

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**

Semester -IV

Course Title: Manufacturing Technology

(Course Code: 4340204)

Diploma programme in which this course is offered	Semester in which offered
Automobile Engineering	4 th semester

1. RATIONALE

As a diploma engineer, students are supposed to manage operations of manufacturing in the industries. Therefore, they should have operational knowledge and expertise of different types of machine tools and manufacturing processes. This course provides operational knowledge and skills related to a variety of manufacturing processes. It also provides background knowledge on the different machine tools and machining operations performed on them. Course also delivers a better understanding of modern manufacturing technologies and machine tools. The course also attempts to build safety awareness among students so that they can work safely in the machine shop.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop different types of skills leading to the achievement of the following competency.

- **Supervise simple manufacturing processes required for manufacturing and repairs of systems / components of automobiles.**

3. COURSE OUTCOMES (COs)

The underpinning knowledge and the relevant skills associated with this competency are to be developed in the student to display the following COs:

- a) Comparing conventional and manufacturing processes and machine tools.
- b) Summarizing casting process, its defects & remedial measures.
- c) Categorizing metal working processes, identify their defects and remedial measures.
- d) Interpreting metal joining processes, their defects and remedial measures.
- e) Summarizing advancement in manufacturing process, machine tools and manufacturing technology.

4. TEACHING AND EXAMINATION SCHEME

(Load taken by Mechanical Dept.)

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			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

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

Sr. No	Practical Outcomes (PrOs)		Unit No.	Approx. Hrs. required
1	Identify various manufacturing processes & its application in Automobile.	Any one	I	04
2	Demonstrate any one surface finishing operation (honing, buffing, lapping & polishing).		I	04
3	Demonstrate operation of lathe, milling, drilling, shaper, planer and grinding machine.		I	04
4	Prepare a pattern for the given components/drawings, considering pattern allowance.	Any one	II	04
5	Prepare a mould using a prepared pattern, and molding sand. Also pour molten metal and get the casting. (Use wax in place of molten metal for the purpose of demonstration.		II	04
6	Identify various casting defects of given casting parts and suggest remedial measures.		II	04
7	Prepare a job using hot/cold forging/hot smithy process.	Any one	III	04
8	Identify various defects of given hot/cold metal working process and suggest remedial measures.		III	04
9	Prepare a job using arc welding. This includes cutting of raw material and edge preparation.	Any Two	IV	04
10	Prepare a job using gas welding. This includes cutting of raw material and preparation of pre-weld parts.		IV	04

11	Prepare a job using special welding processes such as TIG, MIG, Friction welding, Resistance welding, laser beam & Electron beam welding.		IV	04
12	Prepare two jobs, one using soldering and another using brazing.		IV	04
13	Demonstrate or Make a chart on, any two advance manufacturing process. (EDM, USM, AJM, LBM and EBM.)	Any Two	V	04
14	Make a report on Automation in Manufacturing Technology.		V	04
15	Demonstrate working of CNC Lathe and/or CNC Milling Machine.		V	04
Total Hrs.				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. Care must be taken in assigning and assessing study report as it is a 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.
- iii. 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.

S. No.	Sample Performance Indicators for the Practicals	Weightage in %
1	Basic idea of practical.	25
2	Preparation and participation in practical work.	25
3	Accuracy, neatness, safety awareness of work.	25
4	Timely submission	25
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 usher in uniformity of practical in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	<ol style="list-style-type: none"> 1. Bench Grinder 2. Hand Grinder 3. Lapping Machine 4. Honing tools 5. Buffing tools 6. Polishing tools 	2
2	Machine tools: <ol style="list-style-type: none"> 1. Lathe 	3

	<ol style="list-style-type: none"> 2. Milling 3. Shaper 4. Planner 5. Bench drill 	
3	<p>Pattern Making:</p> <ol style="list-style-type: none"> 1. Wood cutting planer machine/Wood 2. jack plane 3. Carpentry vice 4. Flat file 5. Hammer 6. Steel rule 7. Right angle 8. Saw 	4
4	<p>Molding:</p> <ol style="list-style-type: none"> 1. Cope and drag Boxes 2. Molding sand with additives and 3. binder 4. Vent wire 5. Furnace or Oven 6. Consumable (Wax) 	5
5	<p>Smith forging:</p> <ol style="list-style-type: none"> 1. Anvil 2. Furnace 3. Hammer 4. Tong 5. Steel rule 6. Air blower 7. Swage block 	7
6	<p>Arc welding:</p> <ol style="list-style-type: none"> 1. Arc welding Machine with electrodes 2. holder 3. Tong 4. Chipping hammer 5. Wire brush 6. Hand gloves 7. Hand screen 8. Safety goggles 9. Hacksaw cutting machine 10. Hand files 	9
7	<p>Gas welding:</p> <ol style="list-style-type: none"> 1. Oxy acetylene gas cylinders with Regulators 2. Welding torch 3. Tong 4. Chipping Hammer 5. Steel rule 6. Hand gloves 7. Safety goggles 	10

