. Improved Accuracy: AI reduces errors and improves accuracy in tasks such as data analysis and decision-making.
3. Enhanced Customer Experience: AI-powered chatbots and virtual assistants provide personalized customer service.
4. Job Creation: AI creates new job opportunities in fields such as AI development, deployment, and maintenance.

The Future of AI

As AI continues to evolve, we can expect:

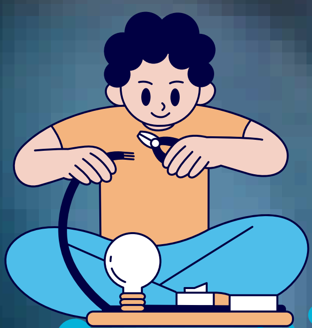
1. Increased Adoption: AI will become ubiquitous in industries and households.
2. Advancements in Machine Learning: AI will become more sophisticated, enabling more complex decision-making.
3. Human-AI Collaboration: AI will augment human capabilities, enabling more efficient and effective collaboration.

Conclusion

AI has revolutionized the modern generation, transforming the way we live, work, and interact. While challenges and concerns remain, the benefits of AI far outweigh the risks. As AI continues to evolve, it is essential to prioritize ethics, accountability, and transparency to ensure a future where AI enhances human life.

S.Thushyanth
4th year
MECHANICAL - C

STUDENT PROJECTS



Project Developed by Mechanical students

1.Development of Real Time Robot

- The Development of Real-Time Robot project undertaken by mechanical engineering students ABDHISHEAK AM,AKHIL PRATHAP .RP,BESLINLUEI D,AFIGITH SELVAN S focused on creating an autonomous robot capable of navigating and interacting with its environment in real-time, under the guidance of Dr.KAILAINATHAN. This project integrates various engineering principles, including mechanics, electronics, and programming, to design a robot that can perform tasks such as obstacle avoidance and path following using sensors and actuators. Students engage in hands- on learning by utilizing microcontrollers and programming languages to implement control algorithms. The project emphasizes teamwork, problem-solving, and innovation as student's prototype and test their designs. Ultimately, this initiative not only enhances technical skills but also prepares students for careers in the rapidly evolving field of robotics.

The project was carried out in collaboration with ENTUDIO Pvt. Ltd., Tirunelveli.

2.Regenerative Braking system

- The Regenerative Braking System project undertaken by Bachelor of Mechanical Engineering
- students AATHITHYA VALLUVAN, ANTO JAISON J, ASWIN C, BIBIN RAJ S focuses on
- harnessing kinetic energy during braking to improve vehicle efficiency under the guidance of Mr.RAJASUTHAN. This innovative system converts the vehicle's kinetic energy into electrical energy, which can be stored for future use, thereby reducing energy waste and enhancing overall vehicle performance. The project involves designing a prototype that utilizes components such as motors, batteries, and dynamo systems to effectively capture and store energy generated during braking. Students have emphasized the importance of this technology in the context of increasing fuel efficiency and reducing carbon emissions in electric vehicles. Through hands-on experience, they aim to contribute to sustainable automotive technologies while gaining valuable engineering skills.

3.Fabrication of Rock Boring Mechanism

- The Fabrication of Rock Boring Mechanism project by JESSO THOMAS, KALIRAJ M MUTHU KRISHNAN M, NAVIN NIRMAL N focused on designing and constructing a device capable of
- efficiently boring through various rock types under the guidance of Mr.M.RAJAKUMAR. This mechanism aims to enhance the drilling process used in mining and civil engineering applications, where precision and speed are critical. The project involves utilizing advanced materials and engineering principles to ensure durability and effectiveness under high-stress conditions. Key components of the mechanism include a robust cutting head, a reliable power source, and an efficient waste removal system to handle the excavated material. Ultimately, this project seeks to contribute to improved excavation techniques, reducing costs and increasing safety in underground operations.

