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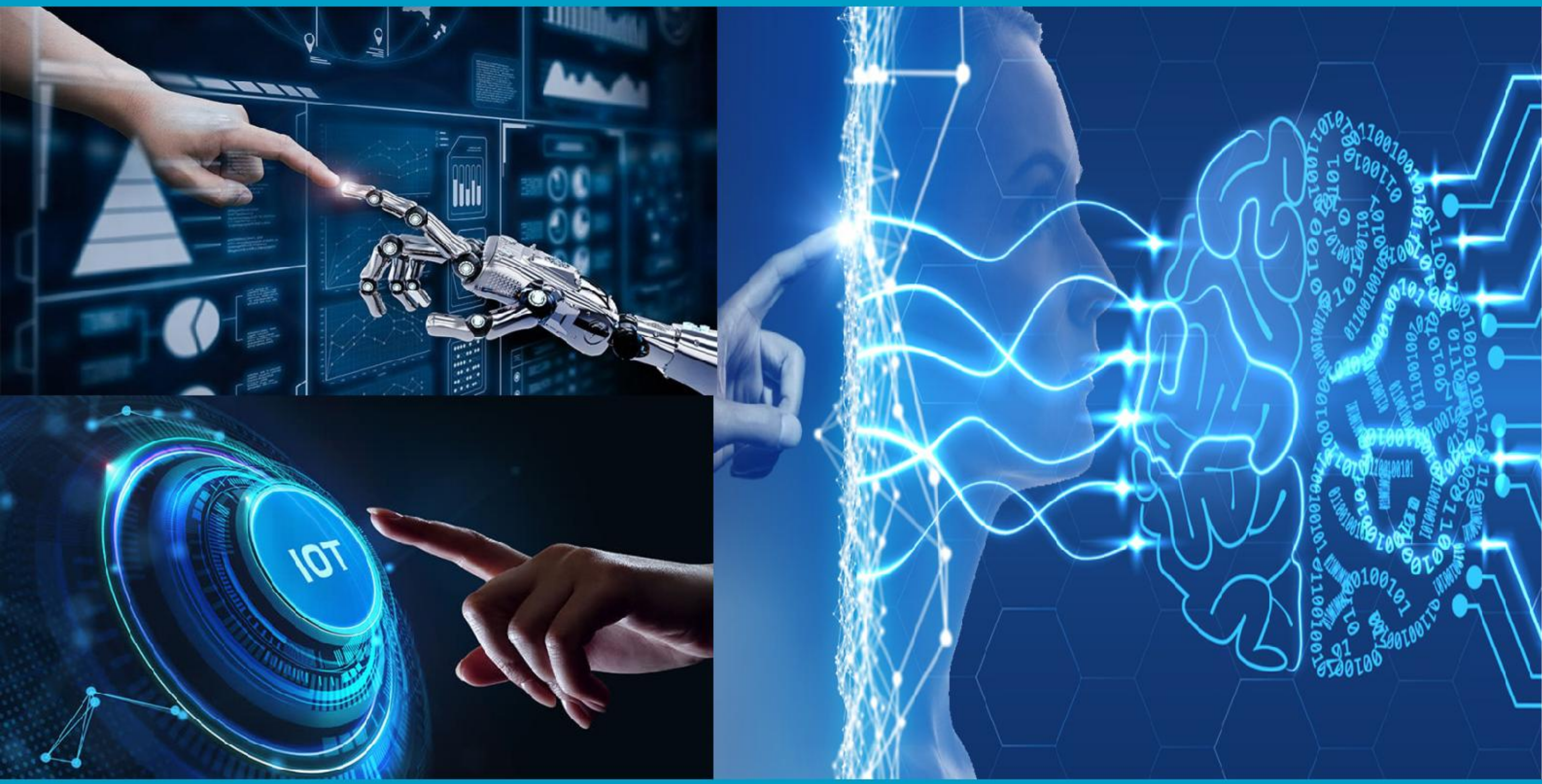

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Implementation of Taguchi method for Evaluating the Problems of Metal Cutting and Study on Surface Roughness and Removal Rate in CNC Lathe Machine

