GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Mould Fabrication Technology - I
(Course Code: 4322302)

Diploma programme in which this course is offered	Semester in which offered
Plastics Engineering (Sandwich Pattern)	Second

1. RATIONALE

A plastic diploma engineer has to use various metals, metal alloys and basic machine tools for selected mould components. This competency requires the knowledge of ferrous metals & its alloys, non ferrous metals & alloys alongwith their structures and properties for selection of materials for fabricating machine components and mould use in plastic industries. This may help to understand different heat treatments and other advanced mould fabrication techniques. Hence the course has been designed to develop this competency and its associated cognitive, practical and affective domain learning outcomes. This is an important course for plastic engineers.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Operate various basic machine tools for selected mould materials.

3. COURSE OUTCOMES (COs)

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

a) Select engineering materials for making moulds.
b) Select ferrous metals and alloys for making moulds.
c) Select non ferrous metals and alloys for making moulds.
d) Suggest heat treatment process for moulds.
e) Operate machine tools to fabricate moulds.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+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 pattainment 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. *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	Collect one sample of each engineering material and list their properties.	1	04
2	Perform hardness testing of mild steel.	2	02
3	Perform hardness testing of Aluminum.	3	02
4	Perform hardening of mould steel using oil as quenching media. Measure change in hardness.	4	04
5	Perform Tempering process for the above hardened component and measure change in properties/hardness.	4	04
6	Perform Annealing treatment for the given job and measure the change in hardness.	4	04
7	Perform Normalising treatment for the given job and measure the change in hardness.	4	04
8	Perform Case hardening treatment for the given component.	4	04
9	Perform shaping operation on metal plate.	5	04
10	Perform drilling operation on metal plate.	5	04
11	Prepare guide pin on lathe machine.	5	04
12	Prepare core insert for given product.	5	04
	Total		**44**

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. *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 PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
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 usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Lathe Machine	11,12
2	Drilling Machine	10,11,12
3	Shaping Machine	9
4	Milling Machine	12
5	Boring Machine	12
6	Industrial Oven	6,7
7	Mettalurgical Microscope	1
8	Hardness Tester	2,3,4,5,6,7
9	Induction Furnace	4,5,6,7,8

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 fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmental friendly methods and processes to avoid metal waste.

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

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. 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)** (4 to 6 UOs at Application and above level)	**Topics and Sub-topics**
Unit-I Introduction to Engineering Materials	1.a Aware about engineering materials 1.b Classify various engineering materials 1.c Compare properties of various engineering materials 1.d Select proper engineering material	1.1 Introduction 1.2 Classification of engineering materials 1.3 Properties of engineering materials 1.4 Applications of engineering materials
Unit-II Ferrous Metals and Alloys	2.a Describe different types of steel 2.b Select proper iron 2.c Identify effect of various alloying elements on properties of steel 2.d Select proper tool steel	2.1 Basics of steel, Types of steels based on Carbon - Low, Medium and High 2.2 Composition and uses of Iron- Cast Iron and Wrought Iron. 2.3 Effect of alloying elements on steels: • Silicon • Sulphur • Phosphorus • Chromium • Nickel • Manganese • Tungsten • Vanadium • Molybdenum 2.4 Composition of tool steels
Unit-III Non Ferrous Metals and Alloys	3.a Understand non-ferrous metals and alloys 3.b Describe different types of non-ferrous metal alloys 3.c Compare various non-ferrous metal/alloys 3.d Select appropriate non ferrous metals and alloys	3.1 Introduction 3.2 Properties and applications of non-ferrous metals • Aluminum & its alloys • Copper & its alloys • Nickel & its alloys • Zinc & its alloys
Unit-IV Heat Treatment of Steel	4.a Identify the need of heat treatment 4.b Describe heat treatment process 4.c Compare various heat treatment process 4.d Select proper heat treatment process	4.1 Introduction of heat treatment. 4.2 Principle of heat treatment. 4.3 Heat treatment processes: • Annealing – Full and process • Normalizing • Quenching • Tempering, • Case hardening : ➢ Pack carburizing & Gas carburizing ➢ Nitriding ➢ Cyaniding

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
		➢ Flame hardening
Unit – V Basic Machine Tools	5.a Classify basic machine tools 5.b Describe various machine tools 5.c Compare various machine tool operations 5.d Select proper machine tool for particular part	5.1 Introduction of basic machine tools. 5.2 Working principle, types, constructional features, operations, applications, advantages and disadvantages : ➢ Shaping machine ➢ Drilling machine - Bench and Radial ➢ Lathe Machine - Engine, Bench, Tool room, Capstan & Turret ➢ Milling machine - Vertical and Horizontal ➢ Horizontal boring machine

***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.*

8. 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 Engineering Materials	05	3	2	2	07
II	Ferrous Metals and Alloys	08	5	5	4	14
III	Non Ferrous Metals and Alloys	03	3	2	2	07
IV	Heat Treatment of Steel	08	4	6	4	14
V	Basic Machine Tools	18	8	8	12	28
Total		**42**	**23**	**23**	**24**	**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 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 vary slightly from above table.*

9. 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 about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

1. Students will collect information related to the experiment through internet.
2. Students will visit nearby mould making industry.

10. 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.11***, 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.
g) Visit to nearby industries/workshops/metal treatment plants.
h) Video/animation films on working of different type of machine tools.
i) Video/animation films on different treatments of metals.

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 be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/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 not be less than ***16 (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:

a) Ferrous Metals: Prepare a chart for types of ferrous metals.
b) Ferrous Metals: Collect samples of ferrous metals.
c) Non-ferrous Metals: Prepare a chart for types of ferrous metals.

d) Non-Ferrous Metals: Collect samples of non-ferrous metals.
e) Prepare chart for various heat treatment processes.
f) Collect products made by various machine tools.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1.	Elements of Workshop Technology (Volume I,II and III)	Choudhary Hajra S.K and Choudhary Hajra A.K.	Media Promoters & Pub Pvt Ltd, Mumbai, 2014, 5551234002069
2.	A Textbook of Workshop Technology	Khurmi R.S and Gupta J.K	Sultan Chand & Sons, New Delhi, 2010, 9788121908689
3.	Workshop Technology	Bawa H.S.	Tata McGrow Hill Education Pvt. Ltd, Delhi, 2015, 9780070671195
4.	Elements of Metallurgy	Swarup D.	Rastogi Publications, Meerut, 2005, 9788171338139
5.	Material Science & Processes	Hajra & Choudhary	Media Promoters & Pub Pvt Ltd, Mumbai, 2009, 9780906216002
6.	A Text-Book of Material Science & Metallurgy	Khanna O.P	Dhanpat Rai Publications, New Delhi,2021, 9789383182459
7.	Material Science and Metallurgy	Jindal U.C	Pearson Publications,Delhi,2012, 9788131759110
8.	Mechanical Metallurgy	George E. Dieter	Mcgrawhill Education, Delhi, 2017, 9781259064791
9.	Production Technology Vol. I,II	Jain R.K	Khanna Publishers,New Delhi, 1976, 9788174090997
10.	A Textbook of Production Technology	Sharma P.C	Sultan Chand & Sons, New Delhi, 2021, 9789355010698
11.	Manufacturing Processes for Engineering Materials	Kalpakjian S, Schmid S.R	Pearson Publications,Delhi,2018, 9780134425122

14. SOFTWARE/LEARNING WEBSITES

1. http://www.lathemachinesindia.com/lathe-machine.html
2. https://learnmechanical.com/lathe-machine
3. https://www.theengineerspost.com/types-of-drilling-machine/
4. https://www.youtube.com/watch?v=JVX70JRihhY
5. https://learnmechanical.com/grinding-machine/
6. http://www.hnsa.org/doc/pdf/lathe.pdf
7. http://www.hnsa.org/doc/pdf/milling-machine.pdf
8. https://sedyono.files.wordpress.com/2015/10/ch-02.pdf
9. http://uhv.cheme.cmu.edu/procedures/machining/CH8.PDF
10. http://www.efunda.com/processes/heat_treat/introduction/heat_treatments.cfm
11. http://web.iitd.ac.in/~suniljha/MEL120/L4_Heat_Treatment_of_Metals.pdf
12. https://irimee.indianrailways.gov.in/instt/uploads/files/1435551458629-Overview%20of%20HT.pdf
13. http://www.technologystudent.com/equip1/heat1.html

15. PO-COMPETENCY-CO MAPPING

Semester I	Mould Fabrication Technology - I (Course Code: 4322302)									
	POs and PSOs									
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**	**PSO 1** An ability to apply principles of material selection, product & mold/die design and development in plastic engineering.	**PSO 2** An ability to conduct safe and environment friendly manufacturing and recycling of plastic products.	**PSO 3** (If needed)
Competency **Operate various basic machine tools for selected mould materials.**	2	2	3	2	3	2	2	2	2	-
Course Outcomes										
1 Select engineering materials for making moulds.	2	-	2	-	2	-	1	2	-	-
2 Select ferrous metals and alloys for making moulds.	2	1	2	1	2	2	2	2	1	-
3 Select non ferrous metals and alloys for making moulds.	2	1	2	1	2	2	2	2	1	-
4 Suggest heat treatment process for moulds.	1	2	2	2	2	2	1	2	1	-
5. Operate machine tools to fabricate moulds.	2	2	3	2	3	2	2	2	2	-

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Shri Dharmendra M. Makwana Head of Plastic Engineering	G.P., Valsad	9426359006	1224dmm@gmail.com
2	Shri Jaymin R. Desai Lecturer in Plastic Engineering	G.P., Ahmedabad	9428159779	jayminrdesai@yahoo.com
3	Shri Ajay S. Amin Lecturer in Plastic Engineering	G.P., Valsad	9426044254	ajayamin2000@yahoo.co.in
4	Shri Dhrupatsinh M. Gadhavi Lecturer in Plastic Engineering	G.P., Ahmedabad	9426838975	dhrupat@yahoo.co.uk