iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 Issue: I Month of publication: January 2016

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Effects of Machining Parameters in Turning Process for grooving operation on aluminium & Optimizing by the application of Taguchi Method & MINITAB 14 software

Arjun Avinash Abhyankar[1], Amogh Avinash Abhyankar[2]
Department of Mechanical Engineering, Dr. D.Y.Patil Institute of Engineering & Technology, Pune, India
Department of Mechanical Engineering, Government College of Engineering, Chandrapur, India

Abstract-This study based on optimization of turning process (Grooving) by the effects of machining parameters using Taguchi technique to improve the quality of manufactured product and engineering development for analysis of variation. . Taguchi orthogonal array is generated with three levels of turning parameters by using software Minitab 14. In the first step nine experiments are performed and material removal rate (MRR) is calculated. Taguchi method gives the importance of Analsing the response variation using the signal–to–noise (S/N) ratio, resulting in reducing of quality characteristic changes due to uncontrollable parameter. The metal removal rate was taken as the quality characteristic with the concept of "the larger-the-better". The S/N ratio for the larger-the-better Where n is the number of measurements in a trial/row, in this case, n=1 and y is the measured value in a run/row. The S/N ratio values are calculated by taking into consideration by using software Minitab 14. The MRR values measured from the analysis and their optimum value for maximum material removal rate . Aluminium is used as the work piece material for the experimentation to optimize the Material Removal Rate. The bars used are of diameter 40 mm and length 100 mm. There are three machining parameters i.e. Spindle speed, Depth of cut. Feed rate. The study aimed at evaluating the best process which could satisfy requirements of both quality and as well as productivity. This study investigates the effects of various parameters.
Keywords— Plunge Turning (Grooving) operation, Taguchi Method, Machining parameters, minitab 14 software

I. INTRODUCTION

This Groove cutting on CNC lathes is a multi step machining operation. grooving usually applies to a process of forming a narrow cavity of a certain depth, on a cylinder, cone, or a face of the part. Turning is carried out on a lathe that provides the power to turn the work piece at a given speed and to feed the cutting tool at specified rate and depth of cut. Therefore three cutting parameters namely cutting speed, feed and depth of cut need to be determined in a turning operation.

The Taguchi method is a well known technique that provides a systematic and efficient methodology for design and process optimization.

The speed and motion of the cutting tool is specified through several parameters. These parameters are selected for each operation based upon the work piece material, tool material, tool size etc . Cutting tools for grooving are either external or internal and use a variety of inserts in different configurations. grooving tool is normally used to cut in a single direction only

A. 8-STEPS in Taguchi Methodology

Step-1: IDENTIFY THE MAIN FUNCTION, SIDE EFFECTS, AND FAILURE MODE
Step-2: IDENTIFY THE NOISE FACTORS, TESTING CONDITIONS, AND QUALITY CHARACTERISTICS
Step-3: IDENTIFY THE OBJECTIVE FUNCTION TO BE OPTIMIZED
Step-4: IDENTIFY THE CONTROL FACTORS AND THEIR LEVELS
Step-5: SELECT THE ORTHOGONAL ARRAY MATRIX EXPERIMENT
Step-6: CONDUCT THE MATRIX EXPERIMENT
Step-7: ANALYZE THE DATA, PREDICT THE OPTIMUM LEVELS AND PERFORMANCE

Volume 4 Issue I, January 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Step-8: PERFORM THE VERIFICATION EXPERIMENT AND PLAN THE FUTURE ACTION

II. PROBLEM DESCRIPTION

CNC lathe is programmed by speed, feed rate and cutting depth, which are determined based on the job type . However, the machine performance and the product characteristics are not constant. Therefore, the optimum turning conditions needed to calculate

A. Parameter Identification

The input parameters which affect the output quality characteristics of the grooving parts a) Cutting speed b) Feed rate. c) Depth of cut. d) Types of grooving.f) work piece & Cutting tool material.g) Working condition h) Operator. i) Type of CNC machine.