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ABSTRACT: This thesis, the surface roughness and removal rate of a CNC lathe were affected by several process parameters (cutting speed, feed and depth of cutting). An important consideration in the production of high-quality, fully automated products is the quality of the machined surface's polish and surface condition. This procedure relies heavily on exact tolerances and high-quality surface polishing. Many CNC manufacturing lines use towing as a typical machining procedure. The most frequent way to remove metal is through turning. When it comes to machining, production managers must keep an eye on the removal rate (MRR). Analysis of the cutting speed, twisting cutter feed speed, and cut profile may provide the MRR productivity statistic. The most significant component in surface finishing is reducing water. When a large nose radius is used, surface roughness increases at the same feed rate. The correct feed rate and geographical boundary conditions might boost efficiency and MRR. Using a laboratory set-up based on good scientific principles, Taguchi's technique avoids network modifications. The manufacturer's ultimate goal is to provide high-quality products at a lesser cost via this process. An orthogonal array is one of Taguchi's methods for organizing processes and rates that may fluctuate. The Taguchi Model, unlike the factorial approach, only tests pairs of potential combinations. This study's metal cutting problems are well-suited to Taguchi's methodical design approach.

KEYWORDS:CNC lathe, Taguchi method, metal cutting, MRR

I. INTRODUCTION

Different process parameters have an effect on CNC lathe surface roughness and removal rate, as seen in this experiment (cutting speed, feed and depth of cutting). High-quality and completely automated manufacturing places an emphasis on surface condition and finish of the machined surface because of their influence on product appearance, operation, and longevity. Maintaining precise tolerances and high-quality surface finishing are critical in this process.

Towing is a standard machining method in a large number of CNC production lines. Turning is the most common method of metal removal. The removal rate (MRR) is a key control component for machining activities, and production managers must regulate this rate. MRR is a productivity statistic that may be derived analytically from the cutting speed component, the twisting cutter feed speed, and the cuts profile. In surface finishing, cutting water is the most important factor. Surface roughness rises at the same feed rate when a wide nose radius is utilised. It was possible to increase efficiency and MRR by selecting the right feed rate and spatial boundary conditions.

Taguchi optimization is explained in this study, which discusses how to enhance machining settings. The inspection is done on steel die EN18. Machines are used to complete the work under finishing circumstances. Processor characteristics were assessed, mainly power, feed rate, and cutting range. Experiments were done utilising the orthogonal spectrum recommended by Taguchi from L-9 (34). (34). With a device called the rotating knife, the cutting edges are referred to as the "nose" in this technique. During this procedure, the job is rotating and the gadget is fixed to one spot. This is often done using the turning machine's instrument.

It has lately been employed in manufacturing, biotechnology, marketing, and advertising. Genichi Taguchi invented Taguchi techniques to boost the efficiency of processed materials.

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TURNING MACHINES

Centre Lathe

Lathes of many kinds are used by the turners. Motors, cannons, mechanical and numerical control systems, and so on are all examples of lathes that are now undergoing research and development. Powered by high duty motors, these machines are capable of completing a wide range of movements with ease. An inbuilt cooling spreader is found on the majority of engine threads.

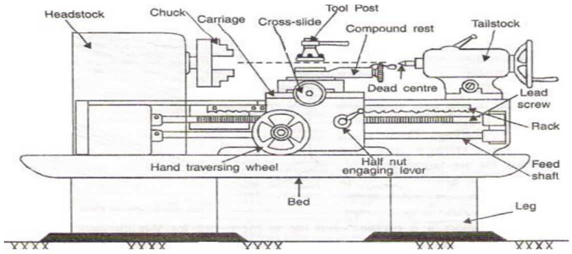

Figure 1: Centre lathe used for turning

Turret Lathes:

The tailstock is replaced with a longitudinal feeding fit in a tower. Rotating the turret, which can hold six tools, is done via a vertical axis, and the machine may be turned longitudinally to feed the as needed.

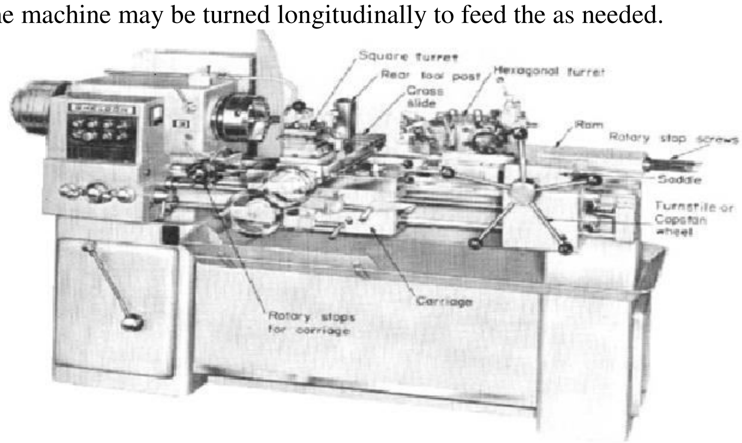

Figure 2: Turret lathe

To handle an entire component without additional modification, shifting, or computation, these basic properties of a Rotary Tool are all that is needed to get it into operating order.

