Laboratory Plan

FMTH0303-3.1

Semester: 3rd *Year*: 2019-20

Laboratory Title: Manufacturing Processes Lab	*Lab. Code*: 16EMEP201
Total Hours: 24	*Duration of Exam*: 2 Hrs
Total Exam Marks: 100	*Total ISA Marks*: 80
Lab. Plan Author: Veeresh Balikai, V. Komalapur, Praveenkumar P., Satish J	*Date*: 25-05-2019
Checked By: Dr. B B Kottürshettar	*Date:* 10-06-2019

Preamble:

This course has no prerequisites.

Course Outcomes-CO

At the end of the course students will be able to:

1. Carryout preventive maintenance of machines and adhere to the safety and security norms.
2. Establish process flow & estimate machining time for given component drawings.
3. Perform the different machining operations on lathe, milling and grinding machines and inspect the same.
4. Generate/write G & M codes (part programme) and simulate the same on software.
5. Design and analyze bulk deformation in various metal forming processes like forging, rolling, and sheet metal processes like shearing, punching, blanking or bending.
6. Study the effects of process parameters on machinability aspects in turning, milling and drilling for a given work tool combination.

Course Articulation Matrix: Mapping of Course Outcomes (CO) Program outcomes

Laboratory (Course) Title: Manufacturing Processes Lab

Laboratory (Course) code: 16EMEP201 Semester: 3rd Year: 2019-20

Course Outcomes / Program Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1. Carryout preventive maintenance of machines and adhere to the safety and security norms.															M
2. Establish process flow & estimate machining time for given component drawings.														H	
3. Perform the different machining operations on lathe, milling, drilling and grinding machines and inspect the same.														M	
4. To generate/write G & M codes (part programme) and simulate the same on software.					M										
5. To design and analyse bulk deformation in various metal forming processes like forging, and sheet metal processes like shearing, punching, blanking or bending.		L			M										
6. Study the effects of process parameters on machinability aspects in turning, milling and drilling for a given work tool combination.				M											

Degree of compliance **L**: Low **M**: Medium **H**: High

Competency addressed in the Course and corresponding Performance Indicators

2.1 Demonstrate an ability to identify and characterize an engineering problem	2.1.2 Identify engineering systems, variables, and parameters to solve the problems 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2 Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.2 Identify, assemble and evaluate information and resources. 2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
4.1 Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities 4.1.4 Establish a relationship between measured data and underlying physical principles.
4.2 Demonstrate an ability to design experiments for solving open ended problems	4.2.1 Design and develop experimental approach, specify appropriate equipment and procedures 4.2.2 Understand the importance of statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3 Demonstrate an ability to analyze data and reach valid conclusion/s	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data 4.3.2 Analyze data for trends and correlations, stating possible errors and limitations 4.3.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions
5.1 Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2 Demonstrate an ability to select and apply discipline specific tools, techniques and resources	5.2.2 Demonstrate proficiency in using discipline specific tools
14.1 Demonstrate an ability to carry out feasibility study	14.1.1 Ability to prepare a brief outline of the possible steps of manufacturing
14.2 Demonstrate an ability to prepare process flow chart	14.2.1 Identify appropriate metal cutting/ metal forming/ any other manufacturing processes for a given component. 14.2.2 Apply manufacturing knowledge to develop process sheets to manufacture a component in a most economical way with the available resources.
15.1 Demonstrate an ability to explain basic steps involved in preventive maintenance of machine tools	15.1.1 Apply knowledge of principles of preventive maintenance 15.1.2 Prepare preventive maintenance chart for a given machine tool referring to OEM's manual.

Course Assessment Plan

Course Title: **Manufacturing Processes Lab**		Code: **16EMEP201**	
Course outcomes (COs)	Weightage in assessment	Assessment Methods	
		Lab activity	SEE
1. Carryout preventive maintenance of machines and adhere to the safety and security norms. 2. Establish process flow & estimate machining time for given component drawings.	10%	√	√
3. Perform the different machining operations on lathe, milling and grinding machines and inspect the same.	30%	√	√
4. To generate/write G & M codes (part programme) and simulate the same on software.	10%	√	
5. To design and analyse bulk deformation in various metal forming processes like forging, and sheet metal processes like shearing, punching, blanking or bending.	20%	√	
6. Study the effects of process parameters on machinability aspects in turning, milling and drilling for a given work tool combination.	30%	√	√
Weightage		80%	20%

Experiment wise plan

Category: Exercises — **No. of lab sessions: 10**

Learning Outcomes:

The students should be able to:

1. Establish process flow & estimate machining time for given component drawings.
2. Perform the different machining operations on lathe, milling and grinding machines and inspect the same.
3. To generate/write G & M codes (part programme) and simulate the same on software.
4. To design and analyse bulk deformation in metal forming processes on AFDEX2014 software.