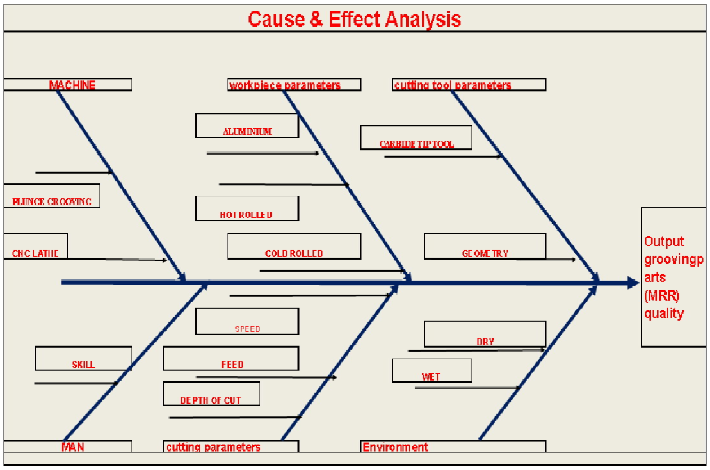


Fig: 2.1 Ishikawa cause-effect diagram of a turning process.

III. EXPERIMENT SET UP / UNDERTAKEN WORK

A. The experimental setup consists of Grooving tool on CNC Lathe for conducting experiment

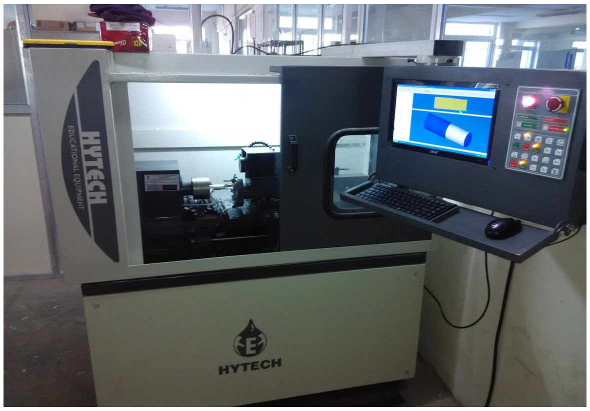


Fig:3.1 Experiment set up

B. Cutting tool

The tool is grooving tool made of carbide tip.

Fig: 3.2 Cutting tool

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

C. Work piece material

Aluminum is used as the work piece material for the experimentation to optimize the Material Removal Rate. The bars used are of diameter 40mm and length 100mm.

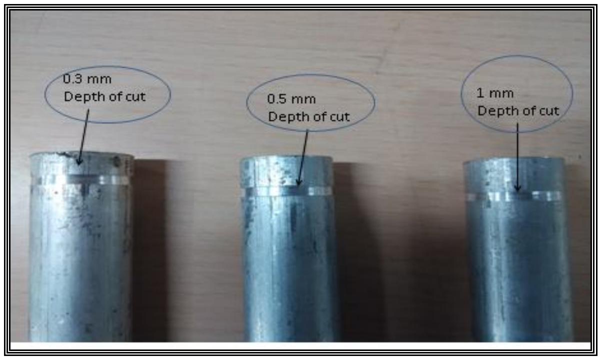


Fig: 3.3 Work piece materials (Aluminium)