4.Rescue the child from bore well using automation

- The traditional way to rescue the child is to dig a parallel pit t adjacent to the bore well. This method is difficult, lengthy and also risky to rescue the trapped child. In the proposed method mechanical system moves inside the bore well channel and moves its gripper arm in accordance with the user commands given. Our final year students of Prabin Jeba P, Rajavignesh R and Siva Kiruthick N G J presented the project in the spectra 2023.

5.Desalination of sea water using solar system

- Solar-powered desalination is a sustainable way to produce clean water from
- seawater using solar energy. In this method, saline water absorbs solar energy and
- evaporates, leaving behind salt and other impurities. Solar stills are an example
- of this method, where the pure water vapor is collected and condensed in an
- enclosed environment. The project was presented by Gokil R M, Honest Raj S,
- Jeneesh C a and Logesh R

6.Integrated solar tracking with vertical windmill for enhanced renewable energy harvesting

- Abinesh P, Ajin B and Nivin S of mechanical engineering were presented a project on Integrated solar tracking with vertical windmill for enhanced renewable energy harvesting in SPECTRA 2023. An integrated solar system typically refers to a setup where various components of solar energy technology are combined and managed cohesively to maximize efficiency and performance.

STUDENT COMPOSITIONS

BEFORE I WAS READY TO SPEAK

I needed to discover myself in silence. I don't need to constantly make noise or be in constant movement

The real understanding of self comes from being in silence, it comes from the quiet exploration.

Even when life is loud out there, I know I can drown out the noise to sit in stillness to really hear my own voice.

ASHOK KUMAR
4th year
MECHANICAL - A

FUNNIEST FACTS

1. "The Life of a Bolt"

"Born in a factory, tightened in assembly, forgotten in operation, and cursed in maintenance."

2. The Engineer's Prayer

"Lord, give me the strength to tighten what I can, the patience to loosen what I can't, and the wisdom to know when to call for a hammer."

3. "Heat Transfer Love Story"

"Our love is like conduction. The closer we get, the hotter it feels, but when you leave, it’s pure convection—everything rises to chaos!"

4. The Engineer's Anthem

"If it moves and it shouldn’t: Duct tape. If it doesn’t move and it should: WD-40."

5. Definition of Stress

"Stress: When the load applied exceeds the yield strength of my patience."

R.ROBIN RAJA

4th year

MECHANICAL - C

ENGINEERING FACTS

LAMBORGHINI CARS WERE A RESULT OF A TRACTOR COMPANY OWNER BEING INSULTED BY THE FOUNDER OF FERRARI

THE GREAT PYRAMIDS OF EGYPT WERE BUILT USING THE ADVANCED KNOWLEDGE OF MECHANICS AND ENGINEERING PRINCIPLES.

• 92% OF ALL NEW SOLD CARS IN BRAZIL USE ETHANOL AS FUEL, WHICH IS PRODUCED FROM SUGAR CANE.

• THE AVERAGE CAR HAS 30,000 PARTS.

•THE TRAUB, IS THE RAREST MOTORCYCLE IN THE WORLD

SHAJITH HUSSAIN.M
4TH YEAR
MECHANICAL - C

REASONS TO STUDY MECHANICAL ENGINEERING

1. Versatile Career Options: Work in industries such as automotive, aerospace, energy, manufacturing, and more.
2. Innovation and Problem-Solving: Design and improve products and systems, contributing to technological advancements.
3. Strong Job Market: High demand for skilled mechanical engineers, offering job stability and competitive salaries.
4. Hands-On Experience: Gain practical experience through labs, projects, and internships.
5. Interdisciplinary Collaboration: Work with professionals from other disciplines, fostering holistic problem-solving.
6. Global Impact: Contribute to sustainable energy, healthcare technology, transportation, and other critical fields.
7. Continuous Learning: Stay up to date with evolving technologies and methodologies.
8. Creativity and Innovation: Design innovative solutions and optimize existing systems.
9. Entrepreneurial Opportunities: Leverage skills to start businesses or work on entrepreneurial ventures.
10. Global Opportunities: Collaborate internationally and explore diverse work environments.