	8. Hacksaw cutting machine 9. Hand files	
8	Spot/Resistance welding 1. Spot welding machine 2. Plier cutter 3. Hammer 4. Steel rule 5. Anvil	11
9	Soldering/ Brazing 1. Brazing torch 2. Consumables 3. Tong 4. Hammer 5. Anvil 6. Wire brush 7. Soldering iron & lead wire 8. Circuit holding Clamps	12
10	1. Electric discharge machine 2. Ultrasonic cutting machine 3. Abrasive jet machine 4. Laser beam cutting machine 5. Electron beam discharge machine	13
11	1. CNC Lathe machine with all tools & attachments 2. CNC Milling machine with all tools & attachments	15

7. AFFECTIVE DOMAIN OUTCOMES

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

- a) Work as a leader/a team member.
- b) Follow ethical practices.
- c) **Practice environmental friendly methods and processes. (Environment related)**

The ADOs are best developed through the field based exercises/project work. 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 higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
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	(4 to 6 UOs at different levels)	
Unit I Introduction to manufacturing technology	<p>1.a Describe various manufacturing processes & its application.</p> <p>1.b Describe working principle of common machine Tools.</p> <p>1.c Demonstrate surface finishing methods.</p> <p>1.d Describe Factors affecting the selection of suitable Machine tool.</p>	<p>1.1 Nature, role and scope of manufacturing process.</p> <p>1.2 Classification, Selection and Applications of each manufacturing processes</p> <p>1.3 Describe working principles of surface finishing methods such as honing, buffing, lapping and polishing</p> <p>1.4 Introduction to Basic Machine Tools</p> <p>1.5 Working principle and Operation of: lathe, milling, drilling, shaper, planer and grinding machine.</p> <p>1.6 Factors affecting the selection of suitable Machine tool.</p>
Unit II Metal Casting Processes	<p>2.a Summarized types of patterns, pattern allowances, pattern materials, types of molding sands and properties of moulding sand.</p> <p>2.b Explain gating system.</p> <p>2.c Explain working of melting furnaces and main casting processes.</p> <p>2.d Explain Casting defects & Remedial measures.</p>	<p>2.1 Introduction and classification of metal casting methods.</p> <p>2.2 Working principles of sand casting</p> <p>2.3 Types of patterns, allowances and pattern materials</p> <p>2.4 Types of moulding sands and its properties.</p> <p>2.5 Introduction about Gating system</p> <p>2.6 Working of melting furnaces.</p> <p>2.7 Working principles of centrifugal casting, die casting & investment casting.</p> <p>2.8 Casting defects & remedial measures.</p>
Unit III Metal Working Processes	<p>3.a. Classify metal working methods.</p> <p>3.b. Describe principles & application of different metal working processes</p> <p>3.c. Explain Defects and its remedies in metal working processes</p> <p>3.d. Describe working principles of press machine.</p>	<p>3.1 Introduction and classification of metal working methods.</p> <p>3.2 Hot and cold working processes.</p> <p>3.3 Working principles and application of: Rolling, Blanking, Piercing, Wire and Tube Drawing, Spinning, Forging, Bending, Embossing and Extrusion.</p> <p>3.4 Defects observed in cold and hot working processes & its Remedial measures.</p> <p>3.5 Classification, construction and Working principle of press machine.</p>

Unit IV Metal Joining Processes	<p>4.a. Describe different metal joining processes.</p> <p>4.b. Explain working principle of welding process.</p> <p>4.c. Describe principles, application and limitation of gas welding and arc welding.</p> <p>4.d. Describe special welding processes.</p> <p>4.e. Compare welding, soldering, brazing and braze welding.</p> <p>4.f. Explain welding defects and remedial measures.</p>	<p>4.1 Introduction and classification of metal joining methods</p> <p>4.2 Types of Welding joints</p> <p>4.3 Working principles, application, and limitations of Gas Welding, Arc Welding,</p> <p>4.4 Special welding processes such as TIG, MIG, friction welding, Resistance Welding, Laser beam welding and Electron beam welding.</p> <p>4.5 Working principle of Soldering, Brazing and Braze Welding.</p> <p>4.6 Defects and Remedial Measures in Welding.</p>
Unit V Advancement in manufacturing technology	<p>5.a. Compare conventional and non-conventional manufacturing processes.</p> <p>5.b. Explain need and role of automation in automobile industry.</p> <p>5.c. Interpret basics of advance machine tool.</p> <p>5.d. Illustrate working principle, application and limitations of various non-conventional manufacturing processes.</p> <p>5.e. Interpret application of automatic material handling tools.</p> <p>5.f. Describe Additive manufacturing.</p>	<p>5.1 Classification, comparison between conventional and non-conventional machining processes</p> <p>5.2 Need and Role of Automation in manufacturing of automobile industry.</p> <p>5.3 Basic concepts of NC, CNC, DNC, CIM, GT, FMS</p> <p>5.4 Application of Automated Material handling tools like AGVs, AS/RS and Robots</p> <p>5.5 Working principles, application, and limitations of Electrical Discharge Machining (EDM), Ultrasonic Machining (USM), Abrasive Jet Machining (AJM), Laser Beam Machining (LBM), Electron Beam Machining (EBM)</p> <p>5.6 Introduction, basic principles and need of Additive Manufacturing.</p>

Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

	Unit Title		Distribution of Theory Marks
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Unit No.		Teaching Hours	R Level	U Level	A Level	Total Marks
I	Introduction to manufacturing technology	10	3	7	4	14
II	Metal Casting Processes	8	3	7	4	14
III	Metal Working Processes	8	3	7	4	14
IV	Metal Joining Processes	8	3	7	4	14
V	Advancement in manufacturing technology	8	3	7	4	14
	Total	42	15	35	20	70

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

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary 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 conduct following activities in group and prepare reports of each activity. They should also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Charts can be prepared.
- Small report on any topic given by concern faculty.
- Small groups of students can be formed for assigned work. Assigned work should be such that it covers market survey, team work, presentation, time management, quality development.

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:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- Guide student(s) in undertaking micro-projects.
- 'L' in section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- 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.
- With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.

- f) **Guide students on how to address issues on environment and sustainability**

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-project are group-based. However, in the fifth and sixth semesters, it should be preferably being **individually** undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, 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 total duration of the micro-project should be about **14 - 16 (fourteen to sixteen) student engagement hours** during the course. The student 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:

Seminar by Students on manufacturing processes like forging, casting, welding process etc..
Prepare Display Board such as gas cutting kit, welding kit etc.
Prepare job to explore various welding techniques applicable in automobile Industries.
Prepare job to explore various operations using various machine tools and measuring Equipment's.
Internet Base Assignment, Teacher guided self-learning activity etc.(These could be Individual or group base.)
Each student will present and will prepare report on: <ul style="list-style-type: none"> a. His/her observation for the jobs made. b. His/her experience during industrial visits. Process parameters and their effects.
Select four industrial components (approved by teacher) and list various methods of manufacturing used to produce these components.
Prepare a list of household items which are prepared by joining processes.
Prepare videos of any working-job practical.
Prepare a list of industries/workshops in the nearby area which are producing Components by casting/forming/ Joining.

Identify the types of manufacturing processes used in making the main component of a car engine.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Production Technology	R. K. Jain & S.C.Gupta	Khanna Publications. ISBN: 9788174090997
2	Production Technology Vol-I, Vol-II	O.P.Khanna	Dhanpat Rai and Sons ISBN: 978-9383182046
3	Elements of Workshop Technology Vol-I, Vol-II	Hazra Choudhary	Media promotors and publishers pvt. Limited, ISBN: 978-8185099156
4	Workshop Technology Vol-I, Vol-II	Raghuwanshi	DhanpatRai and Sons,Publication:01-01-2017
5	Manufacturing processes	M. L. Begeman	Willey International edition, USA,ISBN(10)0471062405, ISBN(13)978-0471062400
6	A Textbook Of Workshop Technology: Manufacturing Processes	R.S. Khurmi and J.K. Gupta	S. Chand Limited ISBN(10)812190868X , ISBN(13)978-8121908689
7	Manufacturing Technology: Foundry, Forming & Welding	P.N. Rao	TATA Mc-Graw Hill ISBN (13)978-9353160500 , ISBN (10)9353160502
8	Automation, Production Systems, and Computer-integrated Manufacturing	Mikell P. Groover	PEARSON ISBN 13: 978-0-13-349961-2 ISBN 10: 0-13-349961-8
9	Computer Aided Manufacturing	P. N. Rao, N. K. Tewari, T. K. Kundra,	TATA Mc-Graw Hill , ISBN(13):978-0-07-068193-4

14. SOFTWARE/LEARNING WEBSITES

- a) <https://www.howacarworks.com>
- b) <https://swayam.gov.in>
- c) <https://auto.howstuffworks.com>
- d) <https://nptel.ac.in>
- e) <https://tinyurl.com/mpvhf2as> for video link
- f) <https://tinyurl.com/ms4pe636> for web link

15. PO-COMPETENCY-CO MAPPING

Semester IV	Manufacturing Technology (4340204)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
• Supervise simple manufacturing processes required for manufacturing and repairs of systems / components of automobiles.	3	2		3	2	3	3
a) Comparing conventional and manufacturing processes and machine tools.	3			2	2		2
b) Summarizing casting process, its defects & remedial measures.	3	2		3	2	2	2
c) Categorizing metal working processes, identify their defects and remedial measures.	3	2		3	2	2	2
d) Interpreting metal joining processes, their defects and remedial measures.	3	2		3	2	3	2
e) Summarizing advancement in manufacturing process, machine tools and manufacturing technology.	3				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**

S. No	Name and Designation	Institute	Contact No.	Email
1	Mr. D. A. Dave (Retd. HOD Automobile)	Sir B.P.T.I, Bhavnagar	9427182407	deven_a_dave@yahoo.co.in
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GTU BOS and Branch Co-Ordinator Persons

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