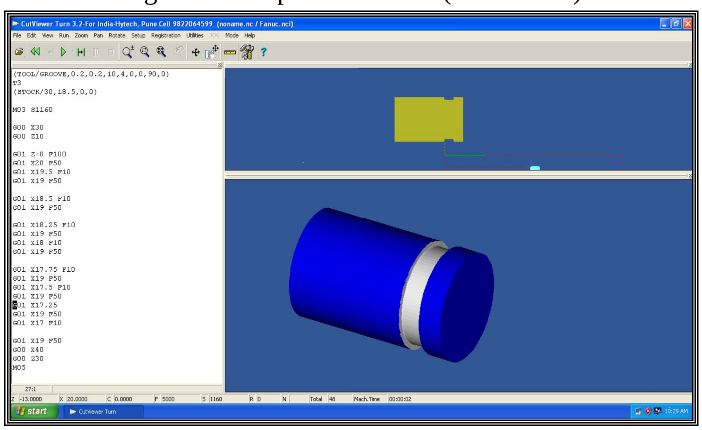


Fig.3.4CutViwer Turn Simulation (CNC Program for Grooving)

D. Material Removal Rate (MRR)

Measurement From the initial and final weight of job MRR is calculated:

MRR = (Initial Wt - Final Wt)/Time Taken

IV. DESIGN OF EXPERIMENT

A. Orthogonal Array Taguchi

In this study, L9(3) orthogonal array of Taguchi experiment was selected for three parameters (speed, feed, depth of cut) The experiment consists 3 factors ,then total number of experiment is 27... Those L9 experiments will give 99.96% accurate result. By using this method number of experiments reduced to 9 instead of 27 with almost same accuracy

Taguchi's designs aimed to understanding of changes than occurs during experiment . Taguchi proposed extending each experiment with an "outer array" or orthogonal array should simulate the random environment in which the experiment would function.

Table: 4.1 Process Parameters

Sr No	Spindle speed (RPM)	Feed Rate (mm/min)	Depth of cut (mm)
1	980	4	0.3
2	1160	7	0.5
3	1220	10	1

Volume 4 Issue I, January 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

B. Taguchi Orthogonal Array

Taguchi orthogonal array is designed with three levels of turning parameters with the help of software Minitab 14.

Job no	Spindle speed (RPM)	Feed Rate (mm/min)	Depth of cut (mm)
1	980	4	1
2	980	7	0.5
3	980	10	0.3
4	1160	4	0.5
5	1160	7	0.3
6	1160	10	1
7	1220	4	0.3
8	1220	7	1
9	1220	10	0.5

Table: 4.2 Taguchi Orthogonal Arra

C. Observation

Nine experiments are performed and material removal rate (MRR) is calculated. The observation tables are given below.

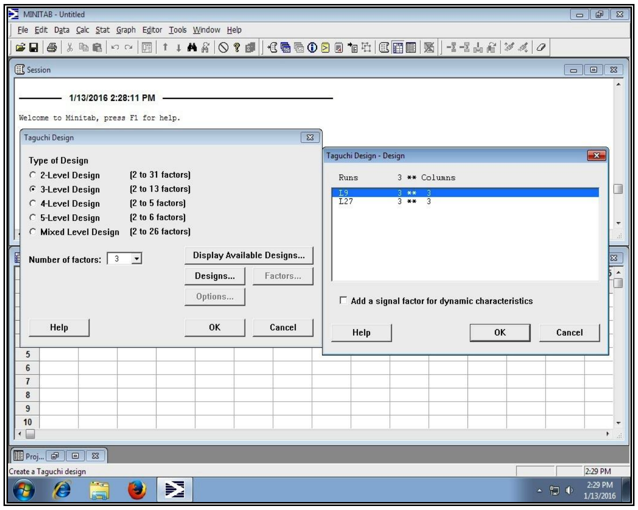
Sr No	Spindle speed (RPM)	Feed Rate (mm/min)	Depth of cut (mm)	Initial weight (g)	Final weight (g)	Diff, of weight (g)	Time taken (sec)	MRR (g/Sec)
1	980	4	1	0.142	0.141	0.001	9	0.00011
2	980	7	0.5	0.143	0.142	0.001	11	0.00009
3	980	10	0.3	0.145	0.144	0.001	9	0.00011
4	1160	4	0.5	0.149	0.148	0.001	11	0.00009
5	1160	7	0.3	0.141	0.139	0.002	11	0.00018
6	1160	10	1	0.142	0.139	0.003	8	0.00037
7	1220	4	0.3	0.143	0.142	0.001	9	0.00011
8	1220	7	1	0.142	0.139	0.003	7	0.00043
9	1220	10	0.5	0.142	0.141	0.001	10	0.0001

Table: 4.3 Observations

D. Orthogonal array design

Taguchi Orthogonal Array is designed in Minitab 14 to calculate S/N ratio and Means. Create Taguchi Design is selected as shown in figure.