Exp. No.	Experiments	No. of Lab. Session/s per batch (estimate)	Marks	CO	PI	*Correlation of Experiment with the theory*
Machine shop exercises						
1	Carryout preventive maintenance of machines and adhere to the safety and security norms.	01	05	CO1	15.1.2	MP Chapter 4
2	Machining practices involving machining time calculation and estimation of machining cost for the jobs for turning, taper turning, threading, knurling.	01	10	CO2	14.2.2	
3	To manufacture and assemble parts for ball valve which involves turning, milling, tapping/slot milling, etc.	05	20	CO3	14.2.2	
Computer Integrated Manufacturing						
4	CNC milling simulation on Master cam.	02	10	CO4	5.2.2	MP Chapter 5
Design and analysis of bulk deformation and sheet metal processes						
5	Design and model punch and die and simulate the piercing process using AFDEX software and analyse the results.	01	10	CO5	2.2.3	MP Chapter 7

Non-traditional Machining Processes

Category: Demonstration — **No. of lab sessions: 01**

Learning Outcome:

The students should be able to:

1. To demonstrate the non-traditional machining processes

Exp. No.	Experiments	No. of Lab. Sessions	Marks	CO	PI	*Correlation of Experiments*
6	Demonstration of CNC machines and Non-traditional machines such as laser cutting, plasma cutting, electro-discharge machine.	01	05	CO6	1.4.1	MP Chapter 8

Machinability studies on Turning, milling and drilling

Category: Structured enquiry/Open ended						**No. of lab sessions: 02**
Learning Outcomes: The students should be able to: 1. Measure the cutting force components in orthogonal and oblique cutting.						
Exp. No.	**Experiments**	**No. of Lab. Session/s per batch (estimate)**	**Marks**	**CO**	**PI**	***Correlation of Experiment with the theory***
7	Study on a lathe machine, drilling and milling machine using dynamometer to establish force component, machinability and surface finish using comparator	02	20	CO6	4.3.4	MP Chapter 6

1. Materials and Resources Required:

1. Lab manual
2. Text books

   i. Kalpakjain S., and Schmid S.R. Manufacturing Engineering & Technology, 7th edition, Pearson Education, 2014.

   ii. Mikell P. Groover. Fundamentals of Modern Manufacturing, 5th edition, John Wiley & Sons, 2012

2. Evaluation:

Students Assessment through ISA (80%) + ESA (20%)

	Assessment	**Marks**	
ISA (80%)	Demonstration	05	**80**
	Exercise	55	
	Open ended experiment	20	
ESA (20%)	Writing procedural steps	04	**20**
	Execution and interpretation of results	08	
	Viva-voce	08	
	Total	**100**	**100**

Date: **School Head**

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KARNATAKA

An Open Ended Experiment Report on

STUDY OF EFFECT OF PARAMETERS ON MACHINING PERFORMANCE

Submitted by

BATCH: A2

TEAM: 1

Experience Engineering @

School of Mechanical EngineeringKLETECH

Engage | Explore | Excel | Evolve

2019-2020

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List of Students:

Roll no.	SRN	Name of students	Signature
119	01FE18BME019	AMIT HARWAD	
120	01FE18BME092	PRITAM RAVI PAWAR	
122	01FE18BME022	AMOGH N	
123	01FE18BME079	NANDEESH GADGIMATH	
124	01FE17BME034	BRIAN KHANAPUR	

28/11

A. Planning or Designing The Experiment

The students of the batch A2 have identified three major cutting parameters such as cutting speed, feed, depth of cut, which affect the cutting force and power consumption during a simple turning operation. The process was carried out for copper work piece with HSS tool combination. Table1 illustrates the process parameters and their levels identified by the batchA2.

