GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Steel Making
(Course Code: 4352101)

Diploma Programme in which this course is offered	Semester in which offered
Metallurgy Engineering	5th Semester

1. RATIONALE

From very ancient time steel is used as a major component of structural material and many other industrial and domestic appliances, because of its availability and economic values, some major uses of steel is in power sector, machine manufacturing, automobiles, and utensils. Its application is noticed from a small paper pin to airplane.

Steel making is a complex process starting from extraction of metal from iron ore to the final product as steel. Although there are various grades of steel which are demanded by the industries for various purposes. The industrial requirements are changing day by day in present scenario and our steel making technology must be so advanced to cope up with the present demanding situations.

This course is designed to explore the latest techniques and processes of steel production, refining and its casting, so that to provide a complete knowledge and expertise to the students for getting required level of competency.

2. COMPETENCY

The course 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.

- Supervise the production of steel by various steel making processes.
- Inspect the various ingot defect.

3. COURSE OUTCOMES (COs)

At the end of the study of this course the student will able to;

CO1: Classify various routes of steel production.
CO2: Differentiate between primary and secondary steel making.
CO3: Choose proper refining process for appropriate steel.
CO4: Identify different ingot defects and their 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	0	3	30*	70	--	--	100

(*): 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.AFFECTIVE DOMAIN OUTCOMES

1. Assist metallurgical industry in up gradation.
2. Modify the refining processes of liquid steel.
3. Practice ecofriendly methods and processes.

6.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 Steel Making	1.a. Define Steel. 1.b. Types of steel as per IS standard. 1.c. Describe raw materials required for steel making. 1.d. Write brief history of steel making. 1.e. Differentiate between acid and basic steel making. 1.f. Classify various routes of steel making.	1.1. Steel and its classification. 1.2. Raw materials used for making steel. 1.3. Working principle of steel making. 1.4. Crucible and cementation process. 1.5. Acid and basis steel making. 1.6. Different routes for making steel.
Unit-II Primary Steel Making	2.a. Enlist pneumatic processes of steel making. 2.b. Explain various pneumatic processes of steel making. 2.c. Explain construction and working of Open Hearth process. 2.d. Explain construction and working of EAF(electric arc furnace).	2.1. Pneumatic steel making processes: raw materials used, construction, working, chemical reactions, quality of product. (I)Bessemer process (II) L.D Process (III) Kaldo process 2.2. Steel making by open hearth

	2.e. Describe Induction furnace with neat sketch. 2.f. Differentiate between EAF and Induction furnace. 2.g. Merits and demerits of aforesaid processes.	process: raw materials used, construction, working, chemical reactions, quality of product. 2.3. Steel making by EAF and Induction furnace: raw materials used, construction, working, chemical reactions, quality of product. 2.4. Comparison between EAF and Induction furnace.
Unit-III Secondary Steel Making	3.a. Enlist Secondary steel making processes. 3.b. Explain L.F(laddle Furnace) with neat sketch. 3.c. Explain Working principle of degassing. 3.d. Describe AOD and VOD. 3.e. Illustrate RH(Ruhrstahl Heraus) degasser. 3.f. Explain de-oxidation and decarburization of steel. 3.g. Explain desulphurization and dephosphorization of steel.	3.1. Secondary steel making processes. 3.2. Steel refining furnaces; construction and working. • Laddle Furnace(L.F) 3.3. Degassing of liquid steel. 3.4. Degassing processes. 3.5. Decarburization techniques. 3.6. Vacuum treatment of liquid steel.
Unit-IV Steel Casting	4.a. Give types of mould. 4.b. Explain different structure steel ingots. 4.c. Explain various ingot defects and their remedies. 4.d. Illustrate flow diagram of continuous casting of liquid steel. 4.e. Differentiate between ingot and continuous casting.	4.1. Casting of liquid steel. 4.2. Types of mould. 4.3. Types of steel ingots. 4.4. Ingot defects and their remedies. 4.5. Continuous casting of liquid steel.

7.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 Steel Making	08	4	4	2	10
II	Primary Steel Making	14	14	10	6	30
III	Secondary Steel Making	12	8	8	4	20
IV	Steel Casting	08	6	2	2	10
	Total	**42**	**32**	**24**	**14**	**70**

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

Notes:

a) 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 the above Table.

b) 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.

4. 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. Collect and review sample of various steels from the market with their standards, specifications and rates.
2. Explore various websites of reputed steel manufacturers to study the latest trends and their processes for steel making.
3. Industrial visit at steel manufacturer plants and prepare a report on it.

5. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Sr. No.	Unit Title	Strategies
I	Introduction to Steel Making	1. Case study of various steel manufacturing plants. 2. Use of ICT tools in classroom teaching. 3. Expert lecturer/ Seminar on recent trends. 4. Workshop on Industrial automation.
II	Primary Steel Making	
III	Secondary Steel Making	
IV	Steel Casting	

6. 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 is 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 a dated work diary consisting of individual contributions 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 a 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. Prepare chart for different routes of steel making processes.
2. Review and report on raw materials used in different steel plants, their steel making processes and their products.
3. Make a flow diagram of different units of operations used in steel manufacturing plants.
4. Make a demonstrative chart showing comparison between Electric Arc furnace (EAF) and Induction Furnace.
5. Prepare a presentation based on a case study of a renowned steel manufacturing plant.
6. Make a flow diagram showing different processes liquid steel refining.
7. Prepare a comparative chart of Electric Arc Furnace (EAF) and Induction Furnace.
8. Make a demonstrative model of Continuous casting process.

7. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author / Editor	Publication with place, year and ISBN
1	An Introduction to Steel Making	Dr. R.H.Tupkary and V.R. Tupkary	Khanna Pub., New Delhi, India, 2010 (ISBN: 81-7409-026-6)
2	Ironmaking and Steelmaking – Theory and Practice	Ahindra Ghosh and Amit Chatterjee	PHI Learning, New Delhi, India, 2011 (ISBN: 978-81-203-3289-8)

8. SOFTWARE/LEARNING WEBSITES

Search engine could be used to locate steel manufacturing related sites, such as

i. https://en.wikipedia.org/wiki/Steel
ii. https://www.britannica.com/technology/steel
iii. https://nptel.ac.in/courses/113104013

9. PO-COMPETENCY-CO MAPPING

Semester V	Steel Making [Course Code: 4352101]						
	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
Competency	**Select a suitable metal working operation for the specific application of metals and alloys.**						
Course Outcomes: CO 1) Classify different routes of steel production.	3	-	-	-	-	-	1
CO 2) Differentiate between primary and secondary steel making.	3	-	-	-	-	-	1
CO 3) Choose proper refining process for appropriate steel.	3	-	2	2	-	-	1
CO 4) Identify various ingot defects and their remedies.	3	2	2	1	1	-	1

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

10.COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons:

Sr. No.	Name and Designation	Institute	Email
1	Mr. Ehjajehmad Usmanbhai Ghanchi, Lecturer Metallurgy	Government Polytechnic, Bhuj	azazghanchi92@gmail.com
2	Ms. Anjuman Samirimtiyaz Kadiwala Lecturer Metallurgy	L.E.College(Diploma), Morbi	anjumankadiwala29@gmail.com

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