Fig: 4.1



International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Fig.4.2

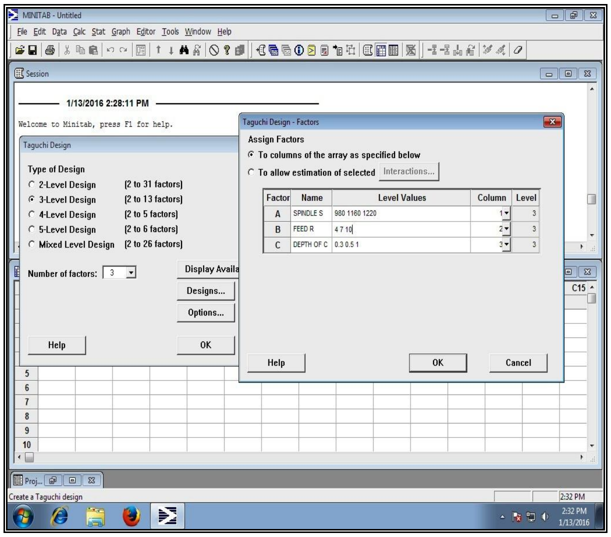
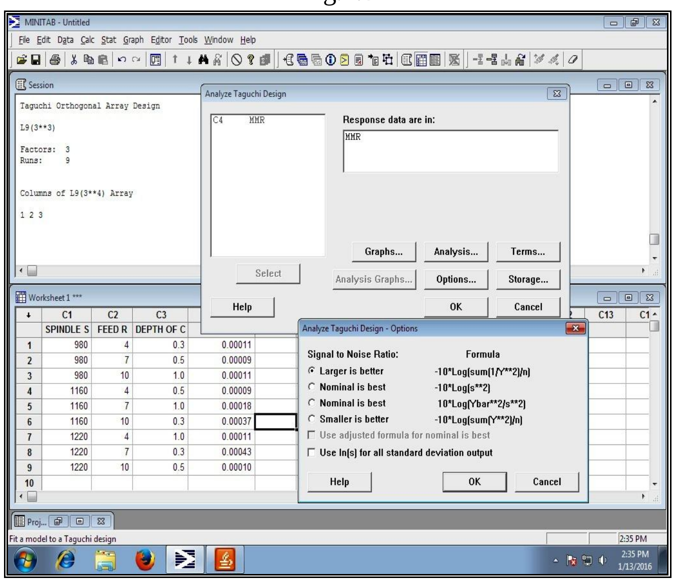


Fig.4.3



V. RESULTS

For the maximum material removal rate, the solution is "Larger is better" and S/N ratio is determined according to the following equation:

$$S/N = -10 \log_{10} \{n^{-1} \Sigma y^{-2}\}$$

where,

S/N = Signal to Noise Ratio,

n = No. of Measurements,

y = Measured Value

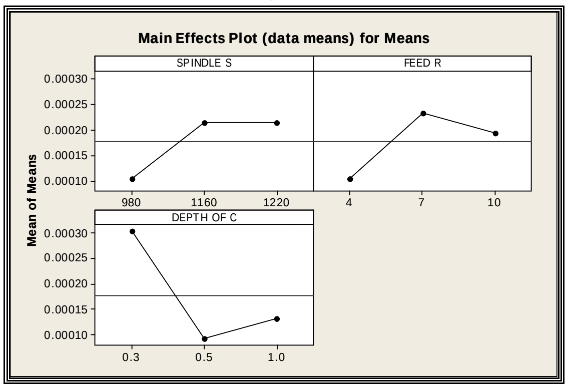
The MRR values measured from the experiments & their corresponding S/N ratio values :

