

## GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

### COURSE CURRICULUM COURSE TITLE: ALLOY STEEL (COURSE Code: 3352103)

Diploma Programme in which this course is offered	Semester in which offered
Metallurgy Engineering	5 <sup>th</sup> Semester

#### 1. RATIONALE

Different types of steels are widely used world over to produce various products. A diploma metallurgical engineer is required to know the basic properties, composition and applications of different types of steels. This course is therefore designed to provide a basic knowledge of Alloy Steels.

#### 2. LIST OF COMPETENCY

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

- **Explain the effect of alloying various elements in steels to form useful steel alloys.**

#### 3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes..

- i. Distinguish metallic and non-metallic materials.
- ii. Distinguish between plain carbon steels and alloy steels.
- iii. Explain composition, properties, and applications of Low alloy, High Speed Steel alloy, stainless steel, and commercial quality steels.
- iv. Analyse problems pertaining to requirement of material and provide solutions based on development of requisite property of material/alloy using modern tools and solutions be based on societal, health, safety, legal and cultural considerations.

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

## 5. COURSE CONTENT DETAIL

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
<b>Unit – I Introduction to Ferrous Alloys</b>	1a. Classify ferrous group of alloys. 1b. Describe steels according to kind, class, grade and quality. 1c. Classify steels according to kind, class, grade and quality	1.1 Classification of ferrous group of alloys. 1.2 Properties of ferrous groups of alloys. 1.3 Plain carbon steels with respect to iron-carbon diagram. 1.4 Classification of steels according to kind, class, grade and quality.
<b>Unit – II Introduction to Alloy Steels.</b>	2a. Justify the need for alloy steels and effects of alloying  2b. Describe properties and applications of plain carbon steels. 2c. Distinguish between plain carbon steels and alloy steels. 2d. Explain the distribution (mode of combination) of alloying elements in steels. 2e. Describe various international standards for steels.	2.1 Composition, properties and applications of different types of carbon steels 2.2 Limitations of plain carbon steels. 2.3 Need of alloy steels; effects of alloying elements. 2.4 Types of alloy steels. 2.5 International standards like ASTM, DIN, IS, BS.
<b>Unit – III Low Alloy Steels</b>	3a. Justify the need for low alloy steel. 3b. Describe the low alloy structural and high strength steels. 3c. Describe the effect of Nickel, Chromium and Tungsten on mechanical properties of steels 3d. State the effects of Vanadium, Silicon, Manganese, Cobalt, Molybdenum on mechanical properties of steel applications of these steels	3.1 Low alloy steels. 3.2 Low alloy structural and high strength steels. 3.4 Effects of Nickel, Chromium and Tungsten on Mechanical properties of steels and applications of these steels. 3.5 Effects of Vanadium, Silicon, Manganese, Cobalt, Molybdenum on Mechanical properties of steel and applications of these steels.
<b>Unit – IV Tool Steels</b>	4a. Describe types of tools. 4 b. Classify tool steel. 4c. Differentiate between T type and M type HSS. 4d. Explain effects of various alloying elements	4.1 Types of tools. 4.2 Classification of tool steels. 4.3 High speed tool steels (HSS) classification, composition and applications. 4.4 Effect of various alloying elements - chromium, molybdenum, tungsten, cobalt

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	in HSS. 4d. Describe composition and applications of HSS	and vanadium in HSS
<b>Unit – V Stainless Steels</b>	5a. Describe stainless steel as corrosion resistant steel. 5b. Distinguish different types of stainless steel with reference to composition, microstructure, properties,.	5.1 Definition of stainless steels (SS). 5.2 Classification of stainless steels. 5.3 Types of stainless steel with reference to composition, microstructure, properties, and application.
<b>Unit VI Steels of Commercial Importance</b>	6a. Describe, Applications properties, composition and microstructure of steels like spring steel, electrical steel, ball bearing steel, triple alloy steel, dual phase steel and valve steel.	6.1 Properties, Applications, composition and microstructure of commercially important steels: Spring Steels, Electrical steels, Ball bearing steels, Triple alloy (Ni-Cr-Mo, EN 24) steels, Dual phase steels 6 Valve steels

