**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM**
**COURSE TITLE: METALLURGICAL ANALYSIS**
**(CODE: 3342106)**

| Diploma Programmes in which this course is offered | Semester in which offered |
|---|---|
| Metallurgy Engineering | 4th Semester |

## 1. RATIONALE

Beginning from the minerals and ores from which the metals are extracted at each and every stage of metal processing, chemical composition needs to be ascertained so as to establish the requisite quality and process control. A Diploma engineer pass out is expected to work at supervisory level in various production units. Therefore a diploma engineering student must be conversant with chemical analysis techniques of metals and alloys. This course aims to equip the student with the knowledge of various conventional and modern metallurgical analysis techniques needed to establish the composition of metals and alloys as prevalent in industry.

## 2. COMPETENCY

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

- **Ascertain the chemical composition of metals and alloys using appropriate methods and techniques.**

## 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. Compare the conventional and modern methods of quantitative analysis
ii. Explain sampling of ores, and metals.
iii. Select the relevant conventional method for analysis for different metals and alloys.
iv. Enumerate the advantages and limitations of modern methods of analysis.

## 4 TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| L | T | P | C | ESE | PA | ESE | PA | |
| 3 | 0 | 0 | 3 | 70 | 30 | 00 | 00 | 100 |

**Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

## 5 COURSE DETAILS

| Unit | Major Learning Outcomes (Outcomes in Cognitive Domain) | Topics and Sub-topics |
|---|---|---|
| **Unit – I Introduction to Metallurgical analysis** | 1a. Explain importance of metallurgical analysis,<br>1b. Differentiate between qualitative and quantitative analysis.<br>1c. Enlist the methods of quantitative analysis.<br>1d. Compare the conventional and modern methods of quantitative analysis | 1.1 Metallurgical analysis<br>1.2 Importance of metallurgical analysis<br>1.3 Qualitative and quantitative analysis<br>1.4 Conventional and modern methods of quantitative analysis. |
| **Unit- II Sampling** | 2a. Define sample<br>2b. Explain the importance of sampling.<br>2c. Explain sampling of ores, and metals. | 2.1 Importance of sampling<br>2.2 General procedure for sampling.<br>2.3 Sampling of ores<br>2.4 Sampling of molten metal<br>2.5 Sampling of solid metal.<br>2.6 Various glassware and filter paper used in conventional methods |
| **Unit – III Conventional methods of analysis** | 3a. Differentiate between volumetric and gravimetric analysis method<br>3b. Define Normality, molarity and standard solution, Law of mass action,pH and pH scale, Buffer solutions, common ion effect.<br>3c. Differentiate between neutralization and hydrolysis.<br>3d. Select the relevant conventional method for analysis for different metals and alloys.<br>3e. Ascertain the amount of carbon and sulphur in steel by Rollas apparatus. | 3.1 Compare volumetric and gravimetric analysis method<br>3.2 Normality, molarity and standard solution, Law of mass action ,pH and pH scale, Buffer solutions, common ion effect, neutralization and hydrolysis<br>3.3 Determination of Silicon in cast iron by Gravimetric analysis method.<br>3.4 Determination of antimony in white bearing metal by volumetric analysis.<br>3.5 Importance of indicators in volumetric analysis.<br>3.6 Titration curves for various types of titration<br>3.7 Determination of carbon and sulphur in steel by Rollas apparatus |
| **Unit-IV Modern Methods of analysis** | 4a. Enlist the modern methods of analysis<br>4b. Enumerate the advantages and limitations of modern methods of analysis.<br>4c. Determine copper in brass by electrolytic method | 4.1. Methods of analysis.<br>4.2. Advantages and limitations of modern methods of analysis.<br>4.3. Electrolytic method of analysis<br>4.4. Colorimetry method of analysis<br>4.5. Laws of colorimetry and methods of colorimetry. |
| | 4d. Explain the laws and methods of colorimetry<br>4e. Explain principle, construction and working of | 4.6. Principle of spectroscopy<br>4.7. Construction and working of spectrometer. |

## 6 SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| 1. | Introduction to Metallurgical analysis | 06 | 04 | 05 | 01 | 10 |
| 2. | Sampling | 06 | 04 | 02 | 02 | 08 |
| 3. | Conventional methods of analysis | 12 | 06 | 06 | 10 | 22 |
| 4. | Modern Methods of analysis | 18 | 10 | 10 | 10 | 30 |
| | **Total** | **42** | **24** | **23** | **23** | **70** |

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

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

## 7. SUGGESTED LIST OF EXERCISES/PRACTICALS

**----NA----**

## 8 SUGGESTED LIST OF STUDENT ACTIVITIES

i. A r r a n g e Quiz. Among themselves
ii. Collect samples of alloys from market and analyse their composition and verify this with that guaranteed by suppliers.

## 9 SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

i. Arrange expert lectures from Industry
ii. Arrange Industrial visit to nearby industry and show the metallurgical analysis methods.
iii Show video/animation films to explain various methods for metallurgical analysis of metals and alloys.

## 10 SUGGESTED LEARNING RESOURCES

### A. List of Books

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| **1.** | Metallurgical Analysis | B.C. Agrawal and S.P Jain | Khanna Publishers Delhi |
| **2.** | A textbook of quantitative analysis | Vogel | Prentice Hall |
| **3.** | Fundamentals of physical chemistry | Crockford and Knight | H.B Publishers Newyork |

### B. List of Equipment/Instruments

Not Applicable

## C. List of Software/Learning Websites

i. en.wikipedia.org/wiki/Metalanalysis
ii. www.nptel.com
iii. http://www.spectro.com/pages/e/p30000100_metals_industry.htm?gclid=CJOp2NvH7bsCFUcB4godfgYACQ
iv. http://www.astm.org/Standards/analytical-chemistry-standards.html
v. http://www.bruker.com/products/x-ray-diffraction-and-elementalanalysis/handheld-xrf/alloy-app.html

# 11 COURSE CURRICULUM DEVELOPMENT COMMITTEE

**Faculty Members from Polytechnics**

- **Prof. Smt B. H. Goyal**, I/c. Head of Department of Metallurgy, Dr S & S.S Ghandhy college of Engineering and Technology
- **Prof. S.F. Parmar** Lecturer Department of Metallurgy Engineering, L.E College Morbi

**Co-ordinator and Faculty Members from NITTTR Bhopal**

- **Dr. C.K Chugh**, Professor, Department of Mechanical Engineering
- **Dr. K. K. Jain,** Professor and Dean, Department of Mechanical Engineering