

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021) Semester -III

Course Title: Manufacturing Engineering Process-II
(Course Code: 1336502)

Diploma programmer in which this course is offered	Semester in which offered
Mechanical Engineering (CAD/CAM)	3 rd Semester

1. RATIONALE

This subject of Manufacturing Engineering Processes provides knowledge and embeds skill to students to develop different products using various machining process. Manufacturing processes are the most important element in any engineering industry. Mechanical Engineer is a key person for shop floor activities related to manufacturing. He/she should have knowledge and associated skill of machining processes to produce quality products at optimum cost. This course will make student familiar with fundamentals of cutting mechanics, kinematics, constructional features and selection criterion for various basic machine tools and automates with some basic exposure to conventional work holding devices and cutting tools and tool holders used on the same machines. Developing strong domestic manufacturing base is vital for our country to accomplish the nation's vision "Make in India".

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency.

- **Make a part/component as per given specification using appropriate machine tools, work holding devices, cutting tools & tool holders by employing optimum process parameters and safe working procedures.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

CO-1	Describe mechanics of cutting, calculate cutting parameters & its effects
CO-2	Demonstrate working of basic machine tools with kinematics.
CO-3	Select appropriate grinding processes, grinding machine, grinding wheels.
CO-4	Select tool and tool holder.
CO-5	Identify the machine tool, able to operate machine tool and select cutting parameters for given job.
CO-6	Produce the job as per given manufacturing drawing.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25*	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken

during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: *L*-Lecture; *T*- Tutorial/Teacher Guided Theory Practice; *P* -Practical; *C* – Credit, *CA* - Continuous Assessment; *ESE* -End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos). Some of the PrOs marked “*” are compulsory, as they are crucial for that particular CO at the ‘Precision Level’ of Dave’s Taxonomy related to ‘Psychomotor Domain’.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	<p>Preparatory Activity:</p> <p>a. For given work piece and tool material; select, set and observe cutting speed, feed and depth of cut on lathe machine. Also define these terms.</p> <p>b. Calculate metal removal rate (MRR) for above case.</p> <p>c. Calculate revolution per minute (RPM) for lathe, milling cutter and drill spindle based on given data.</p>	1	04
2	<p>Effect of Various Input Variables on Output variables during machining processes:</p> <p>Demonstrate type of chips, surface finishes and tool life for varying cutting parameters for different work piece material and tool material. Tabulate the observations.</p>	1	02
3	<p>Turning Job:</p> <p>Prepare a job on center lathe as per the given drawing. (Including plain turning, step turning, taper turning, threading, knurling, grooving, Etc.) Student will also prepare report including:</p> <p>a. Drawing of the job.</p> <p>b. Operation sequences including details of cutting parameters used.</p> <p>c. Sketch of cutting tools used.</p> <p>d. Specification of machines used.</p>	2	08
4	<p>Milling Job:</p> <p>Prepare a simple job using milling operations including use of indexing head (Excluding gear tooth cutting). Student will also prepare report including:</p> <p>a. Drawing of the job(like hexagon, pentagon)</p> <p>b. Operation sequences including details of cutting parameters used.</p> <p>c. Specification of machines used.</p> <p>d. Machine settings for indexing.</p>	4	06
5	<p>Shaping and Drilling Job:</p> <p>Prepare a job having plain surfaces on shaping machine with minimum two holes as per given drawing. Student will also prepare report including:</p> <p>a. Drawing of the job. (may use same job of Milling Job)</p> <p>b. Operation sequences including details of cutting parameters used.</p> <p>c. Specification of machines used.</p>	3 & 5	04

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6	Grinding Process Prepare a job on Grinding machine (surface or cylindrical) as per the given drawing. (Suggestion: use same job as prepared in 3&4 for grinding operation of flat and cylindrical surface). Student will also prepare report including: <ol style="list-style-type: none"> Drawing of the job. Specification of machines used. Grinding wheel used. 	7	02
7	Industrial Visit: Visit a nearby machine shop and prepare a two page report comprises of list of machine tools including automates, its technical specification, machining parameters for various operations being performed, cutting tools and work holding devices used, observation of skill and safety criteria.	All	00
8	Mini Project and Presentation: For a given product (different for each student) prepare complete report in suggested format including selection of raw material type & section, sequence of various Machining operations, selection of machine, machining parameters, work holding device, tool , etc. For each machining operation. Each student will also present the outcome.	All	02
Total			28

Note

- More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- Care must be taken in assigning and assessing study report as it is a Second-year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

Sr. No	Sample Performance Indicators for the PrOs	Weightage in %
1	Identify machine tools & their equipment's (Knowledge)	10
2	Able to operate, set the machine and select machining parameters. (Procedure followed)	20
3	Perform the experiment with accuracy. (Quality of job)	40
4	Follow safety practices. (Safety followed)	10
5	Submit the report. (Timely submission / Quality of report)	20
	Total	100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to user in uniformity of practical in all institutions across the state.

Sr. No	Equipment Name with Broad Specifications	PrO. No.
1.	Hacksaw machine.	2 to 5
2.	Lathe with standard and special accessories.	2
3.	Milling machines-Vertical /horizontal with standard accessories and indexing/dividing head.	3
4.	Column drilling or Radial Drilling machine	4
5.	Shaper machine.	5
6.	Tool and cutter grinder	2 to 5
7.	HSS cutting tool and their tool holders	2 to 5
8.	Carbide inserts and their tool holders	6
9.	Drill bit and their tool holder	4
10.	Surface grinding machine	7
11.	Cylindrical grinding machine	7

7. AFFECTIVE DOMAIN OUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

- a) Work as a leader/a team member.
- b) Follow safety practices.
- c) Follow ethical practices
- d) Maintain tools and equipment
- e) Practice environment friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit-I Introduction and mechanics of cutting	1a. Explain mechanics of cutting.	1.1 Introduction of Machining Process used in industries & Safety 1.2 Mechanics of cutting action 1.3 Forces acting on tool and chip, tool dynamometer 1.4 Orthogonal and oblique cutting. (Without derivation).
	1b. Explain the effect of varying cutting parameters.	1.5 Chip formation, types of chips. 1.6 Concept cutting parameter

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		1.7 Effect of cutting parameters on surface finish, tool life, economy, and mass production. 1.8 Cutting fluid- Properties, application
Unit-II Basic machine tools Lathe Machine	2a. Explain classification, working principles, construction and operation of lathe 2b. Describe mechanism & motion transmission in lathe. 2c. Explain work holding & Tool holding devices for lathe	2.1 Define and classify basic machine tools. 2.2 Lathe machine. i. Working principle (using block diagram). ii. Detailed specifications. 2.3 All geared head stock center lathe. i. Constructional features. ii. constructional sketch, working, and application iii. Operations performed. iv. Work holding devices- (3 jaw chuck, 4 jaw chuck, face plate, centers). v. Thread cutting setting-concept methods and simple numerical. vi. Tapper turning Method 2.4 Metal removal rate (MRR) – concept and method to calculate on lathe.
Unit-III Basic machine tools Milling Machine	3a. Explain classification, working principles, construction and operation of milling machine. 3b. Describe mechanism & motion transmission in milling machine. 3c. Select appropriate Milling cutter for required milling operation.	3.1 Milling machine. i. Types.(Horizontal/Vertical) ii. Working principle (using block diagram). iii. Detailed sample specifications. 3.2 Construction & Operation. i. Constructional features. ii. constructional sketch, working, and use. iii. Operations performed. iv. Up milling and down milling 3.3 Milling cutters-types and applications. 3.4 Work & tool holding devices- constructional sketch, working and applications. 3.5 Simple indexing methods with simple numerical.
Unit-VI Basic machine tools Drilling Machine	4a. Explain classification, working principles, construction and operation of drilling machines.	4.1 Drilling machine. i. Types. ii. Working principle (using block diagram). iii. Detailed specifications.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	4b. Select work & Tool holding devices for drilling machines.	4.2 Radial drilling machining. i. Constructional features. ii. Operations performed. iii. Work holding devices- constructional sketch, working and application iv. Tool holding and setting methods. 4.3 Metal removal rate (MRR) – concept and method to calculate on drilling machine.
Unit-V Basic machine tools Shaper	5a. Explain types, working principles, construction and operations of shaping, Select work & Tool holding devices for shaping	5.1 Shaping machine i. Working principle (using block diagram). ii. Constructional features and detailed specifications. iii. Quick return mechanisms- kinematic sketch, working and advantages. iv. Operations performed. v. Work holding & tool holding devices.
Unit-VI Cutting tools and tool holders	6.a Select cutting tool material 6.b Select cutting tool for different operation to perform 6.c Interpret carbide insert and tool holder designation system. 6.d Explain tool angles of cutting tools and their importance. 6.e Explain factors affecting tool life.	6.1 Various cutting tool materials, their compositions and properties. 6.2 Cutting tools and its types. i. Various types Single point cutting tool. ii. Plain milling cutter. iii. Side and face milling cutter. iv. Twist drill. 6.3 Carbide inserts: i. Types of carbide Inserts ii. Needs and benefits of carbide inserts iii. ISO designation of carbide inserts iv. Mounting and replacement methods of carbide insert. 6.4 Tool Nomenclature and tool geometry i. Single point cutting tool ii. Plain milling cutter iii. Twist drill 6.5 Tool life, Tool wear and Machinability i. Definition ii. Methods for calculation with example
Unit-VII Grinding processes.	7.a Explain grinding process and its type 7.b Describe constructional features and working of various grinding machines 7.c Select appropriate finishing operation and grinding machine as per production drawing of the component.	7.1 Describe grinding Process i. Definition ii. Basic Working Principle 7.2 Grinding Machine i. Classification and construction of grinding Machines (Surface, cylindrical, Centre less, tool & cutter grinding machine) ii. Basic Detail specification iii. Grinding Operations

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	7.d Select proper grinding wheels for various grinding process	7.3 Honing, lapping and super finishing process i. Constructional & Working Principle ii. Difference between honing, lapping and super finishing 7.4 Grinding wheel i. Abrasive grain ii. Bonding material iii. Nomenclature of grinding wheel iv. Selection and application of grinding wheel 7.5 Terms Associated with grinding wheel i. Loading, Glazing, Trueing, Dressing ii. Self-sharpening action of grinding wheel

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Introduction and mechanics of cutting	4	3	3	2	8
2	Basic machine tools-Lathe Machine	8	3	4	7	14
3	Basic machine tools- Milling Machine	8	3	3	6	12
4	Basic machine tools-Drilling Machine	4	2	2	4	8
5	Basic machine tools-Shaper	6	2	3	3	8
6	Cutting tools and tool holders	6	2	5	3	10
7	Grinding processes	6	2	3	5	10
Total		42	17	23	30	70

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

- Select two industrial components (approved by teacher) and list various machine tools and operations used to produce these components.
- Prepare a list of surrounded items which are prepared by machining processes.
- Collect/download at least four different machine tool catalogues and make report of that with price.
- List various machine tools (min. 5 machine) currently using in market for different operation to perform.
- Identify the process use for re-sharpening different types of tools and prepare report for minimum 3 tools

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) To acquire knowledge of basic machine, tool and their operation arrange two or more **industrial visit** of production industry. After visit student must be submit their industrial visit report.
- c) Guide student(s) in undertaking micro-projects.
- d) **'L' in section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- e) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- f) With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- a) Prepare a small useful product like various machining parts assembly/v-block/ cutting tools/work holding devices/small laboratory equipment/set-up utilizing laboratory resources.
- b) Using Drafting software, prepare machining products drawing with tolerances, quality measure.
- c) Survey/Visit nearby vendor lathe, drilling, milling and shaper etc. machining process and prepare report on products manufacture.
- d) Maintenance of available infrastructure related to.

13. SUGGESTED LEARNING RESOURCES

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	Machining and Machine Tools	A.B. Chattopadhyay	Wiley
2	Fundamentals of Machining Processes	Hassan Abdel-Gawad El-Hofy	CRC Press ISBN-13978-0849372889
3	Workshop Technology I & II	Raghuwanshi	Dhanpat Rai and Company(P) Limited
4	Production Technology (Manufacturing Process)	Dr. P C Sharma	S Chand
5	All about Machine Tools	HEINRICH GERLING	New Age International Private Limited
6	Production Technology	R. K. Jain and S. C. Gupta	Khanna Publishers
7	Elements of Workshop Technology Volume No. II Machine Tools	Hajra Choudhary, Bose S. K., Roy Nirjhar	Media promotors and publishers pvt. Limited
8	Production Technology	HMT	Tata Mcgraw-Hill Publishing Co.

14. SOFTWARE/LEARNING WEBSITES

- i. <http://nptel.iitm.ac.in/video.php?subjectId=112105126> (Introduction ME-II)
- ii. <https://archive.nptel.ac.in/courses/112/105/112105233/> (Metal cutting)
- iii. <https://www.youtube.com/watch?v=wwYQdi68074> (lathe machine)
- iv. <http://www.youtube.com/watch?v=H0AyVUfl8-k&list=PLEFE7D1579523C45D>(lathe operation)
- v. <http://www.youtube.com/watch?v=81Fdif5e85c> (Tool geometry)
- vi. <http://www.youtube.com/watch?v=THVgkBnjLq0> (Milling Machine)
- vii. <https://www.youtube.com/watch?v=mF6G9QyNq1I> (shaper Machine)
- viii. <https://youtu.be/Rf90Jbbcr3M> (Milling Machine)
- ix. <https://www.youtube.com/watch?v=0BiLkExp12A> (Radial Drilling Machine)
- x. <http://www.youtube.com/watch?v=Mn9jqqI8rao> (single point cutting tool geometry)
- xi. <http://www.youtube.com/watch?v=XXUHZxweBcw&list=PLD07DE61CB871A0CB>(milling machine)
- xii. <https://nptel.ac.in/courses/110106146> (Future of Manufacturing process)
- xiii. <https://www.youtube.com/watch?v=gcWj4OcteTk> (surface grinding)
- xiv. <https://nptel.ac.in/courses/112103250> (Abrasive machining)
- xv. <https://www.youtube.com/watch?v=IXYZLxNd-a8> (centre less grinding)
- xvi. <https://www.youtube.com/watch?v=GNLQ81WOytU> (Grinding wheel)
- xvii. https://www.youtube.com/watch?v=Fc_zbYeXAIU (Cylindrical grinding)

15. PO-COMPETENCY-CO MAPPING

Semester III	Manufacturing Engineering Processes-II (3336502)						
	POs						
Competency & Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
	Basic & Discipline specific knowledge	Problem Analysis	Design/ development of solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability & environment	Project Management	Life-long Learning
Competency	Make a part/component as per given specification using appropriate machine tools, work holding devices, cutting tools & tool holders by employing optimum process parameters and safe working procedures.						
CO 1. Describe mechanics of cutting, calculate cutting parameters & its effects	3	2	2	--	--	--	--
CO 2. Demonstrate working of basic machine tools with kinematics.	3	--	--	2	--	--	--
CO 3. Select appropriate grinding processes, grinding machine, grinding wheels.	3	--	--	3	--	--	--
CO 4. Select tool and tool holder.	3	--	--	2	--	--	2
CO 5. Identify the machine tool, able to operate and select cutting parameters for given job.	3	2	2	2	--	--	3
CO 6. Make the job as per given manufacturing drawing.	3	--	--	3	2	2	3

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE**GTU Resource Persons**

Sr. No	Name and Designation	Institute	Contact No.	Email
1.	S. M. Tank, Lecturer in Mechanical Engineering.	RCTI, AHMEDABAD	9825631840	Suresh.a1987@gmail.com
2.	Muhammad Azharuddin U Badi, Lecturer in Mechanical Engg.	Government Polytechnic, Porbandar	9558800951	muhammadabdi92@gmail.com

BOS Resource Persons

Sr. No.	Name and Designation	Department	Contact No.	Email
1.	Dr.S.H.Sundarani BOS Chairman HOD Mechanical Engg.	Government Polytechnic Ahmadabad	9227200147	gpasiraj@gmail.com
2.	Dr.Rakesh.D.Patel BOS Member HOD Mechanical Engg.	B.&B. Institute of Technology V V Nagar	9825523982	rakeshgtu@gmail.com
3.	Dr.Atul.S. Shah BOS Member Principal	B.V.Patel Institute of Technology Bardoli	7567421337	Assshah97@yahoo.in