

**MACHINE TOOLS AND OPERATIONS**  
**B.E, III/IV Semester, Mechanical Engineering**  
**[As per Choice Based Credit System (CBCS) scheme]**

Course Code	17ME35 B / 45B	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

Credits – 04

**Course Objectives:**

- To introduce students to different machine tools in order to produce components having different shapes and sizes.
- To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
- To develop the knowledge on mechanics of machining process and effect of various parameters on economics of machining.

**Module - 1**

**MACHINE TOOLS**

Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine, boring machine, broaching machine, shaping machine, planing machine, grinding machine [Simple sketches showing major parts of the machines]

**Module - 2**

**MACHINING PROCESSES**

Introduction, Types of motions in machining, turning and Boring, Shaping, Planing and Slotting, Thread cutting, Drilling and reaming, Milling, Broaching, Gear cutting and Grinding, Machining parameters and related quantities.  
 [Sketches pertaining to relative motions between tool and work piece only]

**Module - 3**

**CUTTING TOOL MATERIALS, GEOMETRY AND SURFACE FINISH**

Introduction, desirable Properties and Characteristics of cutting tool materials, cutting tool geometry, cutting fluids and its applications, surface finish, effect of machining parameters on surface finish.

Machining equations for cutting operations: Turning, Shaping, Planing, slab milling, cylindrical grinding and internal grinding, Numerical Problems

**Module - 4**

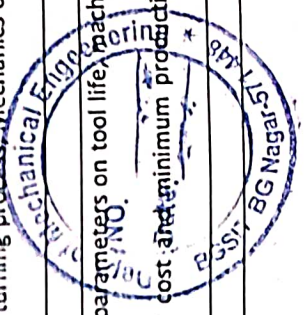
**MECHANICS OF MACHINING PROCESSES**

Introduction, Chip formation, Orthogonal cutting, Merchant's model for orthogonal cutting, Oblique cutting, Mechanics of turning process, Mechanics of drilling process, Mechanics of milling process, Numerical problems.

**Module - 5**

**TOOL WEAR, TOOL LIFE:** Introduction, tool wear mechanism, tool wear equations, tool life equations, effect of process parameters on tool life, Machinability, Numerical problems

**ECONOMICS OF MACHINING PROCESSES:** Introduction, choice of feed, choice of cutting speed, tool life for minimum cost, and minimum production time, machining at maximum efficiency, Numerical problems



**Course outcomes:**

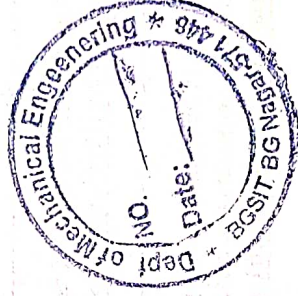
- Explain the construction & specification of various machine tools.
- Describe various machining processes pertaining to relative motions between tool & work piece.
- Discuss different cutting tool materials, tool nomenclature & surface finish.
- Apply mechanics of machining process to evaluate machining time.
- Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

**TEXT BOOKS:**

1. Fundamentals of metal cutting and Machine Tools, B.L. Juneja, G.S. Sekhon and Nitin Seth, New Age International Publishers 2<sup>nd</sup> Edition, 2003
2. All about Machine Tools, Heinrich Gerling, New Age International Publishers revised 2<sup>nd</sup> Edition, 2006

**REFERENCE BOOKS**

1. Fundamental of Machining and Machine Tools, Geoffrey Boothroyd and Winston A. Knight, CRC Taylor & Francis, Third Edition.
2. Metal cutting principles, Milton C. Shaw, Oxford University Press, Second Edition, 2005.







|| Jai Sri Gurudev ||  
Adichunchanagiri Shikshana Trust (R)  
**BGS INSTITUTE OF TECHNOLOGY**  
Department of Mechanical Engineering

**CO-PO & CO-PSO Mapping (17 Scheme)**

Program	Code	Course	Credits	L-T-P	Assessment		Exam Duration
					SEE	CIA	
B.E	17ME35B	Machine Tools and Operations	4	4-0-0	60	40	3Hrs