There's a company in the United States called Brown & Sharp that made this. The second originates in Italy and is categorized as a Swiss product. It's just a brown / pointed screw with the main tower attached to the cross section of the screw. Cameras keep an eye on the spindle, envelope, and feeding system, as well as the cross projection. It is basically a computer program that controls the movement of the turret over a period of time. The menus are often fed from a magazine that comes with these devices.

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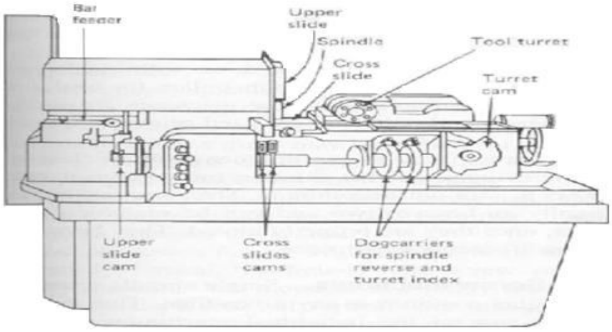

Figure3: Screw-Machine

II. MATERIALS & METHODOLOGY

TAGUCHI PROCESS

Genichi Taguchi created and recently implemented Taguchi's approaches to increase the quality of commodities produced via engineering, biology, and advertising. Competent statisticians, on the other hand, accept criticism for the ineffectiveness of some Taguchi plans and the aims and changes brought about by Taguchi technique. Taguchi created prototypes to better understand the nuances of variation.

Taguchi's method eliminates network changes by using a scientifically sound laboratory setup. The ultimate objective of the procedure is for the manufacturer to offer high-quality items at a lower cost. Among Taguchi's investigations is the use of orthogonal arrays to organise mechanisms and rates that may vary. Instead of checking all possible combinations like the factorial technique does, the Taguchi Model examines pairs of variations. Time and money are saved by reducing the amount of information needed to determine which factors have a greater impact on product consistency. This method is best suited to medium-sized variables (3-50), with minimal interaction between variables, and only if certain variables have a large impact.

This chapter explains how to use the Taguchi technique in study design and explains the fundamental processes involved in utilizing the Taguchi method.

PHILOSPHY OF TAGUCHI METHOD

1. A drug's price cannot be verified. Method, parameter, and tolerance design are all integrated into a cycle to generate quality. Process factors that have the greatest impact on product quality will be discussed in this article, as well as a few more general quality objectives. This report's main goal is to analyse a certain parameter. According to the definition of a commodity rating, the output is created at random, and any values that deviate too far from the average are simply thrown away.

2. In order to increase efficiency, the simplest method is to increase variation. In order to prevent unpredictable external factors, the system should be created. As a result, a high signal-to-noise ratio is required to ensure that the product is of a high quality.

3. The cost of providing the service will be determined using a standard deviation and any associated losses will be tallied throughout the whole network. The lack of a low-quality product or the complete collapse of a consumer and culture are the concepts behind this term. Supplier and client costs will be reduced since the supplier is now a part of the company and customer discontent discourages new clients.

PARAMETER PLAN& ORTHOGONAL DISPLAYCOLLECTION

It is possible to study the effect of a number of particular characteristics on the output trait in a condensed set of trials using Taguchi's orthogonal experimental design. We won't know how to modify these parameters unless they have an effect on a system we can regulate. A thorough understanding of the parameter's minimum, maximum, and present

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meaning is necessary for determining which rates of a variable should be analysed. Additional considerations will be made when selecting how many rates of a function should be employed in the experimental design. In the prior scenario of the suit's temperature, it would be impossible to attain 60 rates at 1 degree. In order to obtain the correct orthogonal series, it is common practise to use the same number of rates in the experimental design for the two criteria.

Once a name has been selected, the default list will be checked (the subscript is the number of complete experiments). Most of the pre-configured arrays in the array selection table are linked. The Taguchi technique was used to create these tablets, and each component must be assessed in the same way, regardless of context. It's simple to see that L4 is the correct list if there are three and two (high and low) parameters, for example. When a user clicks on the L4 icon, a list of four experiments will appear. It is recommended that the P1, P2, P3, and P4 of specified criteria (e.g. stress, temperature, etc.) be replaced for the current list of varied quantities.

