2022-23

MECHANICAL ENGINEERING

MANUFACTURING TECHNOLOGY

PREPARED BY
Abhishek Sharma

Techno India NJR Institute of Technology

Course File

Session 2022-23

MT (5ME4-03)

Abhishek Sharma
(Assistant Professor)
Department of ME

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-03: MANUFACTURING TECHNOLOGY

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Classification of metal removal process and machines: Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS. Concept of orthogonal and oblique cutting.	5
	Type of chips, Mechanics of metal cutting; interrelationships between cutting force, shear angle, strain and strain rate. Thermal aspects of machining and measurement of chip tool interface temperature.	5
3	Concept of machinability, machinability index, factors affecting machinability, Different mechanism of tool wear. Types of tool wear (crater, flank etc), Concept of tool life.	5
	Taylor's tool life equation. Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods.	5
4	Basic machine tools: Constructional configuration, estimation of machining time on lathe, drilling, shaping, milling, grinding, Gear cutting on milling, Gear hobbling.	5
	Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines, operational planning and turret tool layout, sequence of operations.	5
5	Introduction to Grinding and different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications. Honing, lapping, super-finishing.	5
6	High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.	5
	TOTAL	41

Manufacturing Technology is a fundamental course in Mechanical Engineering that deals with the study of different manufacturing processes, such as machining, casting, forming, and welding, among others. The course aims to provide students with the knowledge and skills necessary to understand the principles, processes, and applications of manufacturing technologies.

Course Topics:

Introduction to Manufacturing Technology: This topic covers the fundamentals of manufacturing, including the history and evolution of manufacturing technology, different manufacturing processes, and their advantages and limitations.

Machining: This topic covers the different machining processes such as turning, milling, drilling, grinding, and their applications in manufacturing.

Casting: This topic covers the different casting processes such as sand casting, investment casting, and die casting, and their applications in manufacturing.

Forming: This topic covers the different forming processes such as forging, rolling, and extrusion, and their applications in manufacturing.

Welding: This topic covers different welding processes such as arc welding, gas welding, and resistance welding, and their applications in manufacturing.

Computer Numerical Control (CNC): This topic covers the principles of CNC machines, programming techniques, and applications in manufacturing.

Additive Manufacturing: This topic covers the principles of additive manufacturing, such as 3D printing, rapid prototyping, and their applications in manufacturing.

Surface finishing: This topic covers the different surface finishing processes, such as grinding, polishing, and coating, and their applications in manufacturing.

Course Objectives:

Upon completing the course, students will be able to:

Understand the principles, processes, and applications of different manufacturing technologies.

Identify the advantages and limitations of different manufacturing processes.

Analyze and select the appropriate manufacturing process for a given application.

Understand the use of CNC machines and programming techniques.

Understand the principles of additive manufacturing and its applications.

Understand the surface finishing processes and their applications.

Perform basic calculations for manufacturing process design and selection.

Assessment and Evaluation:

The course will be assessed through a combination of assignments, quizzes, mid-term and final exams, and a project. The final grade will be based on the student's performance on these assessments. The project will involve the selection of a manufacturing process for a given application and the design and production of a part using that process. The project will be evaluated based on the quality of the final product and the student's ability to apply the principles learned in the course.

Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Analyze	Analyze and select the appropriate manufacturing process for a given application. This outcome would involve the ability to evaluate a specific manufacturing need and determine which process or combination of processes would be most appropriate for achieving the desired outcome.
2	Knowledge	Demonstrate proficiency in using CNC machines and programming techniques. This outcome would involve demonstrating practical skills related to programming and operating CNC machines, including understanding of G-code, tool selection, and workpiece setup.
3	Knowledge	Apply principles of additive manufacturing to design and produce a part. This outcome would involve the ability to conceptualize and produce a part using additive manufacturing techniques, such as 3D printing, while adhering to principles such as tolerancing, material selection, and production time/cost optimization
4	Knowledge	Evaluate the quality of a finished product and identify potential process improvements. This outcome would involve the ability to identify and evaluate key factors in the quality of a finished product, such as surface finish, dimensional accuracy, or material properties, and then suggest potential modifications to the manufacturing process to improve quality.
5	Knowledge	Communicate effectively about manufacturing technologies and processes. This outcome would involve the ability to effectively communicate about manufacturing processes and their benefits/limitations to both technical and non-technical audiences. This could involve written reports, oral presentations, or other forms of communication.