**CO's**

15C205.1	Explain the construction & specification of various machine tools.
15C205.2	Describe various machining processes pertaining to relative motions between tool & work piece.
15C205.3	Discuss different cutting tool materials, tool nomenclature & surface finish.
15C205.4	Apply mechanics of machining process to evaluate machining time.
15C205.5	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

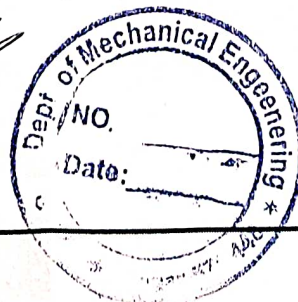
**PSO's**

PSO-1: Ability to acquire competencies in designing, analyzing and evaluating the mechanical components.  
PSO-2: Ability to work professionally by applying manufacturing and management practices.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
15C205.1	3				1									2
15C205.2	3				1									2
15C205.3	3				1									2
15C205.4	3				1									2
15C205.5	3				1									2
AVG	3				1									2

*Janarthan Kumar F.C.*  
Course Owner

*Verified*  
*Kest*



*Pradeep*  
HOD

Head of the Department  
Department of Mechanical Engineering  
BGSIT B G Nagar-571448



	60%	30%	10%	TOTAL
	CIE	SEE	CES	
CO1	2.56	1.19	2.46	2.14
CO2	2.23	1.19	2.59	1.96
CO3	2.09	1.19	2.41	1.85
CO4	1.94	0.00	2.66	1.43
CO5	1.25	0.00	2.46	0.99

### CO PO PSO ATTAINMENT

Subject Name & Code	Machine tool and operation	
Semester	3rd sem	17ME35B
Faculty Name:	Mr.SANTHOSH KUMAR.T.C	

PO/PSO	Total	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2.14	3				1									2
CO2	1.96	3				1									2
CO3	1.85	3				1									2
CO4	1.43	3				1									2
CO5	0.99	3				1									2
Sum		15				5									10
Number		5				5									5
Average		3				1									2
Weighted Sum		25.12298				8.374328									16.74866
PO Attainment		1.67				0.56									1.12

CO-PO/PSO Mapping Table

For Prof  
 Head of the Department  
 Department of Mechanical Engineering  
 BGSIT B G Nagar-571448

*Santhosh Kumar T.C.*







6. Course Information

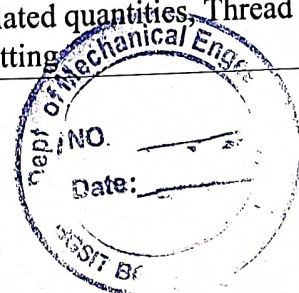
6.2

Semester : 3

Section : A

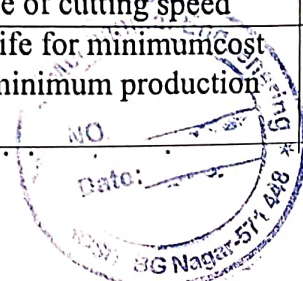
Course : MACHINE TOOLS AND OPERATIONS

P e r i o d	Planned			Execution		
	Date	Topic	Source material to be referred	Date	Topic	Source material to be referred
<b>1</b>						
1	2018-08-07	Introduction	-	2018-08-07	Introduction	-
2	2018-08-08	Classification	-	2018-08-08	Classification	-
3	2018-08-09	construction and specifications of lathe	-	2018-08-09	construction and specifications of lathe	-
4	2018-08-10	drilling machine	-	2018-08-10	drilling machine	-
5	2018-08-11	milling machine	-	2018-08-11	milling machine	-
6	2018-08-14	boring machine	-	2018-08-14	boring machine	-
7	2018-08-16	broaching machine	-	2018-08-16	broaching machine	-
8	2018-08-17	shaping machine	-	2018-08-17	shaping machine	-
9	2018-08-18	planing machine	-	2018-08-18	planing machine	-
10	2018-08-21	grinding machine [Simple sketches showing major parts of the machines]	-	2018-08-21	grinding machine [Simple sketches showing major parts of themachines]	-
<b>2</b>						
11	2018-08-23	Introduction, Types of motions in machining	-	2018-08-23	Introduction, Types of motions in machining	-
12	2018-08-24	turning and Boring, Shaping	-	2018-08-24	turning and Boring, Shaping	-
13	2018-08-25	Planing and Slotting	-	2018-08-25	Planing and Slotting	-
14	2018-08-28	Thread cutting	-	2018-08-28	Thread cutting	-
15	2018-08-29	Drilling and reaming	-	2018-08-29	Drilling and reaming	-
16	2018-08-30	Milling	-	2018-08-30	Milling	-
17	2018-08-31	Broaching	-	2018-08-31	Broaching	-
18	2018-09-01	Gear cutting and Grinding	-	2018-09-01	Gear cutting and Grinding	-
19	2018-09-04	Machining parameters and related quantities	-	2018-09-04	Machining parameters and related quantities	-
20	2018-09-05	[Sketches pertaining to relative motions between tool and work piece only]	-	2018-09-05	[Sketches pertaining to relative motions between tool and work piece only]	-
51	2018-11-20	Machining parameters and related quantities, Thread cutting	-	2018-11-19	Machining parameters and related quantities, Thread cutting	-





