GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

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

Course Title: Foundry Technology
(Course Code: 4342101)

Diploma Programme in which this course is offered	Semester in which offered
Metallurgy Engineering	4th Semester

1 RATIONALE

Casting is one of the oldest methods of production. Casting is preferred as manufacturing process due to its simplicity and versatile product application. There are varieties of materials, and processes involved in casting. However, this labor-intensive process is also moving towards automation for increasing rate of production and reducing cost. Metallurgy engineers are therefore required to have knowledge and skills in this area. Diploma level metallurgy engineers are expected to supervise the foundry operations. This course focuses on knowledge and skills of equipment, principle and their relative merits and demerits of various casting process.

2 COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in students so that they are able to acquire following competencies

- **To supervise production of metal casting in foundry with quality using knowledge and skills of various foundry operations.**

3 COURSE OUTCOMES (COs)

At the end of the study of this course the student will be able to:

CO1: State advantages and applications of casting processes.
CO2: Compare different types of patterns based on their uses.
CO3: Prepare mold for casting processes.
CO4: Design the gating system and riser in the mold making.
CO5: Understand the function and working of casting processes.
CO6: Identify the casting defects with causes and remedies.

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	4	5	30*	70	50	50	200

(*): 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

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Prepare the layouts of foundry and classify each section of foundry.	I	04
2	Prepare standard specimen of sand mold as per AFS standard for testing.	III	08
3	Measure the sand mold strength by universal sand testing machine.	III	08
4	Measure the permeability of sand mold.	III	04
5	Determine the clay content of foundry sand.	III	04
6	Measure the moisture content of sand mold by weight loss method.	III	04
7	Measure the mold hardness by hardness tester.	III	04
8	Determine grain size and distribution by sieve analysis for foundry sand.	III	04
9	Demonstrate operation and maintenance of induction furnace.	V	08
10	Demonstrate the casting for simple shape.	V	08
	Total Hours		**56**

Notes:

1. 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.
2. 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	Identification of the component and Preparation of experimental Set-up	20
2	Operate equipment set-up	10
3	Observation and recording of the data correctly	10
4	Interpretation of the result and conclusion	20
5	Safety precaution and safety gadgets used	20
6	Submission of report within time limit and attendance in the laboratory	20

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's in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Models of various types of patterns	2
2	Universal sand strength testing machine	3
3	Permeability meter	4
4	Clay washer kit for clay content test	5
5	Model of mold	2
6	Mold hardness tester	7
7	Sand muller machine	2
8	Sand rammer	2
9	Core hardness tester	7
10	Rapid moisture meter	6
11	Shatter index tester	8
12	Muffle furnace	10

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 fulfill the development of this course competency

- Student will visit local foundry shops and observe pattern making, sand preparation, mold making, metal melting, alloying, and casting, etc. and prepare reports.
- Student will prepare report of various materials and tools being used in foundry based on observations.
- Student will visit automated foundry and make a report.

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	Major Learning Outcomes	Topics and Sub-topics
UNIT-I Introduction to Foundry	1a. Classify various casting processes. 1b. Explain different sections in foundry. 1c. Draw layout of foundry. 1d. Classify different types of foundries. 1e. Explain materials use in foundry.	1.1. Brief introduction about manufacturing processes 1.2. Principle, steps, advantages, application of metal casting 1.3. Introduction, types, different sections, and layout of foundry industries. 1.4. Classification of foundry metals and alloy 1.5. Introduction, concept and types of foundry fluxes, refractories, and fuels
UNIT-II Pattern and Pattern making	2a. Differentiate between pattern and casting. 2b. Explain different types of patterns. 2c. Describe materials require for pattern making. 2d. List out and explain different pattern allowances. 2e. Explain importance of color coding in pattern.	2.1. Introduction of pattern 2.2. Difference between pattern and casting 2.3. Introduction, function, material used for Pattern making 2.4. Types of patterns used in metal casting. 2.5. Design and allowance of pattern 2.6. Color codes of pattern.
UNIT-III Mold making and Core making	3a. Explain mold making methods with figure. 3b. List out different types of foundry sand 3c. Explain properties require for	3.1. Materials used in mold making 3.2. Types and properties of molding sand. 3.3. Additives and binder used in molding sand

	foundry sand. 3d. Differentiate between mold and core. 3e. Explain different types of molds with their characteristic. 3f. Explain various mold materials according to casting processes.	3.4. Introduction, function and types of cores and core making 3.5. Types of molds, mold making methods
UNIT-IV Principle of Gating and Risering	4a. Draw and explain gating system. 4b. Explain an effect of gating system on casting. 4c. Explain various types of gates 4d. Define gating ratio. Differentiate between pressurize and unpressurized gating system. 4e. Explain importance of riser in mold. 4f. Explain an effect of riser on directional solidification.	4.1. Introduction to gating system 4.2. Requirement, purpose, characteristics of gating system. 4.3. Design and types of gating system. 4.4. Gating ratio, pressurized and unpressurised gating system. 4.5. Introduction, Function, importance and types of risers. 4.6. Progressive and directional solidification
UNIT-V Melting practice and Casting processes	5a. Explain principle, working and application of cupola furnace. 5b. Explain principle, working and application of induction furnace. 5c. Explain principle, working and application of electric furnace. 5d. Classify various casting processes. 5e. Explain principle and working procedural of casting processes. 5f. List out advantages, limitations, and applications of casting processes.	5.1. Principle, working and applications of Cupola, Induction and Electrical furnaces. 5.2. Classifications of casting processes 5.3. Introduction, principle, operational steps, advantages, limitations, and applications of; a. Gravity die casting b. Pressure die casting c. Investment casting d. Centrifugal casting e. Shell mold casting
UNIT-VI Quality inspection and Casting defects	6a. List out primary inspection methods to check casting quality. 6b. Classify various casting defects. 6c. Explain casting defects causes and remedies.	6.1. Primary inspection of cast products 6.2. Introduction to casting defects 6.3. Classification of casting defects 6.4. Causes and remedies of main casting defects

9 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Foundry	04	4	2	2	08
II	Patterns and Pattern making	06	6	2	2	10
III	Mold making and Core making	08	4	4	4	12
IV	Principle of Gating and Risering	06	6	4	2	12
V	Melting practice and Casting processes	12	4	6	8	18
VI	Quality inspection and Casting defects	06	4	4	2	10
Total		**42**	**28**	**22**	**20**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Notes:

1. This specification table shall be treated as a general guideline for students and Teachers. The actual distribution of marks in the question paper may slightly vary from above Table.
2. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

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

1. Make a model/chart for individual casting processes.
2. Collect various defective casting samples and identify cause of defects.
3. Industrial Visit of Manufacturing Industries.
4. Group discussion on environmental issues and control in the foundry.

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.

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

g) Encourage students to read codes and standards.

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 he/she 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:

1. Preparation of a standard sand test specimen as per AFS
2. Prepare pattern
3. Prepare chart/model for Foundry Layout
4. Collect different patterns from scrap
5. Seminar/presentation for relevant development in foundry
6. Collect defective castings and identify defect

13 SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Foundry Technology	O. P. Khanna	Publisher: Dhanpat rai ISBN: 9788189928346
2	Principle of Foundry Technology	P. L. Jain	Publisher: Tata McGraw Hill Inc. ISBN: 10. 0074516981

3	Foundry Technology	S. K. Jain, Dharmendra Kumar	Publisher: CBS ISBN: 10.-8123902905
4	Foundry Technology	Beeley Peter	Publisher: Elsevier Science and Technology ISBN: 9780750645676,
5	Fundamental of metal casting technology	P. C. Mukherjee	Publisher: Oxford ISBN: 19-539138-8,

14 SOFTWARE/LEARNING WEBSITES

1. https://swayam.gov.in/nc_details/NPTEL
2. http://efoundry.iitb.ac.in/index.html

15 PO-COMPETENCY-CO MAPPING

Semester II	Foundry Technology (Course Code: 4342101)						
	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, Experimentation & Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Manage-ment**	**PO 7 Life-long learning**
Competency	To supervise production of metal casting in foundry with quality using knowledge and skills of various foundry operations.						
CO1: State advantages and applications of casting processes	3	--	1	--	--	1	1
CO2: Compare different types of patterns based on their uses.	3	2	2	2	--	1	2
CO3: Prepare mold for casting processes	3	2	2	3	1	2	3
CO4: Design the gating system and riser in the mold making	2	2	3	2	--	1	1
CO5: Understand the function and working of casting processes	3	2	2	2	2	2	3
CO6: Identify the casting defects with causes and remedies	3	--	--	2	--	--	2

16 COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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