Prerequisites:

1. Basic Knowledge about Free Body Diagram
2. Must have completed the course on Manufacturing Process and Basic Mechanical Engineering.

Course Outcome Mapping with Program Outcome:

Manufacturing Technology Year of study: 2021-22															
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	1	0	2	2	1	0	0	1	1	0	1	2	2	1
CO2	1	1	1	2	1	1	0	0	1	1	0	1	2	2	1
CO3	2	1	1	1	0	0	0	0	1	0	0	0	2	1	1
CO4	2	1	1	1	0	0	0	0	1	0	0	0	2	1	1
CO5	2	1	1	1	0	0	0	0	1	0	0	0	2	1	1
Average	1.67	1.00	0.67	1.67	1.00	0.67	0.00	0.00	1.00	0.67	0.00	0.67	2.00	1.67	1.00

Course Coverage Module Wise:

Lecture No.	Chapter	Topic

1	**1**	**INTRODUCTION:** Objective, scope and outcome of the course.
2	**2**	**CLASSIFICATION OF METAL REMOVAL PROCESS AND MACHINES**
3	2	Geometry of single point cutting tool and tool angles
4	2	Tool nomenclature in ASA
5	2	Tool nomenclature in ORS
6	2	Concept of orthogonal and oblique cutting.
7	2	Type of chips
8	2	Continues chip with buildup edge
9	2	Mechanics of metal cutting
10	2	Interrelationships between cutting force
11	2	Shear angle, strain and strain rate
12	2	Thermal aspects of machining and measurement of chip tool interface temperature.
13	2	Concept of machinability
14	2	machinability index,
15	2	factors affecting machinability
16	2	Different mechanism of tool wear(Crater Wear)
17	2	Different mechanism of tool wear(Flank Wear)

18	2	Types of tool wear
19	3	**CONCEPT OF TOOL LIFE**

20	3	Taylor's tool life equation.
21	3	Introduction to economics of machining
22	3	Cutting fluids: Types, properties,
23	3	Selection and application methods.
24	4	**BASIC MACHINE TOOLS:** Constructional configuration
25	4	Estimation of machining time on lathe, drilling
26	4	Estimation of machining time on, drilling
27	4	Estimation of machining time on Milling
28	4	Estimation of machining time on Grinding
29	4	Gear cutting on milling, Gear hobbling
30	4	Special Purpose Machine Tools
31	4	Automatic lathes, capstan and turret lathe machines
32	4	Operational planning and turret tool layout
33	4	Sequence of operations.

34	5	**INTRODUCTION TO GRINDING AND DIFFERENT METHODS OF GRINDING**
35	5	Abrasives; natural and synthetic,
36	5	Manufacturing and selection of grinding wheels,
37	5	Wheel specifications. Honing, lapping, super finishing.
38	6	**HIGH VELOCITY FORMING METHODS**
39	6	Definition; Hydraulic forming,
40	6	Explosive forming
41	6	Electro-hydraulic forming
42	6	Magnetic pulse forming.

TEXT/REFERENCE BOOKS

1. RAO. P.N., MANUFACTURING TECHNOLOGY, VOL. 1,2 AND 3, TATA MCGRAW HILL

2. SCHEY, INTRODUCTION TO MANUFACTURING PROCESSES, TATA MCGRAW HILL

Teaching and Learning resources:

- **MOOC (NPTEL): -** https://drive.google.com/drive/u/1/folders/1gimy5aZo207_Oja05Hw6JE2qNjyotPOz.

YouTube Videos Link –
https://www.youtube.com/c/TECHNICALCLASSES_TC

- **Assessment Methodology:**

1. Two Midterm exams where student have to showcase subjective learning.
2. Final Exam (subjective paper) at the end of the semester.
3. Surprise Test.

Last Year Paper.

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Roll No. ___ Total No. of Pages: 3

5E1323

B. Tech. V - Sem. (Main / Back) Exam., January - 2022
Automobile Engineering
5AE4 – 03 Manufacturing Technology
AE, ME

Time: 3 Hours **Maximum Marks: 120**
Min. Passing Marks: 42

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 What is Machinability Index?

Q.2 What are the main factors which influence the tool life?

Q.3 Why Lathe beds are made of cast iron?

Q.4 What is built-up-edge (BUE)?

Q.5 What is broaching?

Q.6 What are the basic requirements for the selection of a specific cutting fluid?

Q.7 How are the cutting tools classified?

Q.8 What are the popular tool designation system in common use?

Q.9 Why truing and dressing are necessary in grinding wheels?

Q.10 Which materials are used in the manufacturing of grinding wheels?

PART – B

(Analytical/Problem solving questions) **[5×8=40]**

Attempt any five questions

Q.1 Derive an expressions for the cutting ratio, also draw Merchant's circle diagram and show that forces and angles on the cutting tool and different parameters involved in metal cutting.

Q.2 What is the difference between a Capstan and Turret Lathe? Explain Turret Lathe with suitable diagram.

Q.3 A HSS tool is used for turning operation. The tool life is one hour when turning at 30 m/min, but reduces to 2 min if cutting speed is doubled. Find the suitable RPM for turning a 300 mm diameter rod so that tool life is 30 min.

Q.4 Explain lapping operation with a suitable diagram.

Q.5 What are the high velocity forming methods? Explain Electro-hydraulic forming in detail.

Q.6 What are the types of cutting tool wear patterns observed in single point cutting tools? How do they affects the metal cutting performance?

Q.7 Describe step by step process of gear cutting by gear hobbing process with suitable figure.

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) [4×15=60]

Attempt any four questions

Q.1 In an orthogonal cutting operation chip thickness ratio is 0.4 and depth of cut is 0.5 mm, rake angle of tool is 7°. Determine –

(i) Chip thickness

(ii) Shear plane angle

Q.2 Explain the geometry of a single point cutting tool and explain functions of various tool angles.

Q.3 Explain magnetic pulse forming method with suitable diagram.

Q.4 Determine the optimum cutting speed for an operation on a lathe machine using the following information –

Tool change time = 3 min

Tool regrind time = 3 min

Machine running cost ₹ 0.50 per min.

Depreciation of tool regrind ₹ 5.0 and

The constants in the tool life equation are 60 and 0.2.

Q.5 Explain the basis for the selection of a specific cutting fluid for a given application. Take the example of turning, milling and grinding and suggest the type of cutting fluid used.

Total No of Pages: 4

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Roll No. _____

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B. Tech. V - Sem. (Main / Back) Exam., Feb.-March - 2021
PCC/PEC Automobile Engineering
5AE4 – 03 Manufacturing Technology
Common for AE, ME

Time: 2 Hours [To be converted as per scheme]

Max. Marks: 82

Min. Marks: 29

Instructions to Candidates:

Attempt all ten questions from Part A, four questions out of seven questions from Part B and two questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 Why metal removal process is the most expensive among other manufacturing processes?

Q.2 Explain the term "Machine Tool' and how it is different from a machine?

Q.3 Classify various metal removal processes.

Q.4 What is rake angle? How does it affect the cutting process?

Q.5 Compare high speed steel and cemented carbide cutting tool materials.

Q.6 Explain the effect of temperature of cutting on the tool life.

Q.7 What are different functions of cutting fluids?

Q.8 What is the function served by a lead screw in a machine tool?

Q.9 What is magnetic pulse forming?

Q.10 Enlist the factors affecting machinability.

PART – B

(Analytical/Problem solving questions) **[4×8=32]**

Attempt any four questions

Q.1 Explain the chip formation process and types of chips with neat diagrams.

Q.2 Derive an expression of shear force in orthogonal cutting with neat figures.

Q.3 Write a short note on ceramic cutting tool material.

Q.4 Estimate the actual machining time required for the component (C steel) as shown in figure -1 using a centre lathe. The available spindle speeds are 70, 110, 176, 280, 440, 700, 1100, 1760 and 2800. Use a roughing speed of 30 m/min and finish speed of 60 m/min. The feed for roughing is 0.24 mm/rev while that for finishing is 0.10 mm/rev. The maximum depth of cut for roughing is 2 mm. Finish allowance may be taken as 0.75 mm. Blank to be used for machining is 50 mm in diameter. Assume over travel of tool as 2 mm.

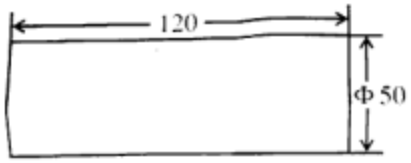

Figure – 1 (Blank)

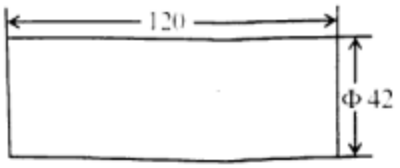

Figure – 2 (Finished component)

Q.5 Why chucks are used? List various types of chucks used in lathes. Describe any one with neat sketch.

Q.6 What is a drill? List various types of drills used. Describe any two types of drills with neat sketches.

Q.7 Compare grinding, honing and lapping.

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[2×15=3**

Attempt any two questions

Q.1 What is a milling machine? Describe working principle and various parts of horizonta knee and column type milling machine with diagram.

Q.2 Describe working principle of electro – hydraulic forming process with neat diagram. What are advantages and limitations of it? Also give application.

Q.3 A 600 mm long job of 150 mm diameter of AISI 4140 steel is to be turned with a dept of cut of 1.5 mm and a feed rate 0.25 mm/rev. The following data is applicable for th problem:

Labour cost per hour = ₹ 12.00, Machine overhead per hour = ₹ 40.00, Grinding co per hour = ₹ 15.00, Grinding machine overhead per hour = ₹ 50.00 and Idle time 5 minutes. The Taylor's tool life equation is given by $VT^{0.2} = 475$. The operation ca be carried out using tungsten carbide tools either as brazed tools or throwaway tools.

For brazed tools:

Initial cost = ₹ 60.00, Grinding time = 5 minutes/edge, Tool change time = 2 minutes 9 grinds per tool before salvage.

For Throwaway tips:

Initial cost = ₹ 40.00, Tool change time = 1.5 minutes, Total cutting edges = 8.

Find the optimum cutting speed, tool life and the cost of operation for both the brazed tip and throwaway type using the following criteria:

(a) Minimum production cost and

(b) Maximum production rate.

Q.4 (i) Find the time required for taking a complete cut on a plate 600×900 mm^2, if the cutting speed is 9m/min. The return time to cutting time is 1:4 and the feed is 3mm for the shaper. The clearance at each end is 75 mm.

(ii) A hole of 30 mm diameter and 75 mm depth is to be drilled. The feed is 1.3 mm/rev and the cutting speed is 62 m/min. Assuming tool approach and tool over travel as 6 mm. Calculate :

(a) Cutting time and

(b) Material removal rate

Q.5 Write short note on the following –

(i) Up milling and down milling processes

(ii) Balancing of grinding wheels

(iii) Gear hobbing