3						
21	2018-09-06	Introduction, desirable Properties and Characteristics of cutting tool materials	-	2018-09-06	Introduction, desirable Properties and Characteristics of cutting tool materials	-
22	2018-09-07	cutting tool geometry	-	2018-09-07	cutting tool geometry	-
23	2018-09-08	cutting fluids and its applications	-	2018-09-08	cutting fluids and its applications	-
24	2018-09-11	surface finish	-	2018-09-11	surface finish	-
25	2018-09-12	effect of machining parameters on surface finish	-	2018-09-12	effect of machining parameters on surface finish	-
26	2018-09-14	Turning, Shaping	-	2018-09-14	Turning, Shaping	-
27	2018-09-15	Planing	-	2018-09-15	Planing	-
28	2018-09-18	slab milling	-	2018-09-18	slab milling	-
29	2018-09-19	cylindrical grinding and internal grinding	-	2018-09-19	cylindrical grinding and internal grinding	-
30	2018-09-20	Numerical Problems	-	2018-09-20	Numerical Problems	-
4						
31	2018-09-22	Introduction	-	2018-09-22	Introduction	-
32	2018-09-25	Introduction	-	2018-09-25	Introduction	-
33	2018-09-26	Chip formation	-	2018-09-26	Chip formation	-
34	2018-09-27	Orthogonal cutting	-	2018-09-27	Orthogonal cutting	-
35	2018-09-28	Merchant's model for orthogonal cutting	-	2018-09-28	Merchant's model for orthogonal cutting	-
36	2018-09-29	Oblique cutting	-	2018-09-29	Oblique cutting	-
37	2018-10-03	Mechanics of turning process	-	2018-10-03	Mechanics of turning process	-
38	2018-10-04	Mechanics of drilling process	-	2018-10-04	Mechanics of drilling process	-
39	2018-10-05	Mechanics of milling process	-	2018-10-05	Mechanics of milling process	-
40	2018-10-06	Numerical problems	-	2018-10-06	Numerical problems	-
5						
41	2018-10-09	Introduction, tool wear mechanism	-	2018-10-09	Introduction, tool wear mechanism	-
42	2018-10-10	tool wear equations, tool life equations	-	2018-10-10	tool wear equations, tool life equations	-
43	2018-10-11	effect of process parameters on tool life	-	2018-10-11	effect of process parameters on tool life	-
44	2018-10-12	machinability	-	2018-10-12	machinability	-
45	2018-10-13	Numerical problems	-	2018-10-13	Numerical problems	-
46	2018-10-16	Introduction, choice of feed	-	2018-10-16	Introduction, choice of feed	-
47	2018-10-17	choice of cutting speed	-	2018-10-17	choice of cutting speed	-
48	2018-10-20	tool life for minimum cost and minimum production time	-	2018-10-20	tool life for minimum cost and minimum production time	-







# BGS Institute of Technology

## Department of Mechanical Engineering (ME)

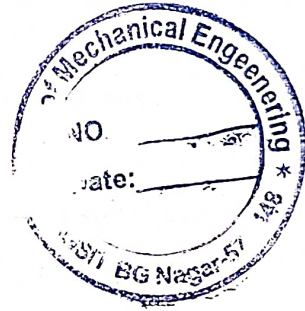
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50	2018-10-25	Numerical problems	-	2018-10-25	Numerical problems	-
52	2018-11-20	Numerical problems	-	2018-11-19	Numerical problems	-



## MODULE-1

# MACHINE TOOLS



### LESSON CONTENTS:

Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine, boring machine, broaching machine, shaping machine, planing machine, grinding machine.