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Introduction to Ferrous Alloys	4	4	4	2	10
2	Introduction to alloy Steels	4	2	4	2	08
3	Low alloy Steels	10	08	6	06	20
4	Tool steel	6	4	4	2	10
5	Stainless Steel	8	4	2	4	10
6	Steels for commercial Importance	10	6	2	4	12
<b>Total</b>		<b>42</b>	<b>28</b>	<b>22</b>	<b>20</b>	<b>70</b>

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

**NOTE:** Suggested specification table shall be treated as a general guidance for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## 7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (*outcomes in psychomotor and affective domain*) so that students are able to acquire the competencies/course outcomes. Following is the list of practical exercises for guidance.

**Note:** *outcomes in psychomotor domain are listed here as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to*

development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty members should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of **Programme Outcomes/Course Outcomes**.

S. No.	Unit No.	Practical/Exercise (Outcomes psychomotor domain)	Approx. Hours. Required
1	II	Study effect of Carbon on micro structure and properties of Hypo eutectoid steel.	04
2	II	Study effect of Carbon on micro structure and properties of Hyper eutectoid steel.	04
3	II	Study effect of alloying elements like Cr and Mn.	04
4	II	Study effects of alloying elements on hardenability.	04
5	III	Study different types of Stainless steel with respect to properties, microstructure and application.	04
6	IV	Study different types of High speed steel with respect to properties, microstructure and application.	04
7	IV	Measure case depth for carburising steel.	04
8	III	Study the effect of alloying elements on (i) Critical cooling rate. (ii) Hardness. (iii) Transformation temperature.	04
9	V	Identification of various types of micro defects such as Segregation - network - inclusion.	04
10	-	Visit Industry to study equipment, process and products for analysis.	08
Total			48

## 8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Students will prepare microstructure of different steels and observe it.
- ii. Students will prepare file and get it checked from concerned faculty.

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (if any )

- i. Industrial visit
- ii. Video film presentation
- iii Seminar by group of students.
- iv. Expert Lecture

## 10. SUGGESTED LEARNING RESOURCES

### (A) List of Books:

S. No.	Title of Books	Author	Publication
1	Physical Metallurgy Principles	R.E. Reed Hill	East - West, Latest edition
2	Introduction to Physical Metallurgy	S. H. Avner	Tata Mc-Graw Hill Latest edition
3	Physical Metallurgy for Engineers	D. S. Clark and W. R. Varney	East-West press Latest edition
4	Engineering Metallurgy : Applied Physical Metallurgy	R. A. Higgins	Viva Books Latest edition
5	Material science and Metallurgy	V.D. Kodgire	Everest Publishing House , Latest edition

### B List of Software/Learning Websites

- i. <http://nptel.iitm.ac.in/courses.php?disciplineId=113>
- ii. [http://www.sv.vt.edu/classes/MSE2094\\_NoteBook/96ClassProj/examples/kimcon.html](http://www.sv.vt.edu/classes/MSE2094_NoteBook/96ClassProj/examples/kimcon.html)
- iii. <http://www.youtube.com/watch?v=IskiZaGDQow>
- iv. <http://ocw.mit.edu/courses/index.htm#materials-science-and-engineering>
- v. [http://en.wikipedia.org/wiki/Alloy\\_steel](http://en.wikipedia.org/wiki/Alloy_steel)
- vi. [http://en.wikipedia.org/wiki/High-strength\\_low-alloy\\_steel](http://en.wikipedia.org/wiki/High-strength_low-alloy_steel)
- vii. <http://www.goodweld.com.tw/upload/product/th-18.pdf>
- viii. <http://www.chasealloys.co.uk/steel/alloying-elements-in-steel/>

## 11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof. Smt B. H. Goyal**, I/c. Head of Department of Metallurgy, Dr S and S.S Ghandhy college of Engg. and Technology
- **Dr. G.H. Upadhyay**, Professor of Metallurgy, Department of Mechanical Engineering, L.D.College of Engineering, Ahmedabad

### Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. C.K Chugh**, Professor, Department of Mechanical Engineering
- **Dr Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering