**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**

**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**
VI– Semester

Course Title: **Mould Fabrication Technology - II**
(Course Code: 4362303)

| Diploma programme in which this course is offered | Semester in which offered |
|---|---|
| Plastics Engineering (Sandwich Pattern) | Sixth |

## 1. RATIONALE

A plastic diploma engineer has to use various metals, metal alloys and machine tools for various mould components. This will requires knowledge of basic & advance fabrication techniques. Advance fabrication techniques used for highly accuracy as well as for mass productions of components with high speed. A Plastic diploma engineer must be aware with modern fabrication techniques to cope up with recent fabrication requirements. This course may help to understand different advanced 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:

- **Fabricate mould & various metal components by advanced machine tools & techniques.**

## 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) Identify need & importance of advance fabrication techniques.
b) Select suitable EDM & electroforming for given component.
c) Work on pantograph, jig boring & cold hobbing machine.
d) Select suitable polishing & rapid prototyping method.
e) Fabricate mold part using CNC machines.

## 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 | |
| 2 | 0 | 2 | 3 | 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 thesub-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 | Prepare core or cavity for hand injection mold by using conventional machinery. | I | 2 |
| 2 | Operate a Spark erosion machine. | II | 4 |
| 3 | Prepare mold insert/ bolster by using wire cut EDM process. | II | 4 |
| 4 | Prepare cavity by using Electroforming process. | II | 2 |
| 5 | Identify the parts of Pantograph die sinking machine | III | 2 |
| 6 | Operate a Jig boring machine and create required dimension hole in given object. | III | 2 |
| 7 | Demonstrate a Cold hobbing machine. | III | 2 |
| 8 | Use appropriate method for polishing given object. | IV | 2 |
| 9 | Operate any one rapid prototyping machine and make desire product. | IV | 2 |
| 10 | Operate a CNC machine for manufacturing of given mold part. | V | 2 |
| | **TOTAL** | | **24** |

***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 | Preparation of machine/ setup | 10 |
| 2 | Operate the equipment | 20 |
| 3 | Follow safe practices measures | 20 |
| 4 | Record observations correctly | 20 |
| 5 | Interpret the result and conclude | 30 |
| **Total** | | **100** |

## 6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specificationsfor 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 and Surface grinding machine | 1 |
| 2 | Spark erosion machine | 2 |
| 3 | Wire cut EDM machine | 3 |
| 4 | Electroforming machine | 4 |
| 5 | Pantograph die sinking machine | 5 |
| 6 | Jig boring machine | 6 |
| 7 | Cold hobbing machine | 7 |
| 8 | Lapping machine | 8 |
| 9 | Rapid prototyping machines | 9 |
| 10 | CNC Machine | 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 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 pollution due to additives.

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**<br><br>**Introduction to Advance Fabrication** | 1a. Identify conventional fabrication techniques<br>1b. Identify need of advance fabrication<br>1c. Understand importance of advance fabrication<br>1d. Compare conventional & advance fabrication techniques | 1.1 Introduction<br>1.2 Introduction To Conventional Fabrication tool- lathe, shaping, drilling, milling etc.<br>1.3 Advancements In Fabrication Techniques<br>1.4 Advantages Of Advance Fabrication Techniques |

| | | |
|---|---|---|
| **Unit – II**<br><br>**Electrical Discharge Machining & Electroforming** | 2.aIdentify Needs For Electro Discharge Machining.<br>2.bSelect Proper EDM Process.<br>2.cClassify dielectric medium for EDM.<br>2.dIdentify Needs Of Electroforming Process. | 2.1Spark Erosion Process<br>• Working Principle<br>• Construction & Working<br>• Dielectric Medium<br>• Different Tool Materials<br>• Advantages And Disadvantages<br>2.2Wire-Cut EDM<br>• Working Principle<br>• Construction & Working<br>• Advantages And Disadvantages<br>2.3Electroforming Process<br>• Basic Working Principle<br>• Construction & Working<br>• Advantages And Disadvantages |
| **Unit – III**<br><br>**Miscellaneous Processes/ machines** | 3.aIdentify Needs Of Pantograph Machine.<br>3.bIdentify Needs Of Jig Boring Machine.<br>3.cIdentify Needs Of Cold Hobbing Process.<br>3.dSelect proper miscellaneous machines/ processes. | 3.1Pantograph Die Sinking<br>• Basic Working Principle<br>• Construction & Working<br>• Advantages and Disadvantages<br>3.2Jig Boring Machine<br>• Basic Working Principle<br>• Construction & Working<br>• Comparison with Vertical Milling Machine<br><br>3.3Cold Hobbing<br>• Characteristics of Mould Materials<br>• Types of Hob Materials<br>• Process<br>• Advantages and Disadvantages |

| | | |
|---|---|---|
| **Unit – IV**<br><br>**Polishing &**<br><br>**Rapid Prototyping** | 4.aIdentify Needs Of Polishing.<br>4.bClassify Polishing Materials.<br>4.cSelect Proper Polishing Method.<br>4.dClassify Various Processes.<br>4.eSelect Proper Prototyping Process. | 4.1Polishing<br>• Need and Significance of Polishing<br>• Types of Polishing Materials<br>• Types of Polishing Methods<br>➢ Lapping<br>➢ Buffing<br>➢ Tumbling<br>➢ Honing<br>4.2Rapid Prototyping<br>• Need and Significance<br>• Types of Processes And Applications<br>➢ Stereo Lithography<br>➢ Selective Laser Sintering<br>➢ Fused Deposition Method<br>➢ Laminated Object Manufacturing<br>➢ 3D Printing |
| **Unit – V**<br><br>**Fundamentals of CNC machines** | 5.aUnderstand importance of CNC machines<br>5.bIdentify components of CNC<br>5.cCompare conventional machine with CNC machines<br>5.dDevelop programme for CNC | 5.1 Fundamentals of CNC Machines<br>5.2 Basics of NC & CNC machines<br>5.3 CAM – Concept and Definition.<br>5.4 Components of CNC Machines<br>5.5 Advantages over Conventional Machines |