### OBJECTIVES:

- To study the constructional details of various machine tools and their specifications.

### Introduction

**Machining Process:** Machining is an essential process of finishing by which work pieces are produced to the desired dimensions and surface finish by gradually removing the excess material from the preformed blank in the form of chips with the help of cutting tool(s) moved past the work surface(s).

**Machine Tool:** A machine tool is a non-portable power operated and reasonably valued device or system of devices in which energy is expended to produce jobs of desired size, shape and surface finish by removing excess material from the preformed blanks in the form of chips with the help of cutting tools moved past the work surface(s).

### Classification of Machine Tool:

Based on the principle of operation, the type of relative motion exists between the tool and the work surface etc., the machine tools are classified as,

#### 1. According to the direction of major axis:

- Horizontal axis machine tools (Lathes, Horizontal milling machine, Boring machines, cylindrical grinding machines etc.,)
- Vertical axis machine Tools (Vertical Milling machines, Drilling machines etc.,)
- Inclined or multiple axis (CNC machine tools and Special purpose machines)



**2. According to the purpose of Use:**

- a. general purpose (center lathes, milling machines, drilling machines etc.)
- b. single purpose (facing lathe, roll turning lathe etc.)
- c. special purpose (for mass production.)

**3. According to the degree of automation:**

- a. non-automatic (center lathes, drilling machines etc.)
- b. semi-automatic (capstan lathe, turret lathe, hobbing machine etc.)
- c. automatic (single spindle automatic lathe, swiss type automatic lathe, CNC milling machine etc.)

**4. According to Size:**

- a. Heavy duty (heavy-duty lathes (e.g.  $\geq 55$  kW), boring mills, planning machine, horizontal boring machine etc.)
- b. Medium duty (lathes – 3.7 ~ 11 kW, column drilling machines, milling machines etc.)
- c. Small duty (table top lathes, drilling machines, milling machines.)
- d. Micro duty (micro-drilling machine etc)

**5. According to precision:**

- a. Ordinary (Conventional Machine tools)
- b. High Precision (CNC machines, Grinding machines, lapping machines)

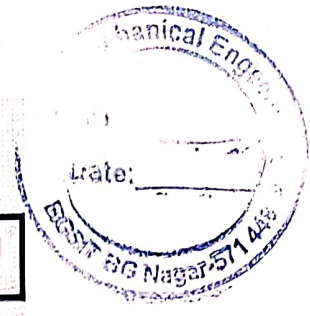
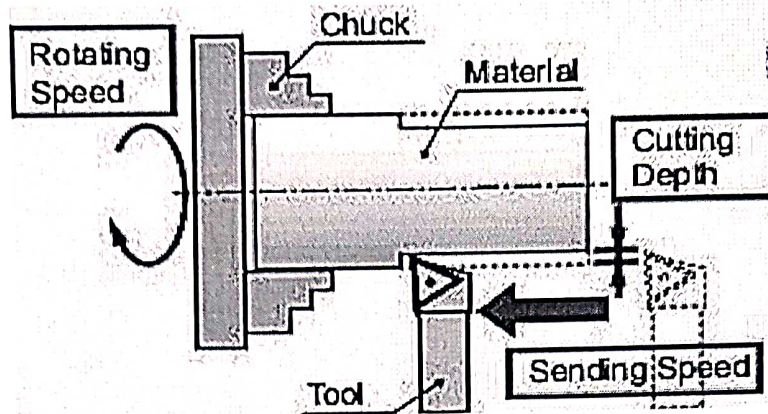
**6. According to the type of automation:**

- a. Fixed automation (Single spindle and multi spindle)
- b. Flexible automation (CNC Milling Machines)



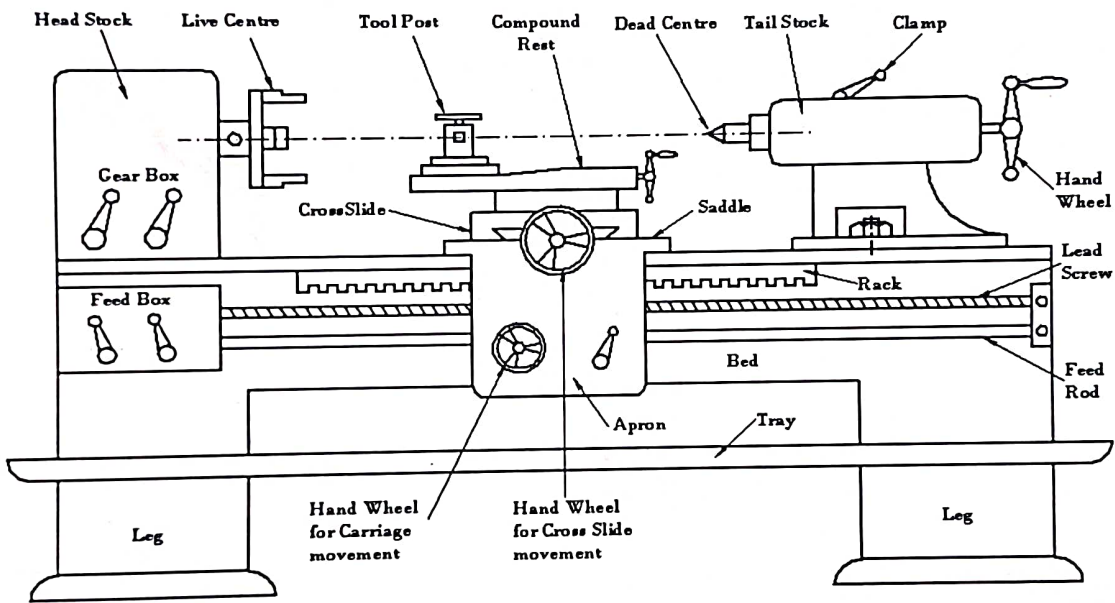
**LATHE MACHINE TOOL**

The lathe is a machine tool which holds the work piece between two rigid and strong supports called centers or in a chuck or face plate which revolves. The cutting tool is rigidly held and supported in a tool post which is fed against the revolving work. The normal cutting operations are performed with the cutting tool fed either parallel or at right angles to the axis of the work. The cutting tool may also be fed at an angle relative to the axis of work for machining tapers and angles.



*Fig: Principle of working of a lathe*

**Construction of Centre Lathe:** The main parts of the lathe are the bed, headstock, quickchanging gear box, carriage and tailstock.



*Fig: Parts of Lathe*

- **Bed:** Usually made of cast iron. Provides a heavy rigid frame on which all the main components are mounted. It is the foundation part of a lathe and supports the remaining parts. The top of the bed is formed by precision-machined guide ways.
- **Guide Ways:** Inner and outer guide rails that are precision machined parallel to assure accuracy of movement.



- **Headstock:** mounted in a fixed position on the inner ways, usually at the left end. Using a chuck, it rotates the work. The housing comprising of the feed gearbox and the cone



FIRST ASSIGNMENT Format – CBCS Scheme BGSIT

Name of the Faculty: SANTHOSH KUMAR T C  
Submission Date: 29/10/2018

Signature: *Santhosh Kumar T.C.*

Reviewer Signature:

*Pmatj*

BGS Institute of Technology  
Department: Mechanical Department  
Assignment – I

Semester: III

Subject Name and Code: Machine Tools & Operations, 17ME35B

1. INSTRUCTIONS: Answer all the question in yellow book  
Max. Marks: 10

Q. No	QUESTIONS	CO	LEVEL S
1.	Explain the constructional features of engine lathe?	1	2
2.	Write a note on radial drilling machine?	1	2
3.	Write a note on horizontal boring machine?	2	2
4.	Write a note on centre less grinding machine?	2	2
5.	Explain the constructional features of continuous surface broaching machine?	2	2





FIRST ASSIGNMENT Format – CBCS Scheme BGSIT

Name of the Faculty: SANTHOSH KUMAR T C  
Submission Date: 13/11/2018

Signature:

*Santhosh Kumar T.C.*

Reviewer Signature:

*Prath*

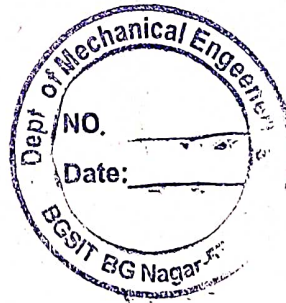
BGS Institute of Technology  
Department: Mechanical Department  
Assignment – II

Semester: III

Subject Name and Code: Machine Tools & Operations, 17ME35B

1. INSTRUCTIONS: Answer all the question in yellow book  
Max. Marks: 10

Q. No	QUESTIONS	CO	LEVELS
1.	Explain types of motion in machine?	2	2
2.	Write down the milling machine operations?	2	2
3.	Write down the process of internal grinding?	3	2
4.	Write down the broaching operations?	3	2
5.	Explain with neat diagram rotary type valve?	3	2



FIRST ASSIGNMENT Format – CBCS Scheme BGSIT

Name of the Faculty: SANTHOSH KUMAR T C  
Submission Date: 25/11/2018

Signature:

*Santhosh Kumar T C*

Reviewer Signature:

*Pmat*

BGS Institute of Technology  
Department: Mechanical Department  
Assignment – III

Semester: III

Subject Name and Code: Machine Tools & Operations, 17ME35B

1. INSTRUCTIONS: Answer all the question in yellow book  
Max. Marks: 10

Q. No	QUESTIONS	CO	LEVEL S
1.	Explain the single point cutting tool nomenclature?	4	2
2.	Explain properties of cutting fluids?	4	2
3.	Types of cutting fluids?	5	2
4.	Explain orthogonal and oblique cutting?	5	2
5.	Comparison between orthogonal and oblique cutting?	5	2







**6 . Course Information**

**6 . 4 Internal Assessment**

**Internal : 1**

Semester:3-CBCS 2017

Date : 11/09/2018

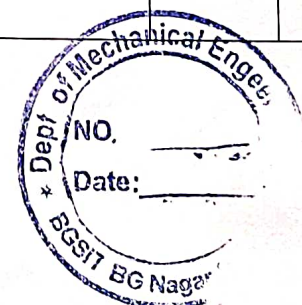
Subject : MACHINE TOOLS AND OPERATIONS (17ME35B)

Time : 09:30 - 10:30

Faculty : T.c. Santhosh Kumar

Max Marks: 30

Answer Any 2 Questions				
Q.No			Max Marks	CO BT/CL
1		<i>Explain any four lathe operation with neat diagram.</i>	15	1 L2
OR				
2		<i>Explain milling operation Slot, End milling, Face milling and Angular milling.</i>	15	1 L1
3		<i>Explain drilling operation Trepanning, Counter boring, Counter sinking and Tapping.</i>	15	2 L1
4		<i>Explain Grinding machine, Surface grinding and Centerless grinding.</i>	7	1 L2
4		<i>Explain shaping, Slotting and Planing.</i>	8	2 L2





**2 Scheme of Evaluation**

BGSIT BG Nagara	Doc. Title: Internal Test Scheme Page 1 of 1	Doc. No.: 06#Form#03 Rev. No. 00
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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution - TEST - I Date: 15/09/2018

Semester: VII Subject Title: Machine Tools And Operations Subject Code: 17ME72

Question Number	Solution	Marks Allotted
1.	Figure of Any <sup>PART-A</sup> Four Lathe operation Explanation of Any Four Lathe operation	10 <u>5</u> 15
2.	Figure of Milling operation Slot, end Milling, Face milling, Form Milling & Angular milling Explanation of Milling operation, Slot end, Face, Form & Angular milling	10 <u>5</u> 15
3.	Figure of Drilling, <del>Thread</del> Taper turning Counter boring, counter sinking, Tapping Explanation of Drilling, Taper turning Counter boring, counter sinking, Tapping	10 <u>5</u> 15
h.a.	Figure of Grinding, Surface, centerless grinding Explanation of grinding, Surface, centerless grinding	4 <u>3</u> 7
b.	Figure of Shaping, slotting & planing Explanation of Shaping, slotting & planing	5 <u>3</u> 8

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Page 1 of 1



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**Internal : 2**

Semester:3-CBCS 2017

Subject : MACHINE TOOLS AND OPERATIONS (17ME35B)

Faculty : T.c. Santhosh Kumar

Date : 17/10/2018

Time : 09:30 - 10:30

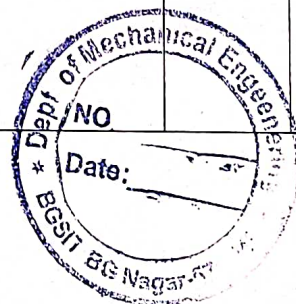
Max Marks: 30

**Answer Any 2 Questions**

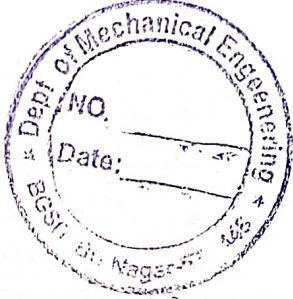




Q.No		Max Marks	CO	BT/CL
1	List and Explain the classification of the LATHE.	8	1	L1
2	Explain with a neat sketch of constructional features of CENTER LATHE.	15	2	L2
1	Explain with a neat sketch of constructional features of DOUBLE COLUMN BORING MACHINE .	7	2	L2
3	Explain with a neat sketch of constructional features of HORIZONTAL MILLING MACHINE .	15	3	L1





4	<p>Explain with a neat sketch of constructional features of RADIAL DRILLING MACHINE .</p> 	10	2	L2
4	<p>Explain the classification of machine tools.</p>	5	3	L2

**Evaluation**

USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
	Gangan Kumar H S	P	0	No Level
	Harsha H S	P	0	No Level
	Srinivasa	P	0	No Level
	Anusha J P	P	0	No Level
	Prathap M	P	0	No Level
	Gowtham D C	P	0	No Level
	Nandan Kumar S S	P	0	No Level
	Theja H P	P	0	No Level
	Bhanuprasad S	P	0	No Level
	Harshith U	P	0	No Level
	Rithisha H G	P	0	No Level
	Adarsha Gowda C	P	0	No Level





2 Scheme of Evaluation

BGSIT BG Nagara	Doc. Title: Internal Test Scheme Page 1 of 3	Date: 01.04.2018	Doc. No.: 06#Form#03 Rev. No. 00
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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution - TEST-II

Date: 22/10/2018

Semester: VII

Subject Title: Machine Tools And Operations

Subject Code: 17ME72

Question Number	Solution	Marks Allotted
1. a.	List of <sup>PART-A</sup> Lathe of its classification	5
	Explanation of Lathe	5
b.	Figure of Double column Boring machine	11
	Explanation of Double column Boring machine OR	5
2.	Figure of Center lathe	10
	Explanation of center lathe	5
3.	<u>PART-B</u>	10
	Figure of Horizontal milling machine Explanation of Horizontal milling machine	5
4. a.	Figure of Radial Drilling Machine	7
	Explanation of Radial Drilling machine	3
b.	Explanation of classification of Machine tools	5

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Page 1 of 3



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Internal : 3

Semester:3-CBCS 2017

Subject : MACHINE TOOLS AND OPERATIONS (17ME35B)

Faculty : T.c. Santhosh Kumar

Date : 24/11/2018

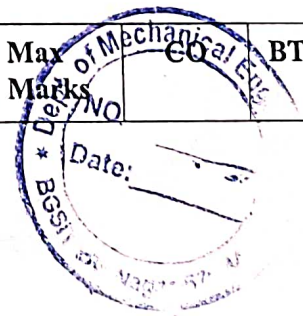
Time : 09:30 - 10:30

Max Marks: 30

Part A

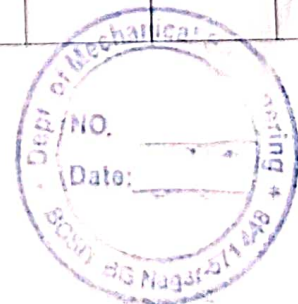


Answer any 1 questions					
Q.No			Max Marks	CO	BT/CL
1		Write a notes on Cutting tool geometry .	15	4	L2
2	a	Write a notes on types of cutting tool materials .	8	2	L3
2	b	Discuss the machining parameter on surface finish.	7	4	L4
<b>Part B</b>					
Answer any 1 questions					
Q.No			Max Marks	CO	BT/CL