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Table: 5.1

Sr No	Spindle speed (RPM)	Feed Rate (mm/min)	Depth of cut (mm)	MRR (g/sec)	S/N ratio
1	980	4	1	0.00011	-79.1721
2	980	7	0.5	0.00009	-80.9151
3	980	10	0.3	0.00011	-79.1721
4	1160	4	0.5	0.00009	-80.9151
5	1160	7	0.3	0.00018	-74.8945
6	1160	10	1	0.00037	-68.636
7	1220	4	0.3	0.00011	-79.1721
8	1220	7	1	0.00043	-67.3306
9	1220	10	0.5	0.0001	-80

Fig: 5.1



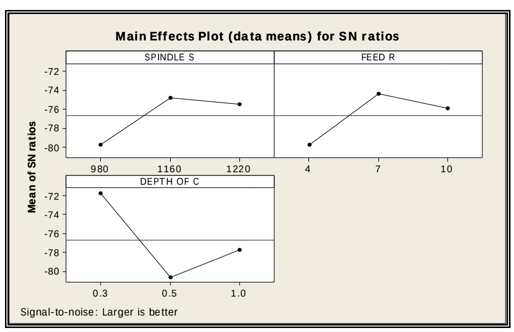


Fig: 5.2

VI. CONCLUSION

Taguchi approach gives us the optimal parameters in the CNC (Grooving) turning process using carbide tip tool the optimum set of speed, feed rate and depth of cut and Effect of turning parameters on material removal rate. From SN ration as under:

Spindle Speed: - Its effect is increasing with increase in spindle speed upto 1160 RPM beyond that it is decreasing. So the optimum spindle speed is level 2 (1160 RPM.)

Feed Rate: - Its effect is increasing with increase in feed rate. So the optimum feed rate is level 2 (7 mm/min)

Depth of Cut: - Its effect is increasing with increase in depth of cut. So the optimum depth of cut is level 1(0.3 mm)

REFERENCES

[1] Kamal, Anish and M.P.Garg (2012), “Experimental investigation of Material removal rate in CNC turning using Taguchi method”International Journal of

Engineering Research and Applications (IJERA) Vol. 2, Issue 2,Mar-Apr 2012, pp.1581-1590