ACHIEVING VARIABLITY REDUCTION

QUALITY BY DESIGN

"Great quality at cheap cost" is the motto of the food design movement led by visionary Japanese statistician Genichi Taguchi. When it comes to solving a problem in the workplace, Taguchi procedures give the same deep re-imagination as Rasch Calculation in the social sciences.
To reduce costs and increase efficiency for consumers, Taguchi techniques were extensively adopted by Japanese industry in the 1950s. They're now well-known all across the globe. Rasch's methodologies may be used to clarify and encourage approaches to dynamic social science issues. Theorists and researchers in cognitive psychology have so far mostly ignored them.

STEPS APPLIED IN TAGUCHI METHODS

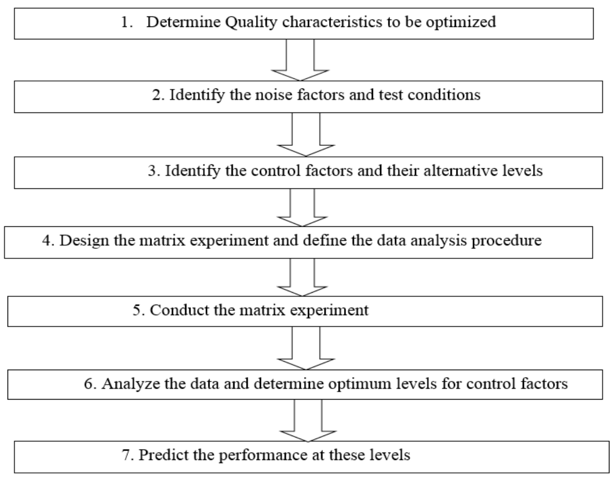

Figure 4: Steps applied in Taguchi optimization method

III. RESULT AND DISCUSSION

EFFECT OF VARIOUS INPUT PARAMETERS ON OUTPUT MEASURES (SURFACE ROUGHNESS):

In order to calculate the mean surface ruggedness (m) value, the results are shown in a table at the given parameters (cutting level, feed rate, cutting depth). Additionally, the S/N (db) data result is provided. An important factor is highlighted, along with its corresponding S/N ratio.

EFFECT OF CUTTING SPEED ON SR: -

Weakness increases with increasing cutting speed (120 m/min). Surface roughness should be minimised as cutting speed increases. The more rapidly the surface finish improves with lower burr measures.

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EFFECT OF FEED RATE ON SR: -

Surface roughness may be reduced by reducing the feed intensity. It's possible to see a reduction in surface roughness when feed rate drops, since instrument wear increases as feed rate reduces.

EFFECT OF DEPTH OF CUT ON SR: -

Surface roughness would be reduced if the cutting depth was reduced. Here, we can see that the final scale is the one considered in this study. Surface finish becomes more important as the cutting depth decreases.

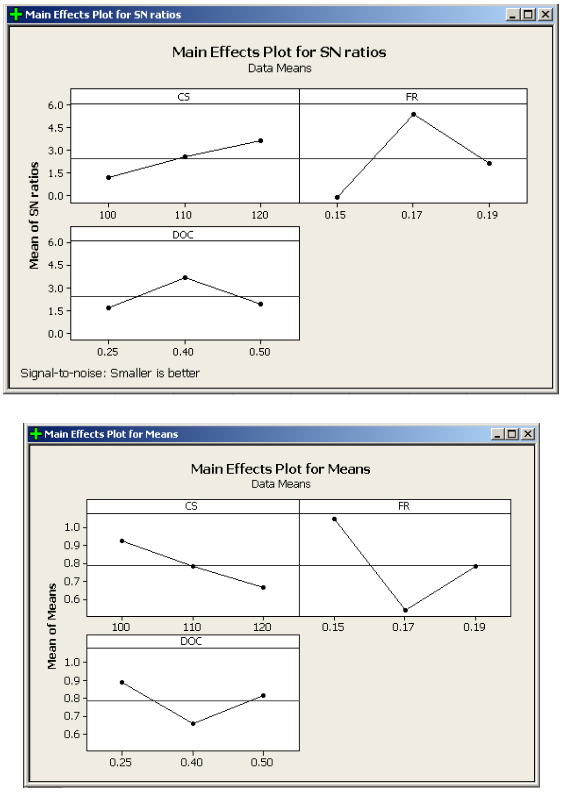

Figure 5: Main effects plot for S/N ratio & means (surface roughness)

According to the graphs, cutting speeds of 120m/min, feed speeds of 0.17mm/d and cutting depths of 0.40mm are the most ideal surface finish for the material being cut.

