**TEACHING & EVALUATION SCHEME**

**DISCIPLINE: Metallurgical Engineering SEMESTER: V**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUBJECT CODE. | Subject | Teaching Scheme  (Hours/Week) | | | Evaluation Scheme | | | | | Total Marks |
| L | T | P | Theory | | | Practical | |
| End Exam | Internal Assessment | | End Exam | Term Work |
| **Theory** | Class Test | Assignment |
| BST -501  OR  HMT 601 | Environmental Studies  or  Entrepreneurship & Management | 5 | - | - | 70 | 20 | 10 | - | - | 100 |
| MTT-501 | Heat Transfer Fluid Flow & Furnace | 4 | - | - | 70 | 20 | 10 | - | - | 100 |
| MTT-502 | Heat Treatment of Metals & Alloys | 5 | - | - | 70 | 20 | 10 | - | - | 100 |
| MTT-503 | Steel Making | 5 | - | - | 70 | 20 | 10 | - | - | 100 |
| MTT-504 | Non – Ferrous Extractive Metallurgy | 4 | - | - | 70 | 20 | 10 | - | - | 100 |

**Practical**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MTP-501 | Heat Treatment Lab. | - | - | 7 | - | - | - | 100 | 25 | 125 |
| MTP-502 | Metallography Lab. | - | - | 7 | - | - | - | 100 | 25 | 125 |
|  | Library Study |  |  | 2 |  |  |  |  |  |  |
|  | **TOTAL** | **23** | **-** | **16** | **350** | **100** | **50** | **200** | **50** | **750** |

NOTE: Evaluation for I.A (Theory& Sessional Practical) to be made as per guide lines of SCTE & VT

|  |
| --- |
| **ENVIRONMENTAL STUDIES**  **(Common to all Branches of Engg.)**  **BST-501** |

Period/Week: 05 Total Marks: 100

Total Periods: 75 Theory End Exams: 70; CT (20) +IA (10)

**Rationale:**

Due to various aspects of human developments including the demand of different kinds of technological innovations, most people have been forgetting that, the Environment in which they are living is to be maintained under various living standards for the preservation of better health. The degradation of environment due to industrial growth is very much alarming due to environmental pollution beyond permissible limits in respect of air, water industrial waste, noise etc. Therefore, the subject of Environmental Studies to be learnt by every Engineering student in order to take care of the environmental aspect in each and every activity in the best possible manner.

**OBJECTIVES:**

After completion of study of environmental studies, the student will be able to:

1. Gather adequate knowledge of different pollutants, their sources and shall be aware of solid waste management systems and hazardous waste and their effects.
2. Develop awareness towards preservation of environment.

**Unit 1: The Multidisciplinary nature of environmental studies (04 periods)**

Definition, scope and importance, Need for public awareness.

**Unit 2: Natural Resources (12 periods)**

**Renewable and non renewable resources:**

1. Natural resources and associated problems.

* Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction mining, dams and their effects on forests and tribal people.
* Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam’s benefits and problems.
* Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.
* Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, .
* Energy Resources: Growing energy need, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
* Land Resources: Land as a resource, land degradation, man induces land slides, soil erosion, and desertification.

1. Role of individual in conservation of natural resources.
2. Equitable use of resources for sustainable life styles.

**Unit 3: Systems (12 periods)**

* Concept of an eco system.
* Structure and function of an eco system.
* Producers, consumers, decomposers.
* Energy flow in the eco systems.
* Ecological succession.
* Food chains, food webs and ecological pyramids.
* Introduction, types, characteristic features, structure and function of the following eco system:
* Forest ecosystem:
* Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries).

**Unit 4: Biodiversity and it’s Conservation (08 periods)**

* Introduction-Definition: genetics, species and ecosystem diversity.
* Biogeographically classification of India.
* Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and optin values.
* Biodiversity at global, national and local level.
* Threats to biodiversity: Habitats loss, poaching of wild life, man wildlife conflicts.

**Unit 5: Environmental Pollution. (18 periods)**

Definition Causes, effects and control measures of:

1. Air pollution.
2. Water pollution.
3. Soil pollution
4. Marine pollution
5. Noise pollution.
6. Thermal pollution
7. Nuclear hazards.

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Disaster management: Floods, earth quake, cyclone and landslides.

**Unit 6: Social issues and the Environment (12 periods)**

* Form unsustainable to sustainable development.
* Urban problems related to energy.
* Water conservation, rain water harvesting, water shed management.
* Resettlement and rehabilitation of people; its problems nd concern.
* Environmental ethics: issue and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.
* Air (prevention and control of pollution) Act.
* Water (prevention and control of pollution) Act.
* Public awareness.

**Unit 7: Human population and the environment (09 periods)**

* Population growth and variation among nations.
* Population explosion- family welfare program.
* Environment and human health.
* Human rights.
* Value education
* Role of information technology in environment and human health.

**Recommended Books:**

1. Textbook of Environmental studies, Erach Bharucha, #UGC
2. Fundamental concepts in Environmental Studies, D.D. Mishra, S.Chand & Co-Ltd,
3. Text book of Environmental Studies by K.Raghavan Nambiar, SCITECH Publication Pvt. Ltd.
4. Environmental Engineering by V.M.Domkundwar- Dhanpat Rai & Co.
5. Environmental Engineering & Safety by B.K.Mohapatra.

**ENTREPRENEURSHIP & MANAGEMENT**

**(Code :HMT-601)**

Period/Week: 05 Total Marks: 100

Total Periods: 75 Theory End Exams: 70; CT (20) +IA (10)

**(COMMON TO ALL BRANCHES OF ENGG EXCEPT CIVIL/ CSE/ IT)**

**OBJECTIVES:**

On completion of the course, students will be able to :

1. Understand the concept of different forms of organization including MSME and various managerial functions.
2. Understand Entrepreneurship and choose it as a career option after study.
3. Learn about the basic financial accounting and cost control.
4. Know different areas of management relating to stores and purchase, finance, production, sales and marketing and human resources in an organization.
5. Learn about various reasons of industrial sickness and its remedial measures.
6. Have a comprehensive idea on important legislations relating to employment in Factory.

**SYLLABUS**

1. **Concept of Organization & Enterprise Management: 12 periods**
   1. Meaning, features and components of Business
   2. Different forms of Business Organizations with features
   3. Meaning, definitions and importance of management
   4. Difference between Management & Administration
   5. Functions of management- Planning, Organizing, Staffing, Directing (including Motivation, Leadership & Communication), Coordinating and Controlling.
   6. Principles of Scientific Management.
2. **Entrepreneurship & Management of MSME: 12 periods**
   1. Meaning & Need of Entrepreneurship
   2. Qualities of an Entrepreneur
   3. Relevance of Entrepreneurship of Socio-economic gain

(Generating national wealth, creating wage & self employment, developing MSME enterprises, Optimizing human and national resources, building enterprising personalities and society

* 1. Micro, Small and Medium Enterprises. (investment limits of MSME)
  2. Project Report- PPR & DPR. (Preparation of a PPR)
  3. Incentives available to MSME as per the latest IPR
  4. Role of DIC, OSFC, OSIC, IDCO, SIDBI, IPICOL and Commercial Banks in the context of MSME.

1. **Financial Accounting & Cost Control: 12 periods**
   1. Double- entry System of Book –keeping and types of accounts
   2. Journal, Ledger, Cash Book (different types), Trial balance
   3. Components of Final Accounts- Trading A/c, Profit & Loss A/c and Balance Sheet
   4. Elements of Cost and Preparation of Cost Sheet
   5. Break-even Analysis
2. **Financial Management: 04 periods**
   1. Meaning & Importance
   2. Finance Functions
   3. Types of Capital- Fixed & Working Capital
   4. Components of Working Capital, Working Capital Cycle
3. **Stores & Purchase Management: 05 periods**
   1. Inventory Control : Importance & Techniques
   2. Purchase management-Principles & Procedures
   3. Important Store Records (Bin Card, Stores Ledger & GRN)
4. **Production Management: 04 periods**
   1. Production & Productivity
   2. Production , Planning & Control- (meaning & steps)
5. **Sales & Marketing Management: 08 periods**
   1. Sales & Marketing Management- Meaning & Importance
   2. Selling Methods
   3. Product Policy- (Branding, Packaging, Labeling)
   4. Product-mix, Pricing methods and Sales Promotion including its techniques.
   5. Advertising & its media
6. **Human Resource management: 06 periods**
   1. Need & Importance
   2. Recruitment & its sources
   3. Selection- Methods
   4. Training- Need, & Methods
   5. Need of Performance Appraisal
7. **Industrial Sickness: 04 periods**
   1. Meaning & Symptoms of Sickness
   2. Causes of Industrial Sickness
   3. Remedial measures of Sickness
8. **Industrial Legislation: 08 periods**
   1. Major Provisions of Factories Act relating to Health, Welfare, Safety, Accidents, Hours of Work, employment of Women
   2. Duties and Power of Factory Inspector
   3. Major Provisions of Employee’s Compensation Act.