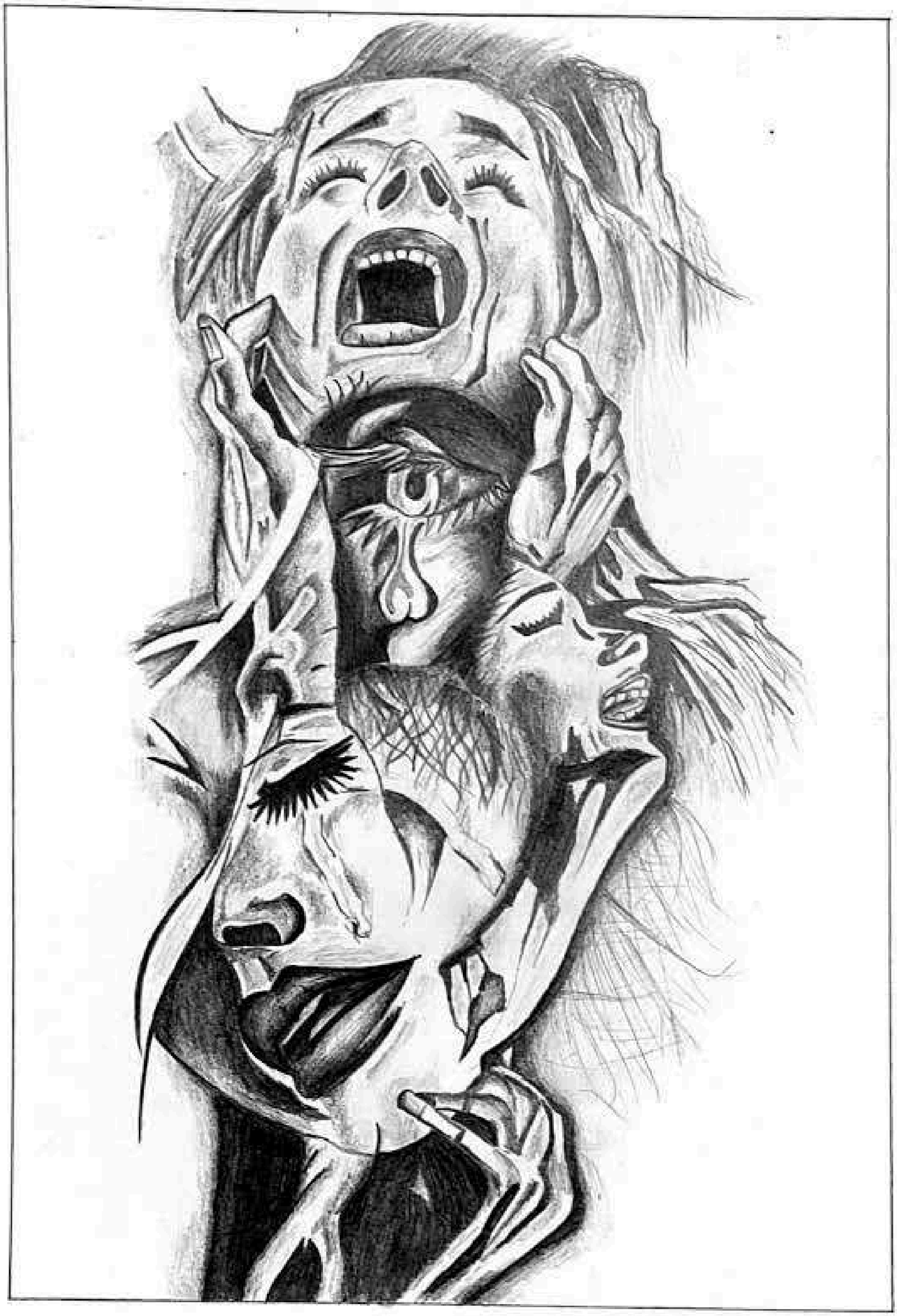
Mechanical engineering can lead to a fulfilling career with growth opportunities and a chance to make a positive impact on society and the environment.