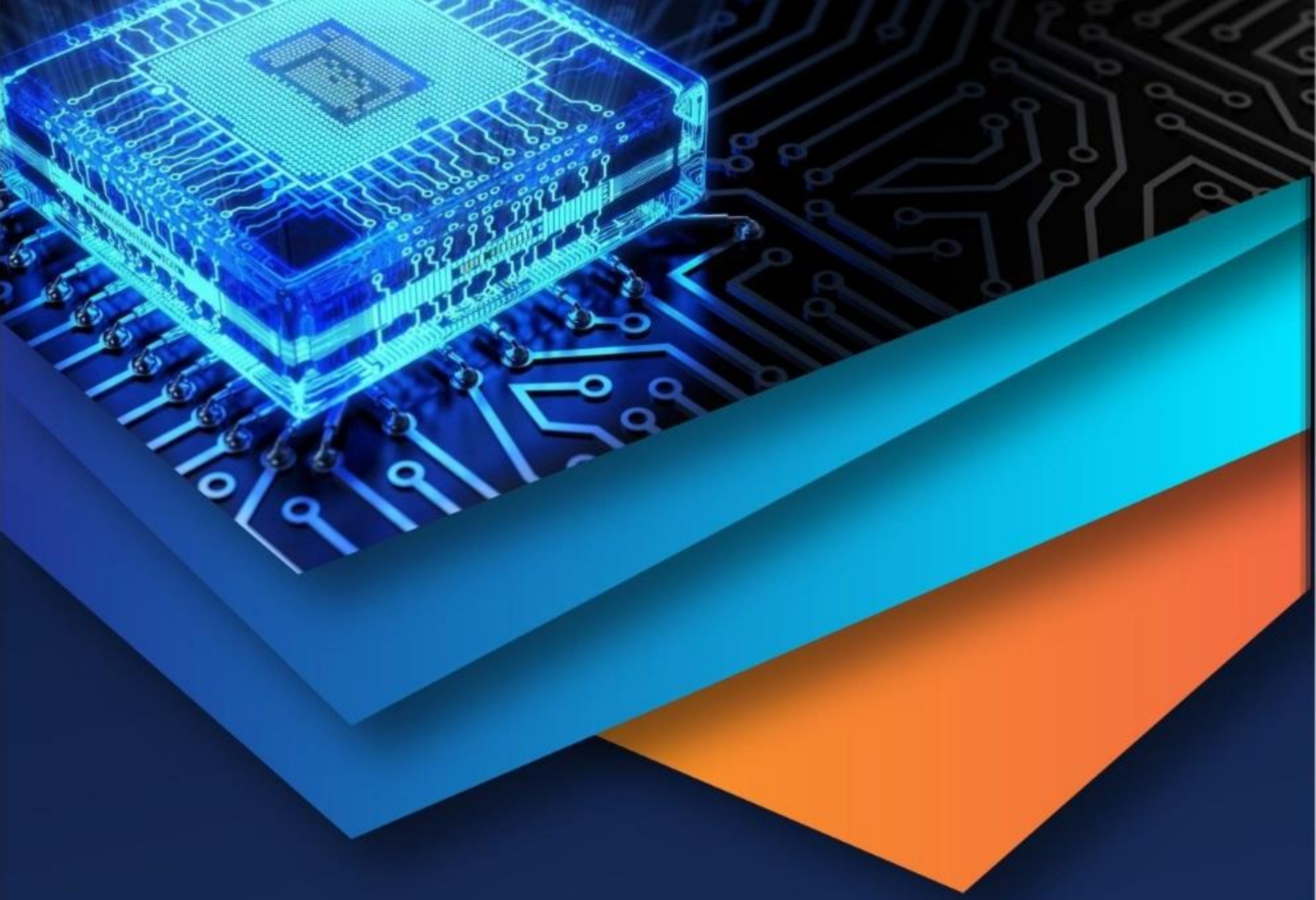
[2] Ashish Yadav, Ajay Bangar, Rajan Sharma, Deepak Pal ," Optimization of Turning Process Parameters for Their Effect on En 8 Material Work piece Hardness by Using Taguchi Parametric Optimization Method," International Journal of Mechanical and Industrial Engineering (IJMIE), ISSN No. 2231 –6477, Volume-1, Issue-3, 2012.

[3] Rama Rao. S, Padmanabhan. G ," Application of Taguchi methods and ANOVA in optimization of process parameters for metal removal rate in electrochemical machining of Al/5%SiC composites ," International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 3, May-Jun 2012, pp. 192-197.

[4] Sujit Kumar Jha, Sujit Singh and Shiv Ranjan Kumar, "Experimental Analysis of CNC Turning using Taguchi Method", Proceedings of Third International Conferences on Advances in Mechanical Engineering, Delhi, India, DOI: 02.AETAME.2012.3.15, pp. 91-95, 2012.

[5] Gaitonde, V.N., Karnik, Paulo Davim, Multi-performance Optimization in turning of Free-machining steel using Taguchi Method and Utility concept, Journal of Materials Engineering and Performance, 18(3), 231, 2009.

[6] Application of Taguchi Method for Optimizing Turning Process by the effects of Machining Parameters Krishankant, Jatin Taneja, Mohit Bector, Rajesh Kumar International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-1, October 2012



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY