GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2021)
Semester-III

Course Title: Mechanical Technology
(Course Code: 4335501)

Diploma programmer in which this course is offered	Semester in which offered
Fabrication Technology	Third

1. RATIONALE

This course focuses on different types of metal cutting machine tools used in fabrication industries. This course will develop capabilities for selection and usage of machine tool, work holding devices, cutting tools and process parameters. It also develops safety consciousness to the work in machine shop. This course focuses on manufacturing processes related to fabrication industries like metal casting and mechanical working of metal. This course develops quality consciousness among the student regarding these processes. It includes hands-on practice for students to develop practical skills.

2. COMPETENCY

The course content should be taught and 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 adopting/selecting 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:

a) Classify the machine tools used in fabrication industry.
b) Select cutting parameters for a job with given specification to be manufactured on lathe machine tool.
c) Select conventional machine tool used in fabrication industries other than lathe machine required to manufacture a given job as per the specification.
d) Prepare procedural steps for making a given job by sand casting process with appropriate selection of pattern, core, mold and furnace.
e) Describe mechanical working process used for manufacturing of given component.

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	
4	0	2	5	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

The following practical outcomes (PrOs) are the sub-components of the COs.*These PrOs need to be attained to achieve COs.*

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Demonstrate safety consideration in machine shop.	1	02
2	Prepare a job for given specification which includes facing & step turning (Straight turning) operation on lathe machine.	2	04
3	Prepare a job for given specification which includes taper turning operation on lathe machine.	2	04
4	Prepare a job for given specification which includes thread cutting operation on lathe machine.	2	02
5	Prepare a job for given specification on drill machine.	3	02
6	Demonstrate the shaper machine.	3	02
7	Demonstrate the milling machine.	3	02
8	Prepare a job for repairing of welded joint by using hand grinder.	3	02
9	Cut different commercial form of metal used in fabrication industries by power hacksaw machine as per given specification.	3	02
10	Cut M.S round bar by using abrasive disc cutter.	3	02
11	Prepare sand casting procedure steps for given job.	4	02
12	Prepare procedural steps of mechanical working process to manufacture given component.	5	02
	Total Hours		**28**

Note

i. *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.*
ii. *Boiler suit, safety shoes and necessary tools & instruments are compulsory while attending laboratory and has to be brought by students (Annexure-1).*

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 %
For PrOs no: 2,3,4,5,8,9,10		
1	Knowledge of experiment	20
2	Performance	30
3	Procedure followed	30
4	Quality of report	10
5	Punctuality	10
Total		**100**

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs no: 1,6,7,11,12		
1	Knowledge of experiment	30
2	Quality of report	30
3	Participation	20
4	Punctuality	10
5	Originality	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Lathe machine tools	1,2,3,4
2.	Drilling machine tools	1,5
3.	Shaper machine tools	1,6
4.	Milling machine tools	1,7
5.	Grinding machine tools	1,8

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
6.	Power Hacksaw machine tools	1,9,10
7.	Disc cutters	1,9,10
8.	Different work holding devices	2,3,4,5,6,7,8,9,10
9.	Foundry equipments & hand tools	11
10.	Different marking and measuring tools	2,3,4,5,6,7,8,9,10

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) Follow safety practices in laboratory.
b) Practice good housekeeping.
c) Work as a leader/a team member.
d) Maintain tools/equipment
e) Follow ethical practices

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 & 4th 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 to machine tools**	1a. Describe functions of machine tools. 1b. Classify machine tools. 1c. Identify types of chips. 1d. Develop safety consciousness among Students.	1.1 Classification of manufacturing/production process. 1.2 Definition and concept of machine tool. 1.3 Criteria for selection of production process. 1.4 Function of machine tools.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		1.5 Classification of machine tools. 1.6 Orthogonal/oblique cutting. 1.7 Shearing action and types of chips. 1.8 Safety consideration in machine shops.
Unit– II **Lathe machine tool**	2a. Describe basic parts of lathe. 2b. Draw single point cutting tool geometry. 2c. Calculate M.R.R for given process parameter. 2d. Calculate Compound Rest angle & tail stock set over distance for taper turning. 2e. Describe function & types of cutting fluids.	2.1 Function and construction of Lathe. 2.2 Size, types and selection of lathe. 2.3 Basic parts of lathe. 2.4 Feed mechanism. 2.5 Lathe accessories and lathe Attachments. 2.6 Lathe operations. 2.7 Lathe cutting tools, its geometry and material. 2.8 Cutting speed, feed, DOC, MRR. 2.9 Cutting fluid and lubricants used.
Unit-III **Conventional machine tools used in fabrication Industries (Other than Lathe machine)**	3a. Describe construction of machine tools. 3b. Identify different machine tools operations required to prepare given job. 3c. Describe indexing mechanism for milling machine. 3d. Select appropriate cutting tool to manufacture a job with given specification. 3e. Select appropriate work holding devices for a manufacture a job with given specification.	3.1 Drilling machine tools. 3.1.1 Construction, types and size of drilling machine 3.1.2 Drill speed and feed mechanism 3.1.3 Operation performed on drilling machine 3.1.4 Types of drills 3.1.5 Twist drill geometry 3.1.6 Drill holding devices 3.1.7 Work holding devices 3.1.8 Drill size, designation and drill material. 3.1.9 Reamers 3.1.10 Taps 3.2 Shaper Machine tools. 3.2.1 Working principle, construction, types & size specification 3.2.2 Shaper drive mechanism 3.2.3 Shaper feed mechanism 3.2.4 Shaper work holding devices 3.2.5 Shaper operation

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		3.3 Milling machine tools. 3.3.1 Working principle, types and size specification 3.3.2 Milling cutters 3.3.3 Milling methods 3.3.4 Milling operation 3.3.5 Dividing head or indexing head 3.3.6 Methods of indexing 3.4 Grinding Machine tools. 3.4.1 Working principle, types, size and specification of grinding. 3.4.2 Grinding Machine operation 3.4.3 Grinding wheels, its classification, size, shape, and type of abrasives, grain size, bond grade, structure, marking system. 3.4.4 Glazing, loading and gumming of grinding wheel. 3.4.5 Truing, dressing, balancing of grinding wheel 3.4.6 Selection of grinding wheel 3.5 Metal Sawing machine. 3.5.1 Metal Sawing machine 3.5.2 Reciprocating Saw 3.5.3 Abrasive disc cutting 3.5.4 Power hacksaw blades
Unit-IV **Foundry**	4a List out the steps of Sand Casting process. 4b. Describe different patterns, Cores and mould of casting process. 4c. Describe melting operation for sand casting. 4d. Describe fettling & finishing of sand casting 4c. Identify casting defects & suggest it's remedies.	4.1. Sand casting process & its steps 4.2. Advantages & Application of casting 4.3. Foundry layout and different sections of foundry 4.4. Pattern : function, material, types, pattern making, pattern color coding, pattern allowance 4.5. Mould : Mould materials, moulding sand & its types, moulding binders, moulding methods, mould making steps, Recovery of sand for control of

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
		environment pollution. 4.6. Core : core sand, core making process, types, core application 4.7. Principle of gating system 4.8. Function of gating system and Its different elements 4.9. Melting Furnace. 4.10. Fettling & finishing of casting 4.11. Defects in casting 4.12. Pollution control in foundry.
Unit- V **Mechanical working of metal**	5a. Compare hot and cold rolling process 5b. Describe hot and cold Extrusion processes 5c. Identify forging defect and Suggest it's remedies 5d. Describe metal spinning process 5 f. Describe different drawing process	5.1 Principle of Hot and Cold working of metals and their effect on mechanical properties of metal 5.2 Rolling : Introduction & Concept, Hot and cold rolling of metals, Types of rolling mills, Defects in rolled products 5.3 Extrusion : Introduction & Concept, Methods of extrusion, Hot and Cold extrusion, 5.4 Forging : Introduction, Merits of forging compare to machining and casting, hand forging tools, Forging Operations, Forging process, Forging defects 5.5 Metals Spinning : Introduction and principle of operation, Spinning process, Application of spinning. 5.6 Drawing of rods, wires & tubes : introduction, principle , Operation & lubrication used.

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
I	Introduction to machine tools	8	6	4	0	10
II	Lathe machine tool	14	7	4	7	18
III	Conventional machine tools used in fabrication Industries (Other than Lathe machine)	14	7	4	7	18

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Foundry	10	3	7	3	13
V	Mechanical working of metal	10	7	4	0	11
	TOTAL	**56**	**30**	**23**	**17**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note: *This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks and marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

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:

a) Prepare solutions of different assignments given by subject faculty.
b) Prepare a list of specifications for various tools/equipment/machines used in the Fabrication/mechanical work.
c) Download videos showing correct practices for different manufacturing processes.
d) Visit at local manufacturer place and prepare the report on it.
e) Arrange the local Industrial visit in machining industry, foundry and/or mechanical working industry.
f) Select three industrial components approved by subject teacher and list various methods of manufacturing used to produce them.
g) Select four different components which are made by sand casting process.
h) Draw different commercial forms of metals and suggest appropriate mechanical working process to manufacture them.
i) List different mechanical properties of metal required for manufacturing a product by using different mechanical working process.
j) Collect sample of different types of chips and list different factors affecting production of that chip.

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) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.

d) 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.

e) 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 eighth 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) **Chart making:** Student have to prepare a chart on construction of various machine tools, work holding devices, tool signature, operations, process etc. given by the subject teacher.

b) **Video Preparation:** Student have to prepare his/her video on demonstrating different machine tool, work holding devices, cutting tools & operations perform on machine tools etc. given by the subject teacher.

c) **E-learning projects:** Students have to use internet and other online resources for preparation of report and/or download video on the topic given by the subject teacher within the syllabus or beyond the syllabus.

d) **Report preparation:** Student has to use different books, technical magazine, journals etc. for preparation of a report on the topic given by the subject teacher within the syllabus or beyond the syllabus.

e) **Power point presentation**: Students has to prepare a power point presentation of 10 to 15 slides on the topic given by the subject teacher within the syllabus or beyond the syllabus. In the end of presentation student has to ask at least 3 to 5 MCQ based question to identify the gain of listeners at the end presentation.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Production Technology Vol-1 & 2	O. P. Khanna	Dhanpat Rai Publication
2	Manufacturing Technology	P. N. Rao	Tata Macgrawhill Publishing Company Ltd, New Delhi
3	Workshop Technology vol-1 & 2	Hajra & Chaudhri	Media Publishers & Promoters,India. ISBN: 9788185099156, 9788185099156
4	Foundry Technology	O. P. Khanna	Dhanpat Rai Publication
5	Production Technology	R.K.Jain	Khanna Publishers
6	Manufacturing Science	S. Dalala	-
7	Workshop technology	R.S.Khurmi	S.Chand
8	Foundry Engineering	P.L. Jain	Tata McGraw Hill Education

14. SOFTWARE/LEARNING WEBSITES

- https://www.mechanicalbooster.com/2016/12/types-of-chips.html-
- https://youtu.be/ljveGnQw2G0
- https://www.theengineerspost.com/types-of-lathe-machines
- https://youtu.be/1AwOzDv7j6o
- https://www.wisc-online.com/LearningContent/mtl8502/MLT8502
- https://esskaymachines.com/blog/types-of-drilling-machine
- https://youtu.be/a07gtJbK9aU
- https://en.m.wikipedia.org/wiki/Milling_(machining)
- https://mechanicalnotes.com/shaper-machine
- https://youtu.be/EgLXmKy2w_k
- http://www.mechanicalwalkins.com/power-hacksaw-parts-working-and-driving-mechanism
- https://www.foundry.com
- https://youtu.be/rL3dLQYEYKw
- http://www.mccannsales.com/book/sandcasting.pdf
- http://www.youtube.com/watch?v=6xnKmt_gsLs
- https://youtu.be/dNbVsmVgOnM

15. PO-COMPETENCY-CO MAPPING

Semester III	Mechanical Technology (Course Code: 4335501)						
	POs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ develop-ment of solutions**	**PO 4 Engineering Tools, Experimen-tation & Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Manage-ment**	**PO 7 Life-long learning**
Competency	**Make a part/component as per given specification using appropriate machine tools, work holding devices, cutting tools & tool holders by adopting/selecting optimum process parameters and safe working procedures.**						
Course Outcomes CO1) Classify the machine tools used in fabrication industry.	2			1	1		2
CO2) Select cutting parameters for a job with given specification to be manufactured on lathe machine tool.	2	2		2	1		3
CO3) Select conventional machine tool used in fabrication industries other than lathe machine required to manufacture a given job as per the specification	3	2		2	1		2
CO4) Prepare procedural steps for making a given job by sand casting process with appropriate selection of pattern, core, mold and furnace.	2	2		1	2		1
CO5) Describe mechanical working process used for manufacturing of given component.	2			1	1		1

*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

S. No.	Name and Designation	Institute	Contact No.	Email
1.	Mr.Samirbhai Y.Merchant I/C H.O.D Fabrication Technology Department	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9428408314	Symerchant72@gmail.com

2.	Mr. Rohankumar B. Zapadiya Lecturer in Fabrication Technology	Sir Bhavsinhji Polytechnic Institute Bhavnagar	9033219351	rohan.zapadiya@gmail.com

ANNEXURE-1

❖ SAMPLE SEFATY CONTRACT:

(To be filled by the students and submitted to concerned faculty/staff)

-- Use for reference purposes only --

1. You have to read and sign the safety contract.
2. The safety contract says that you understand that safety is your responsibility.
3. The safety contract to be signed before you carry out any work in the laboratory and if you

don't observe and obey the safety rules, you will not be allowed in the laboratory.

::

Safety Contract

Date: _______________

Name of Institute: ____

Name of Course with Code: Mechanical Technology (4335501)

Name of Faculty/Staff with Designation: 1. ____

2. ____

3. ____

I RECOGNIZE THAT:

1. Safety is my responsibility when using a tool.
2. Safety regulations have been provided to me.
3. The possibility of accident and injury increases if I do not follow all the safety guidelines.
4. I must act responsibly to ensure my own safety & the safety of others in the work area.

I AGREE TO:

1. Never work in the shop without my faculty's/ Instructor's supervision.
2. Read and practice all the safety regulations that have been distributed to me in this course or have been posted in the work areas.
3. Act in a responsible manner at all times in the laboratory.
4. Follow all instructions given by the faculty/Instructor.
5. Immediately report any unsafe condition or activity to my faculty/Instructor.
6. Wear eye protection at all times when working with tools or working anywhere near someone who is using tools.
8. Cut or Tie back long hair, remove jewellery, secure loosed clothing, and wear boiler suit & safety shoes in the laboratory.
9. Clean all work areas and put equipment away before leaving the laboratory.

I, _____, have read and agree with all the safety instructions.

Particulars:

Programme: _____ Student Signature
Batch No.: _____ _____
Enrolment No.: _____