IHSAAN HUSSEIN.M

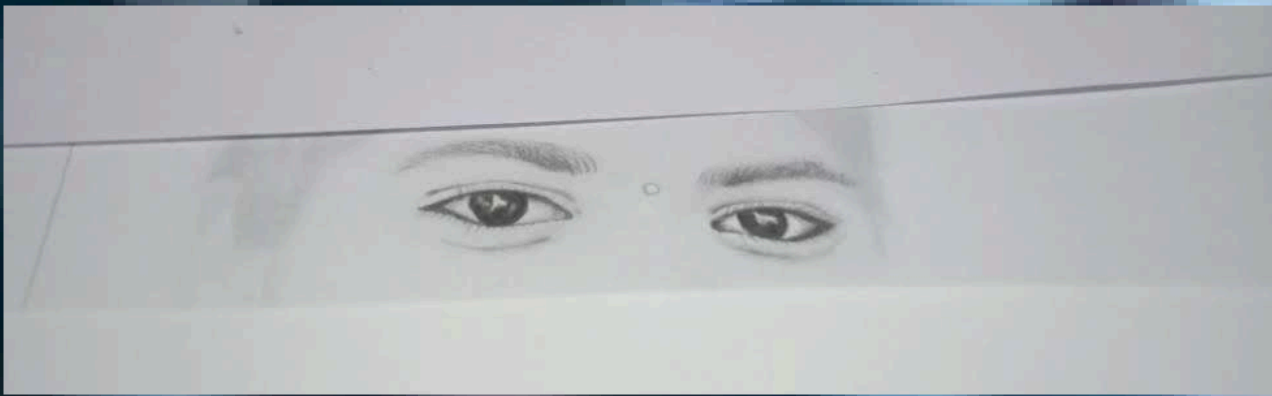
4TH YEAR

MECHANICAL - A

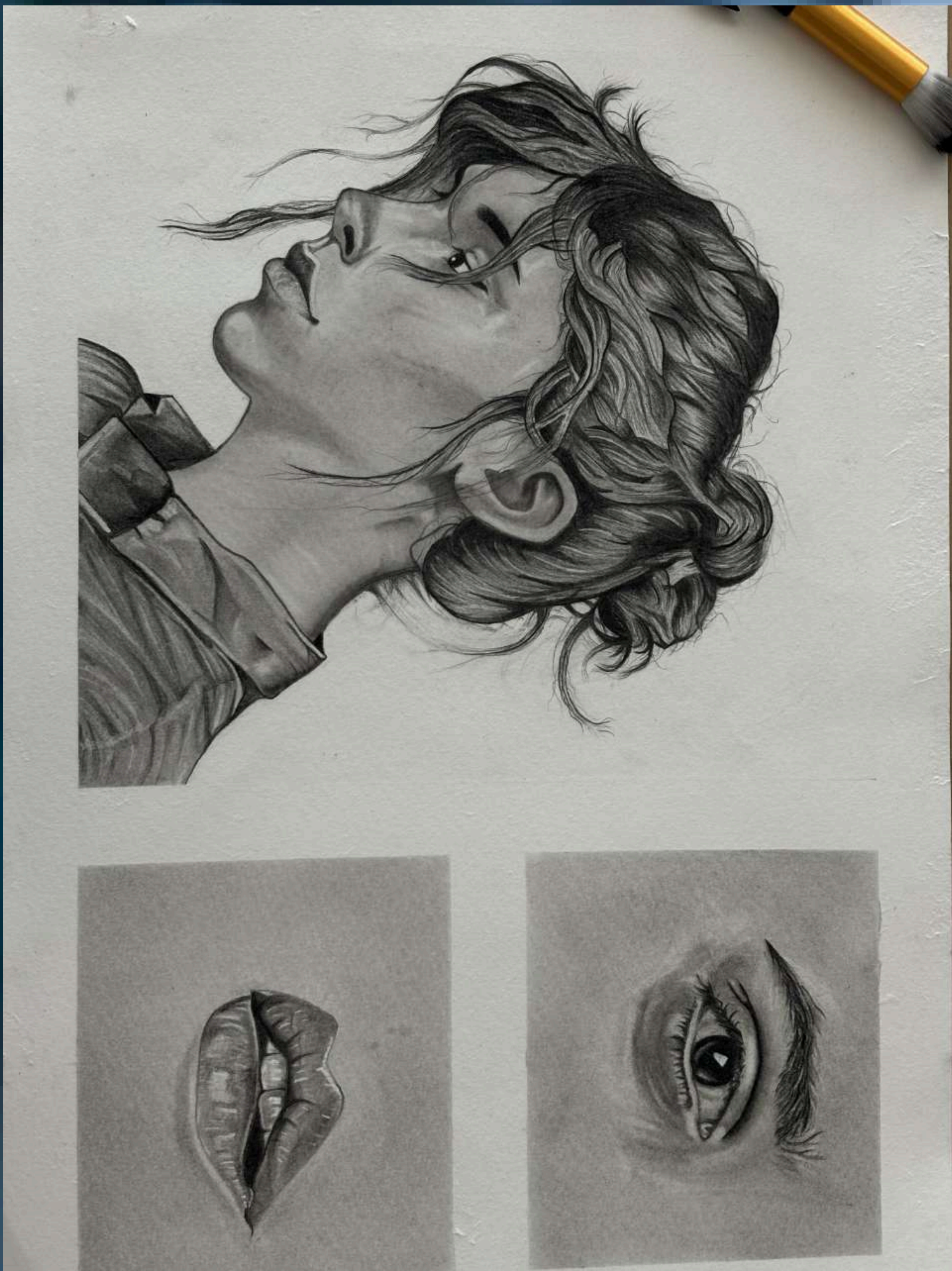
DRAWINGS



YUANJITH .R
3TH YEAR
MECHANICAL - B