3	n	Write a notes on oblique and orthogonal cutting .	10	4	L4
3	b	Write a notes on types of chips.	5	3	L1
4	a	A 150 mm long 12.7 mm diameter stainless steel rod is turned to 12.9 mm diameter on a center lathe with spindle speed 400 rev/min and axial speed 203.2mm/min. Calculate MRR and Machining time.	8	5	L5
4	b	List and explain the properties of cutting fluids.	7	3	L2







2 Scheme of Evaluation

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution - TEST - III

Date: 20/11/2018

Semester: VII

Subject Title: Machine Tools And Operations

Subject Code: 17ME72

Question Number	Solution	Marks Allocated
1.	<p>Part - A</p> <p>Figure of cutting tool geometry Explanation of cutting tool geometry</p> <p>OR</p>	<p>10</p> <p>5</p> <p>5</p>
2. a.	Explanation of Types of cutting tool material	8
b.	Explanation of Machining Parameters of Surface finish	7
	Part - B	
3. a.	Explanation of oblique & orthogonal cutting	10
b.	Explanation of Types of chips	5
	OR	
4. a.	<p>feed - 0.208 mm/rev Depth = 0.25 mm Cutting Speed - 15.96 m/min MRR - 2067.7 mm<sup>3</sup>/min Machining time - 0.73 min</p>	<p>2</p> <p>3</p> <p>3</p> <p>8</p>
b.	<p>List of cutting fluid property</p> <p>Explanation of cutting fluid property</p>	<p>2</p> <p>5</p> <p>7</p>

06#Form#03-0

End

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Principal

**Third Semester B.E. Degree Examination, June/July 2018**  
**Machine Tools and Operations**

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

**Module-1**

- 1 a. Write comparison between central lathe, capston lathe and turret lathe. (08 Marks)  
b. Sketch and explain Radial drilling machine. (08 Marks)

OR

- 2 a. Sketch and explain Horizontal boring machine. (08 Marks)  
b. Write the types and classification of Milling machine. (08 Marks)

**Module-2**

- 3 a. Sketch and explain following boring operations : (08 Marks)  
(i) Facing (ii) Counter boring (iii) Counter sinking (iv) Trl panning. (04 Marks)  
b. Write comparison of up and down milling. (04 Marks)  
c. Explain the working and auxillary cutting motions in machine tool. (04 Marks)

OR

- 4 a. List the operations performed in lathe and drilling machines. (08 Marks)  
b. With suitable sketch explain Milling arbor. (04 Marks)  
c. Explain lathe setting. (04 Marks)

**Module-3**

- 5 a. Give expression for feed, speed, depth of cut and machining time for grinding. (08 Marks)  
b. In a turning operation following data is observed,  $D = 100$  mm,  $l = 400$  mm, cutting speed = 600 mm/sec, feed = 0.4 mm/rev, calculate the machining time? What will be effect of machining time if cutting speed is increased by 50%. (08 Marks)

OR

- 6 a. Write the factors affecting feed for turning. (04 Marks)  
b. Write a note on feed for milling operations. (04 Marks)  
c. A solid cylinder is to be ground longitudinally on a cylindrical grinding machine. The length and diameter of cylinder are 220 mm and 50 mm respectively. The allowance per side is 0.3 mm. The grinding wheel diameter and width is 600 mm and 63 mm respectively. The cutting speed is 30 m/min. Determine machining parameters. (08 Marks)

**Module-4**

- 7 Explain the system of forces acting during cutting and show how they are brought together in Merchant's circle diagram. (16 Marks)

OR

- 8 a. With sketches explain the difference between orthogonal and oblique cutting. (08 Marks)  
b. Discuss briefly the different types of chips encountered in metal cutting. (06 Marks)  
c. Explain shear zone. (02 Marks)

**Module-5**

- 9 What is Tool life? List and explain the factors affecting the tool life along with relevant equations. (16 Marks)

**OR**

- 10 a. Explain the economics of metal machining. (10 Marks)  
b. Explain cutting speed and tool life for minimum cost and maximum production. (06 Marks)