Machine used : Centre Lathe
Tool material : HSS tool
Work piece material: Copper
Dynamometer: Lathe tool dynamometer

Based on the experimental procedure, 16 (3 factors and 2 levels) factorial design has been formulated, which is represented in Table2

TABLE1 IDENTIFIED PARAMETERS AND LEVELS:

Parameters	Level 1	Level 2
Cutting speed(m/min)	500	710
Feed (mm/rev)	0.022	0.05
DOC (mm)	0.5	1.5

Lathe Tool Dynamometer
Work-piece: Ø25.0mm Copper
Tool Material: HSS

Std Order	Run Order	Speed rev/min	Feed mm/rev	ØDOC mm	Tangential Force Fc kgf	Feed Force Ft kgf
1	1	500	0.022	0.5	12	2
2	2	710	0.022	0.5	10	1
3	3	500	0.05	0.5	16	3
4	4	710	0.05	0.5	16	4
5	5	500	0.022	1.5	20	8
6	6	710	0.022	1.5	17	9
7	7	500	0.05	1.5	35	10
8	8	710	0.05	1.5	30	10
9	9	500	0.022	0.5	10	1
10	10	710	0.022	0.5	9	1
11	11	500	0.05	0.5	16	2
12	12	710	0.05	0.5	15	2
13	13	500	0.022	1.5	21	7
14	14	710	0.022	1.5	19	7
15	15	500	0.05	1.5	33	10
16	16	710	0.05	1.5	30	11

B. Conducting Experiment

Based on the experiment plan, the batch conducted the experiment as per full factorial design (FFD) of 16 with 3 replications under each experimental combination. The lathe tool dynamometer was used to measure the cutting force (Fc) and the readings have been recorded for each experimental combination. The power consumption was calculated by the equation

Estimated Effects and Coefficients for Fc (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	3	212.250	212.250	70.750	94.33	0.000
cutting speed	1	0.250	0.250	0.250	0.33	0.580
feed	1	16.000	16.000	16.000	21.33	0.002
DOC	1	196.000	196.000	196.000	261.33	0.000
2-Way Interactions	3	1.500	1.500	0.500	0.67	0.596
cutting speed*feed	1	0.250	0.250	0.250	0.33	0.580
cutting speed*DOC	1	0.250	0.250	0.250	0.33	0.580
feed*DOC	1	1.000	1.000	1.000	1.33	0.282
3-Way Interactions	1	0.250	0.250	0.250	0.33	0.580
cutting speed*feed*DOC	1	0.250	0.250	0.250	0.33	0.580
Residual Error	8	6.000	6.000	0.750		
Pure Error	8	6.000	6.000	0.750		
Total	15	220.000				

Analysis of Variance for Fc (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	3	212.250	212.250	70.750	94.33	0.000
cutting speed	1	0.250	0.250	0.250	0.33	0.580
feed	1	16.000	16.000	16.000	21.33	0.002
DOC	1	196.000	196.000	196.000	261.33	0.000
2-Way Interactions	3	1.500	1.500	0.500	0.67	0.596
cutting speed*feed	1	0.250	0.250	0.250	0.33	0.580
cutting speed*DOC	1	0.250	0.250	0.250	0.33	0.580
feed*DOC	1	1.000	1.000	1.000	1.33	0.282
3-Way Interactions	1	0.250	0.250	0.250	0.33	0.580
cutting speed*feed*DOC	1	0.250	0.250	0.250	0.33	0.580
Residual Error	8	6.000	6.000	0.750		
Pure Error	8	6.000	6.000	0.750		
Total	15	220.000				