EFFECT OF VARIOUS INPUT PARAMETRS ON OUTPUT MEASURES (MRR):-

MRR values for each parameter are calculated and the results are presented in tabular form (cutting speed, feeding intensity, and cutting depth). The S / N meaning of the impact is also highlighted.

EFFECT OF CUTTING SPEED ON MRR:

The MRR is highest at 120 m/min, which is level 3 of the reduction rate. The amount of time it takes to produce a piece increases as the cutting velocity slows.

EFFECT OF FEED RATE ON MRR:-

Machine life may be decreased even more if the feed intensity is reduced. The optimal MRR was estimated at a feed speed of 0.19 mm per revolution in the research.

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EFFECT OF DEPTH OF CUT ON MRR:-

When the cutting depth decreases, MRR decreases because the cutting depth greatly reduces the wear on the instrument flank. In the third stage (0.25 mm) the optimum cutting depth is reached.

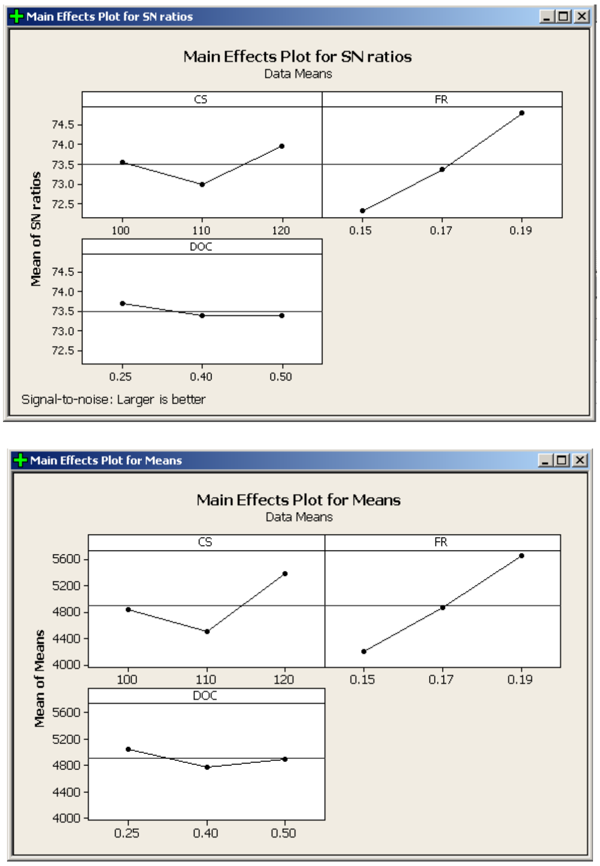

Figure 6: Main effect plots for S/N ratio & means (MRR)

IV. CONCLUSION AND FUTURE SCOPE

THE FOLLOWING ARE THE CONCLUSIONS DRAWN FROM THE WORK DONE IN THIS INVESTIGATION

1. Taguchi's rigorous design methodology is a good fit for this study's metal cutting issues.

2. Surface roughness, feed velocity, and cutting depth all had an effect on the R/N (S/N) ratio, with the latter two having the most effect of the three (.40 mm).

2. Cutting speed (120 m/min), feed rate (0.19 mm/rev), and cutting depth all had greater S/N values throughout the rotating process (.25 mm). MRR's ideal parameters are those that fall within that range.

4. Low cutting speeds will be employed to extend the life of the machine.

5. Cut depth should be small, but not so shallow as to cause excessive machine vibration, in order to provide the optimum surface finishes at high cutting speeds with low feed rates.

6. Typical cutting speeds for mild steel are 30 to 50 m/min.

7. For cutting hot steel, the cutting speed will be between 250 and 350 m/min.

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SCOPE OF FUTURE WORK

Following are the changes and additions made to the programme in this research.

1. An orthogonal sequence (L18, L27) should have been offered in comparison, as should other research approaches (response surface methodologies, swarm control of particles, etc.).

2.Researching the impact of surface roughness may need the addition of other factors (e.g. the vibration of the device, the lubricant, etc.).