**Books Recommended**

1. Industrial Engineering & Management : O.P.Khanna
2. Entrepreneurship for Engineers : B.Badhei
3. Principles & Practice of Management : L.M.Prasad
4. Industrial Engineering & Management: Banga & Sharma
5. Mercantile Law: N.D.Kapoor
6. Industrial Engineering & production Management: M.Mahajan
7. Industrial Policy Resolution ( latest)

**HEAT TRANSFER, FLUID FLOW & FURNACES (MTT-501)**

Exam: 3 Hrs.

Period / Week:4 End Exam: 70 Marks

Total Period:60 I.A: 20+10

Total: 100 Marks

**TOPIC WISE DISTRIBUTION OF PERIODS:**

**SL.NO. TOPICS PERIODS**

1. Fluid Flow 16
2. Heat Flow 16
3. Classification of Furnace. & Examples of some Metallurgical Furnaces 12
4. Principles of heat Generation in electric Furnaces 4
5. Heat Losses, Heat Balance & Furnace Efficiency 6
6. Waste heat Recovery System in Furnaces 6

**Total: 60**

**RATIONALE:**

Furnace is one of the most important group of metallurgical equipment used for making, shaping and treatment of meta1s and alloys. These equipments are used for heating/melting of these metals. Cooling of various parts of a furnace is essential for protection of the furnace. Study of different furnaces along with principles of heat transfer and fluid flow is an important subject.

**OBJECTIVES:**

On completion of the subject the students will have an idea about

1. Types of Fluid Flow.
2. The different parameters of flow and their measurement like pressure, flow rate by orifice, venturimeter and Pitot tube.
3. The loss of head during fluid flow through a system in a pipe and its determination.
4. Mode of heat transfer and calculation of heat flux in different mode of heat transfer.
5. A metllurgica1 furnace, its use and waste heat recovery system by studying such a furnace.

**COURSE CONTENTS (in terms of specific objectives):**

1. **FLUID FLOW**
   1. i) Discuss types of fluids (ideal and real).

ii) Discuss the type of flow (stream line & turbulent).

1.2 i) State and explain Bernoulli’s equation.

ii) Discuss the flow through orifices, Pitot tube and venturies.

* 1. Define and calculate loss of head (friction loss) in straight pipes, in bends and channel with sudden enlargement and sudden contraction.

**2.0 HEAT FLOW**

2.1 Discuss the elementary idea on different modes of heat transfer.

2.2 i) Define and derive the Fourier’s law.

ii) Explain & calculate the steady state heat conduction through flat walls.

2.3 i) Define Convection.

ii) Define and differentiate between natural and forced convection

iii) State the natural and forced heat transfer co-efficient (equation only, no derivation).

2.4 i) Define radiations

ii) State the Stefan Boltzmann’s Law

iii) Define emissivity of black bodies and grey bodies.

**3.0 FURNACES**

3.1 Classify the furnaces based on use, heat source and material movements.

3.2 Discuss the following metallurgical furnaces (a) soaking pits, (b) reheating furnace (c) heat treatment furnace (d) melting (e) smelting (f) refining furnaces

4.0 State the principles of heat generation in electric furnaces such as arc, resistance and induction (core less)

5.0 Discuss on heat losses, heat balance and furnace efficiency.

6.0 Explain the types of’ waste heat recovery system such as regenerators and recuperates.

**RECOMMENDED BOOKS:**

1. Elements of Fluid Mechanics by V.C.Sheshadri & U. Patankar.
2. Heat Transfer - Mir Publishers by Isa Chenkov, Oxipoka & Sukomel.
3. Principles of Extractive Metallurgy by A.Ghosh & H.S.Ray.
4. Metallurgical Furnaces: Mir Publishers by Krivandrim & Markov.

**HEAT TREATMENT OF METAL AND ALLOYS (MTT-502)**

Exam: 3 Hrs.

Period Week: 5 End Exam: 70 Marks

Total Period: 75 I.A: 20+10

Total : 100 Marks

**TOPIC WISE DISTRIBUTION OF PERIOD:**

**SI. No. Topics Periods**

1. Solid State Phase Transformation 18

2. Heat Treatment Process for Steel 15

3. Hardenability Factors, Hardenability 12

4. Surface Hardening Methods 15

5. Heat Treatment of Non-Ferrous Alloys 5

6. Alloy Steels and Heat Treatment of Alloy Steels 10

**Total: 75**

**RATIONALE:**

Physical properties of metals and alloys are dependent on their crystal structures. Heat treatment of metal and alloys explains different aspects of crystal structures of metals and alloys. It is, therefore, a very important subject for a metallurgical engineering.

**OBJECTIVES:**

Upon the completion of the course, students should have the knowledge about

1. Solid state phase transformation and diffusion.
2. Principles of heat treatment of steel.
3. Heat treatment process for steels.
4. Hardenability of steel
5. Different surface hardening methods.
6. Effect of Alloying elements on steels, different alloy steels and their heat treatment
7. Non ferrous alloys heat treatment.

**COURSE CONTENT (in terms of specific objectives):**

**1.0 Solid State Phase Transformation.**

1.1 Give an introduction to diffusion, state fick’s law.

1.2 Discuss the formation of austenite.

1.3 Explain the mechanism of formation’ of austenite

1.4 Discuss austenitic grain size.

1.5 Explain the methods of determination of austenitic grain size.

1.6 State the importance of grain size

1.7 Explain the method of measurement of grain size.

1.8 Discuss the methods of control austenitic grain size.

1.9 Discuss decomposition of austenite and pearlitic transformation.

1.10 Explain the process of construction of T-T-T diagram and CCT diagram.

1.11 Discuss the TTT Diagram for hypo eutectoid, eutectoid and hyper eutectoid steel.

1.12 Explain bainitic transformation.

1.13 Explain martensitic transformation.

**2.0 Heat Treatment Process for Steels.**

2.1 Discuss annealing.

2.2 Explain stress relieving annealing.

2.3 Explain different types of annealing.

2.4 Explain the process of normalizing.

2.5 Discuss the process of hardening.

2.6 Describe the factors affecting hardening process.

2.7 Explain different methods of hardening.

2.8 Discuss quenching media and different types of quenchants.

2.9 Explain the tempering process for steel.

2.10 Discuss thermo-mechanical treatment of steel.

2.11 Discuss martempering, austempering and subzero treatment.

**3.0 Hardenability**

3.1 Define hardenability

3.2 Discuss the method of determination of hardenability (Gross Man’s critical diameter method & Jominey end quench method).

3.3 Discuss the method of estimation of hardenability from chemical composition and fracture test

3.4 Discuss the factors affecting hardenability: effect of austenitic grain size, carbon content, and alloying elements.

**4.0 Surface Hardening Methods**

4.1 Discuss high frequency induction hardening -flame hardening, electron beam hardening, laser hardening.

4.2 Discuss the methods of case depth measurement of steel.

4.3 Explain different carburizing-processes of steel: pack carburizing, liquid carburizing, gas carburizing and vacuum carburizing.

4.4 Discuss the post carburizing heat treatment.

4.5 Explain process of nitriding of steel

4.6 Explain the process of cyaniding, carbo-nitriding of steel

4.7 Explain the plasma nitriding.

4.8 Explain salt bath nitro carburizing.

4.9 Explain boronising, chromizing & Toyato diffusion process.

**5.0 Discuss the Heat Treatment of Non Ferrous Alloys.**

5.1 Discuss Age Hardening of Al-CU alloys.

**6.0 Alloy Steels**

6.1 Discuss different alloy steels- low alloy and high alloy steels.

6.2 Discuss the effect of alloying elements.

6.3 Discuss die steel, high speed steel, high strength, low alloy steels, stainless steels.

6.4 Discus the heat treatment of tool steel and stainless steel.

**RECOMMENDED BOOKS:**

1. Engineering physical Metallurgy by Lakhtin.
2. Physical Metallurgy Principles by Reed-Hill.
3. Introduction to Physical Metallurgy by S.H.Avner.
4. Material Science Engineering by Raghavan.
5. Physical Metallurgy for Engineers by Clark & Varney.
6. Heat Treatment by Rajan &Sharma
7. Physical Metallurgy by Raghavan.
8. Practical Physical Metallurgy by Surajbhan
9. Practical Physical Metallurgy by Rawlings
10. Practical Heat Treatment by Lakhtin.