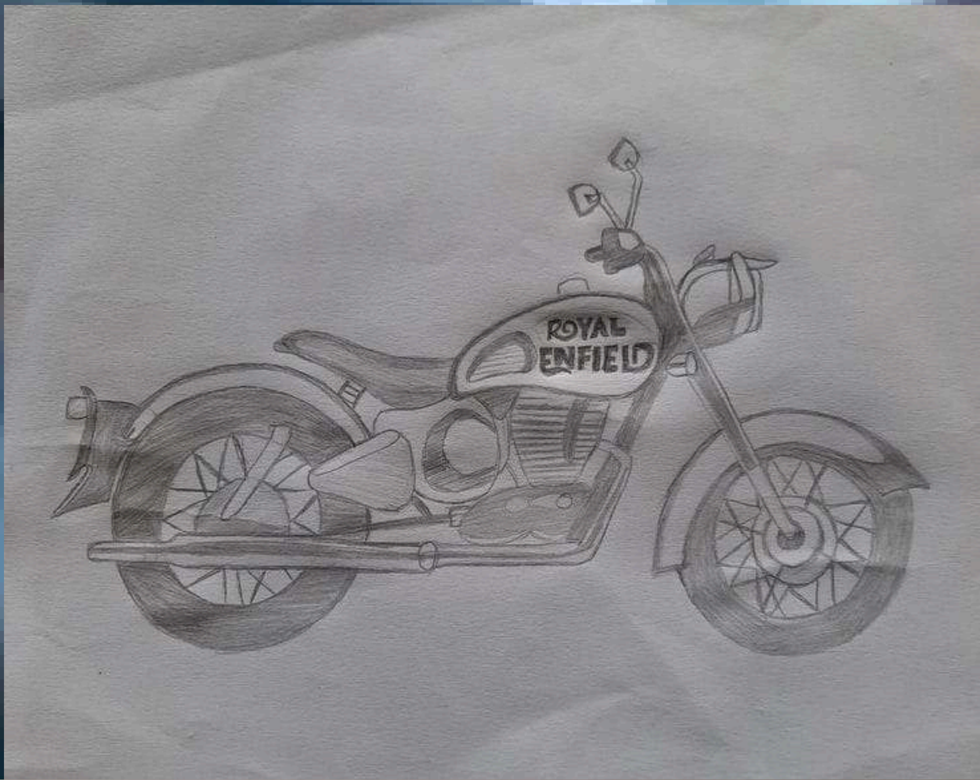


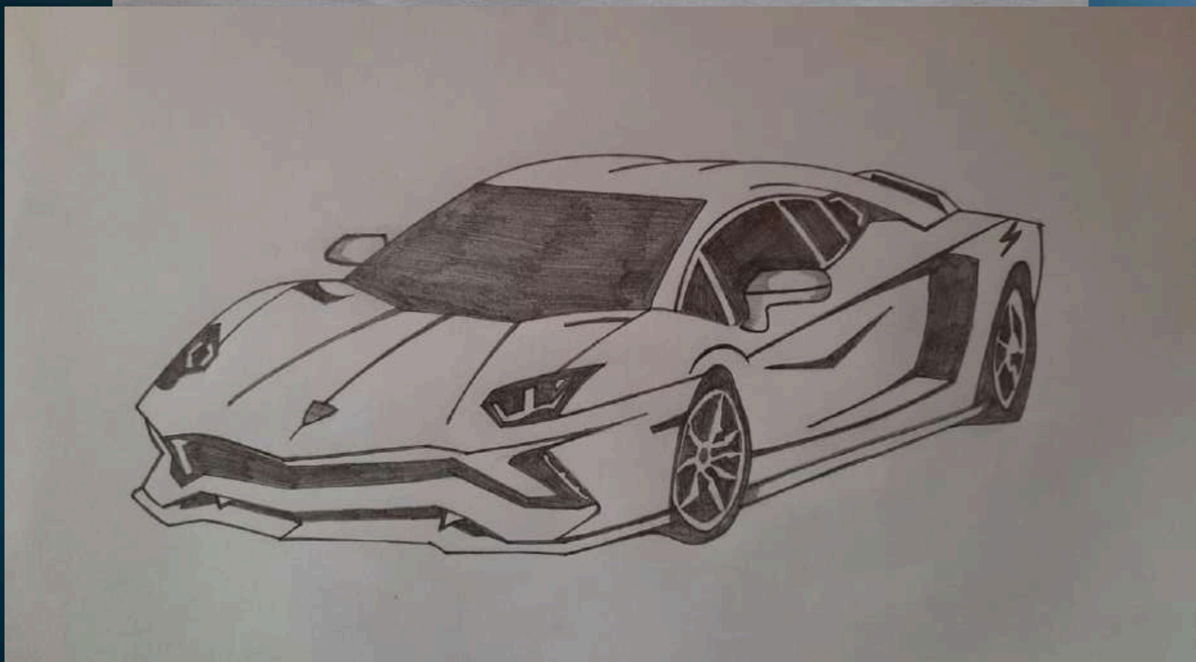
PRAVEEN
3TH YEAR
MECHANICAL - B



KARTHICK.k
3TH YEAR
MECHANICAL - B

ABHIMANYU
3RD YEAR
MECHANICAL - A





SAJIN RAJ .T
2ND YEAR
MECHANICAL

LEARN TODAY FOR A BETTER TOMORROW....

ROHINI
COLLEGE OF ENGINEERING & TECHNOLOGY

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