3. Boiling, grinding, and other activities may be taken into consideration in a more thorough examination.

4. Non-stahl products, such as carbon steel, may be studied in the future.

COST ESTIMATION

The cost of carry out this project will be around Rs. 5000 to Rs. 6000. This cost comprises of following: -

Cost of Raw material = Rs. 1500

Cost of machining = Rs. 2000

Other expenses = Rs. 1800

PROPOSED PLACE OF WORK

B-15-B, Lane No.-8, Opp. TECHNO PRECISION. Anand Parbat Indl, Mandir. , NEW DELHI-110005 area.

In this area, CNC LMW LL20 T L5 turning has been completed. Anand Parbat, Delhi-based manufacturing company "KANSIL BRIGHT STEELS" is the source of the product.

The finishing examination for the surfaces was carried out at "MMU, MULANA."

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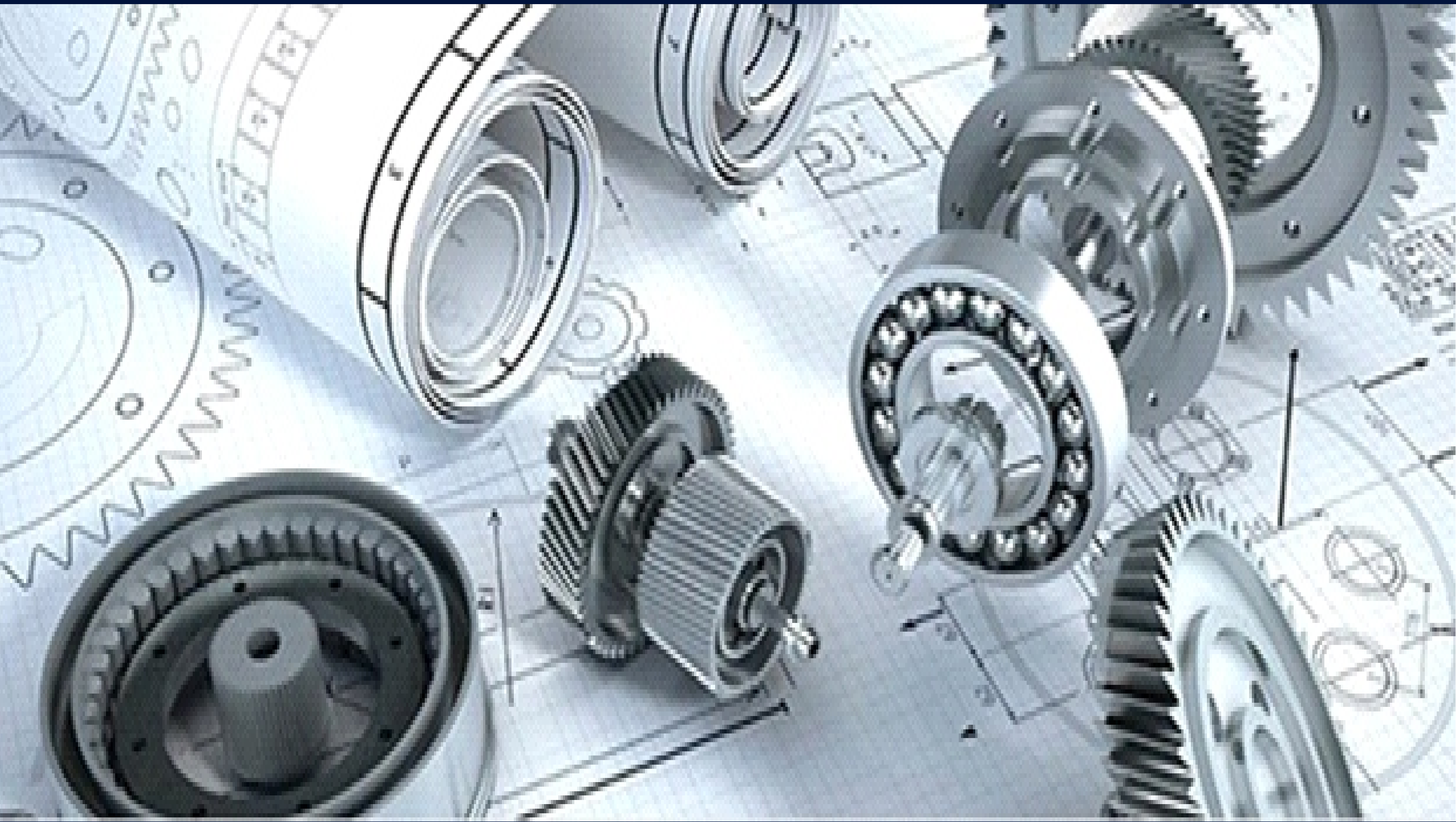

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