**STEEL MAKING (MTT-503)**

Exam: 3 Hrs.

Period /Week: 5 End Exam: 70 Marks

Total Period: 75 I.A: 20 + 10

Total: 100 Marks

**TOPIC WISE DISTRIBUTION OF PERIOD**

**SL. NO. TOPICS PERIODS**

1. Commercial steel making process & Principle of steel Making 7
2. Raw materials for steel making 2
3. Open hearth steel making 10
4. LD process 15
5. Electric and induction furnace process 5
6. Recent steel making process 7
7. De-oxidation practice 5
8. Pit side practice 5
9. Continuous casting of steel 7
10. Secondary steel making process 10

**Total: 75**

**RATIONALE:**

Iron and its alloys are by far the most important and maximum used engineering materials. Therefore, ferrous metallurgy is one of the most important subjects under metallurgical engineering studies.

**OBJECTIVES:**

On completion of the Study the students will able to

1. Know about different steel making processes.
2. Explain the different reactions and principles involved in steel making.
3. Describe operation, merits & demerits of open hearth process. L.D process, electric furnace process & induction furnace process of steel making.
4. Acquaint them with development of recent steel making processes. Deoxidation, practice, pit side practice, secondary steel making, continuous casting of steel.
5. Know the different pollutions caused by iron and steel industries and measures of controlling the pollution.

**COURSE CONTENTS (in terms of specific objectives):**

1.0 Commercial Steel Making Process

1.1 Classify major commercial steel making processes.

1.2 Explain these processes with suitable sketches.

1.3 Mention different reactions involved in steel making.

1.4 Differentiate between acid process & basic process of steel making.

1.5 Explain the principles and conditions required in removal of ‘P’, ‘S’, Si’, ‘Mn’ and ‘C’ in steel making.

**2.0 Raw Materials for Steel Making**

2.1 List the different raw materials required for steel making

2.2 State the important raw materials available in India

**3.0 Open Hearth Steel Making**

3.1 Mention the general principle of open hearth steel making.

3.2 Describe the operational chemistry and steps involved in basic open hearth process.

**4.0 Steel Making by LD Converter**

4.1 Give different raw materials of LD process

4.2 Explain the construction and operation of LD converter

4.3 Describe the refining reaction in LD converter with reference to decarburization and dephosphorisation.

4.4 Mention the quality of steel and composition of slag in LD process

4.5 Give the advantages and limitations of LD process.

4.6 Describe different developments of LD process

a. Bottom, top and combined blowing

b. Multi nozzle converter.