***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 QUESTIONPAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Introduction to Advance Fabrication | 2 | 4 | 0 | 0 | 4 |
| II | Electrical Discharge Machining & Electroforming | 7 | 7 | 6 | 5 | 18 |
| III | Miscellaneous Processes | 8 | 6 | 8 | 6 | 20 |
| IV | Polishing & Rapid Prototyping | 7 | 5 | 8 | 3 | 16 |
| V | Fundamentals of CNC machines | 4 | 4 | 4 | 4 | 12 |
| **Total** | | **28** | **26** | **26** | **18** | **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.*

## 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 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 prepare chart for applications of various advance fabrication methods.
2. Students will prepare mold components by various methods.

3. Students will make neat sketches of advance machinery.
4. Students make list of specification for machinery available in laboratory.

## 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:

f) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
g) Guide student(s) in undertaking micro-projects.
h) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
i) 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.
j) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
k) Guide students on how to address issues on environment and sustainability.
l) Collect information from mould manufacturing industries.
m) Visit to nearby fabrication industries/ workshop.
n) Video/animation on working of different type of equipments.
o) Arrange expert lecture (may be faculty from Mechanical Engineering Department of same polytechnic)

## 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) Prepare chart for principle of various machinery
b) Collect various metal components & enlist methods for manufacturing of that components
c) Make trouble shooting charts for various machines
d) Make safety charts for various machines
e) Prepare maintenance checklist of available machines in lab

## 13. SUGGESTED LEARNING RESOURCES

| Sr. No. | Title of Book | Author | Publication with place, year and ISBN |
|---|---|---|---|
| 1. | Elements Of Manufacturing Processes | B. S. Nagendra Parashar, R. K. Mittal | Publisher: PHI Learning<br>Published year: 2004<br>ISBN:9788120319585, 8120319583 |
| 2. | Elements of Workshop Technology ( Volume I,II and III) | Choudhary Hajra S.K and Choudhary Hajra A.K. | Publisher: Media Promoters & Pub Pvt Ltd, Mumbai<br>Published year: 2014<br>ISBN: 5551234002069 |
| 3. | Modern Machining Technology | Bijoy Bhattacharyya, Bis wanath Doloi | Publisher: Elsevier Science<br>Published year: 2019<br>ISBN:9780128128954, 012812895X |
| 4. | Non-Traditional and Advanced Machining Technologies | Helmi Youssef, Hassan El-Hofy | Publisher: CRC Press<br>Published year:2020<br>ISBN:9781000097146, 1000097145 |
| 5. | A Textbook of Manufacturing Technology: Manufacturing Processes | R.K.Rajput | Publisher: Laxmi Publications<br>Published year: 2007<br>ISBN: 9788131802441, 8131802442 |
| 6. | CNC Fundamentals and Programming | P. M. Agrawal And V. J. Patel | Publisher:Charotar Publishing House Pvt. Limited<br>Published year:2009<br>ISBN:9788185594989, 8185594988 |

## 14. SOFTWARE/LEARNING WEBSITES

1. https://www.reliableedm.com/Complete%20EDM%20Handbook/Complete%20EDM%20Handbook_1.pdf
2. https://reliableedm.com/Complete%20EDM%20Handbook/Complete%20EDM%20Handbook_2.pdf
3. http://www.ignou.ac.in/upload/Unit-3.pdf
4. https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
5. http://acl.digimat.in/nptel/courses/video/112107078/lec38.pdf
6. https://www.youtube.com/watch?v=aWQsEX1TrSI
7. https://www.youtube.com/watch?v=kyeDtbmCSgw&t=5s
8. https://www.youtube.com/watch?v=Az-EI3QHSIE
9. https://www.youtube.com/watch?v=TyZL90po6bg
10. https://www.youtube.com/watch?v=nAQ6QfpgZWM

## 15. PO-COMPETENCY-CO MAPPING

| Semester VI | Mould Fabrication Technology - II (Course Code: 4362303) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 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** Fabricate mould & various metal components by advanced machine tools & techniques. | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 1 | - |
| Course Outcomes | | | | | | | | | | |
| 1 Identify need & importance of advance fabrication techniques. | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | - |
| 2 Select suitable EDM & electroforming for given component. | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - |
| 3 Work on pantograph, jig boring & cold hobbing machine. | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | - |
| 4 Select suitable polishing & rapid prototyping method. | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - |
| 5 Fabricate mold part using CNC machines. | 2 | 1 | 2 | 2 | 2 | 1 | 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<br>Head of Plastic Engineering | G.P., Valsad | 9426359006 | 1224dmm@gmail.com |
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