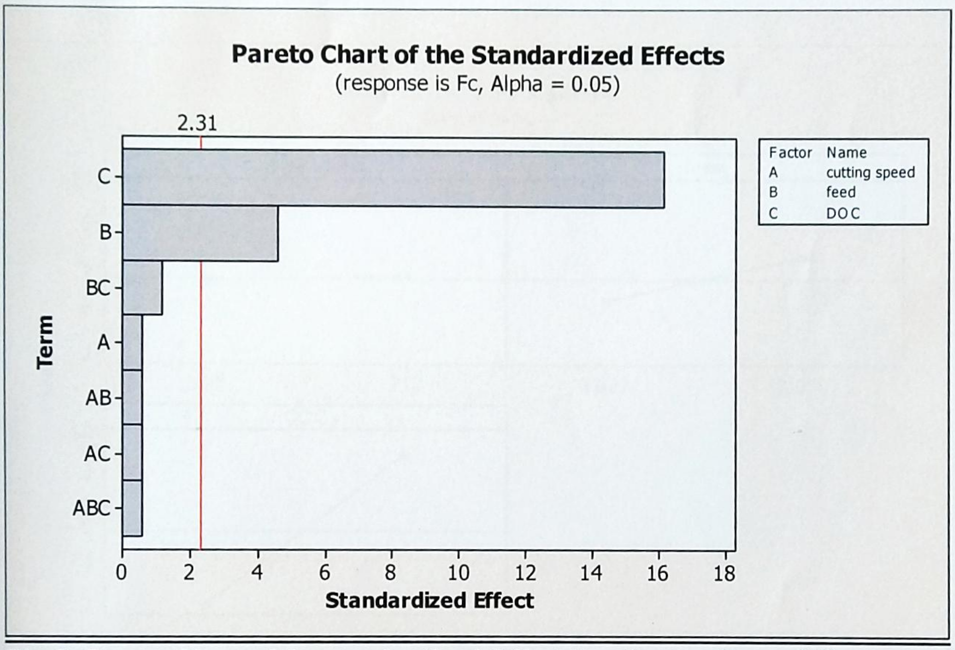

Fig 2: Pareto Chart of the standardized Effect For Cutting Force (N)

The above pareto chart for the cutting force (fc) with the process parameters, shows that the combination of feed and depth of cut and the combination of all the process parameters has less significance on the cutting force.

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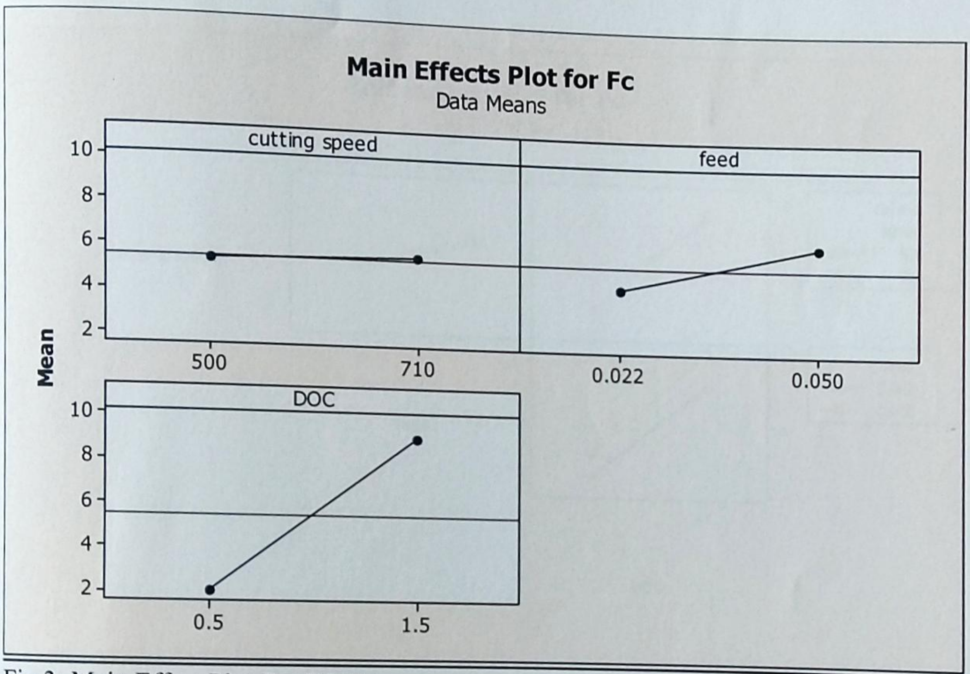

Fig 3: Main Effect Plot For FC(N)

From the main effect plot, it is clear that as the speed increases from low level to high level the cutting force decrease, as the feed rate and depth of cut increases from low level to high level the cutting force increases. The depth of cut has very much effect on the cutting force as observed from the graph having greater slope for depth of cut.

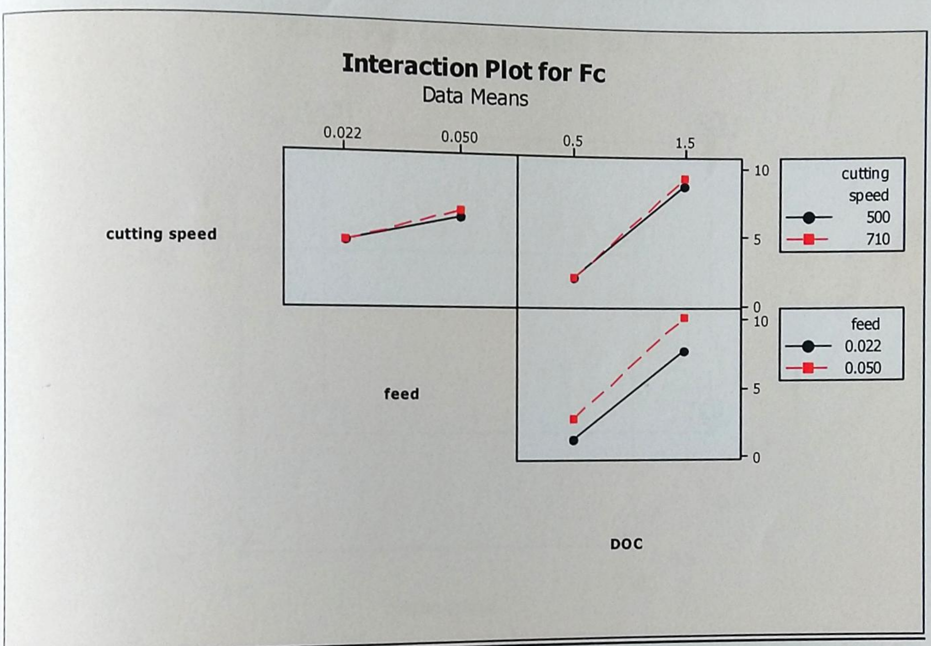

Fig 4: Interaction Plot For FC (N)

From the interaction plot for power we observe that the interaction that there is no interaction or less interaction between the combination of speed-feed and speed-doc and hence less significant but there is a interaction between the graph for feed-doc and this combination has significant effect on the cutting force when compared to the other two combinations.

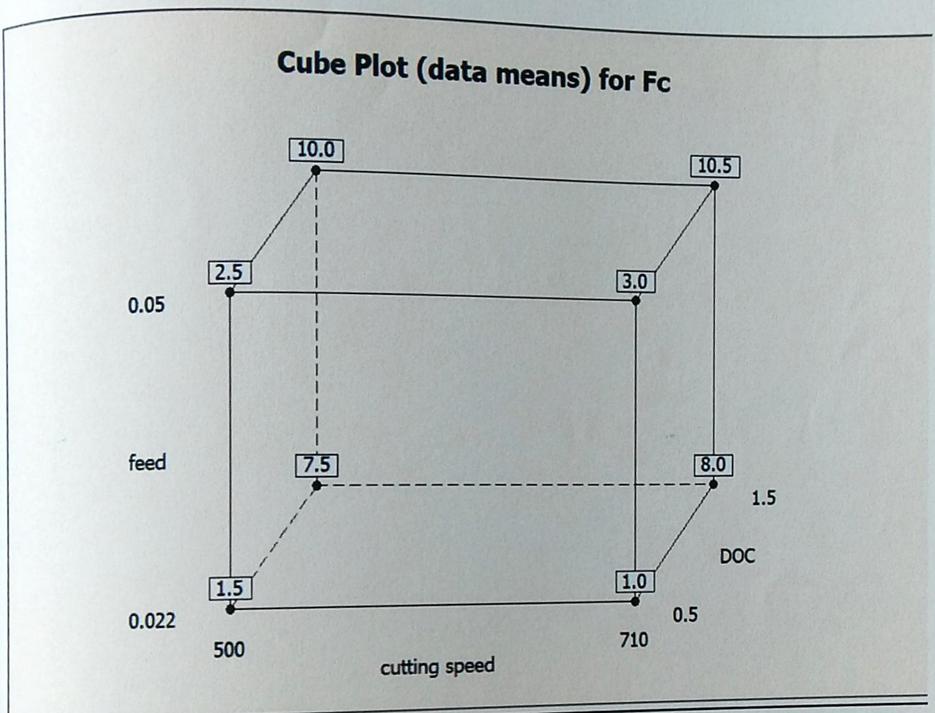

Fig 5: Cube Plot(data means) for FC(N)

Cube plot is a 3 dimensional representation of all the 3 factors with 2 levels forming a cube with 8 corners as the respective combination. To obtain the minimum cutting force for the operation ie 1Newton (from graph) , the operator has to set the following combinations of speed feed and depth of cut

Speed = 710 m/min

Feed 0.022 mm/ rev

Doc= 0.5 mm