4.7 Explain OLP process

**5.0 Electric and Induction Furnace Process**

5.1 Explain the principle, types of slags prepared by electric arc furnace

5.2 Explain the steps of electric arc furnace heating to produce steel

5.3 Mention advantages of electric arc furnace process.

5.4 Explain the steel making induction furnace.

5.5 Mention advantages and limitations of induction furnace process

**6.0 Brief Study of Other Recent Processes of Steel Making.**

6.1 Briefly describe the principle of operation, merits arid demerits of the recent steel making processes such as

a. Ajax Process

b. OBM Process

c. Spray Steel Making Process

**7.0 De-Oxidation Practice**

7.1 Explain different De-Oxidisers and their use.

7.2 Differentiate between killed steel semi killed steel and rimming steel

**8.0 Pit Side Practice**

8.1 Describe different teeming methods such as:

a. Direct pouring

b. Tundish teeming and

c. Bottom teeming

8.2 Describe different ingot defects, their causes and remedies

**9.0 Continuous Casting of Steel**

9.1 Explain the principle and operation of continuous casting

9.2 Describe different types of casters.

9.3 Describe about the moulds and mould maintenance in continuous casting.

9.4 Discuss advantages of continuous casting

**10.0 Secondary Steel Making Processes**

10.1 Explain the principle operation and advantages of secondary steel making processes such as

a. VAD Process

b. VOD Process

c. AOD Process

10.2 Describe the stream degassing process.

**RECOMMENDED BOOKS:**

1. Steel Making by R.H.Tupkary

2. Steel Making by A.K.biswas

3. Manufacture of iron & Steel VoL II by Basforth.

4. Elementary Metallurgy (Steel) by Frier.

5. Metal Process engineering by P.Polukrint

6. Steel, by Honeycomb.

7. Steel by Fedrick & Deca

8. Chemistry of Steel by BodsWorth

9. Steel Making by V. A. Kudrin

**NON-FERROUS EXTRACTIVE METALLURGY (MTT-504)**

Exam: 3 Hrs.

Period Week: 4 End Exam: 70 Marks

Total Period: 60 I.A: 20 + 10

Total: 100 Marks

**TOPIC WISE DISTRIBUTION OF PERIODS**

**SL.NO. TOPICS PERIODS**

1. Non-ferrous ore Reserves and Non-ferrous Metal Industries in India. 03

2. Extraction of Metals from Oxide Ores 15

3. Extraction of Metals from Sulphide Ores 18

4. Extraction of Metals from Halides 10

5. Extraction of Precious Metals 6

6. Production of Secondary Metals 8

**Total: 60**

**RATIONALE:**

Entire range of metals and alloys are grouped under two headings “ferrous” and on-ferrous”. Non-ferrous group consist of a very large number of diverse and useful group of materials and alloys, with their distinct metallurgies This forms an important subject in the study of metallurgical engineering

**OBJECTIVES:**

Upon the completion of the course the students should have the knowledge about.

1. Non ferrous Ore Resources and Non ferrous Industries in India.

2. Methods of Extraction of Metals from Sulphide Ores : Cu, Zn. Pb, Ni.

3. Process of Extraction of Metals from Oxide Ores : Al, Sn,

4. Process of Extraction of Metals from Halides: U, Ti

5. Process of Extraction of Precious Metals: Au

6. Secondary Metal Extraction: Cu, Al, Zn, Pb

7. Environmental Pollution, their causes Method of Prevention and control

**COURSE CONTENTS (in terms of specific objectives):**

**1.0 Discuss the non-ferrous ore reserves in India & non ferrous industries in India.**

**2.0 Extraction of Metals from Oxide ores.**

2.1 Extraction of aluminum

2.1.1 Describe the Bayer’s process of alumina production.

2.1.2 Explain the fused salt electrolysis of alumina by Hall Heroult process.

2.1.3 Discuss anode effect

2.1.4 Explain the method of refining of aluminum

2.1.5 State the uses of aluminum.

2.2 Extraction of Tin

2.2.1 Explain the process of tin ore concentration.

2.2.2 Explain the process of concentrate smelting for tin extraction.

2.2.3 Describe the process of refining of tin.

2.2.4 State the uses of tin.

**3.0 Extraction of Metals from Sulphide Ores.**

3.1 Pyrometallurgical Extraction of Copper.

3.1.1 Describe the process of roasting of copper ore.

3.1.2 Describe the process of matte smelting of copper ore.

3.1.3 Explain the process of converting of copper matte.

3.1.4 Explain the refining of copper.

3.1.5 State the uses of copper.

3.2 Pyrometallurgical Extraction of Lead.

3.2.1 Explain roasting and sintering of lead ore.

3.2.2 Explain the process of extraction of lead by blast furnace smelter.

3.2.3 Describe in detail the process of refining of base bullion.

3.2.4 State the uses of lead.

3.3 Pyrometallurgical and HydrometalliIrgia1 Method of Extraction of j Zinc.

3.3.1 Describe the roasting of zinc ore concentrate.

3.3.2 Explain how zinc is extracted by vertical retot process.

3.3.3 Explain the refining of zinc.

3.3.4 Explain the process of leaching and preparation zinc base solution

3.3.5 Describe the electrolysis of zinc solution

3.3.6 State the uses of zinc

3.4 Pyrometallurgical Method of Nickel Extraction.

3.4.1 Explain the roasting of nickel ore.

3.4.2 Explain the method of smelting of nickel concentrate.

3.4.3 Explain the method of refining of nickel

3.4.4 State the uses of nickel.

**4.0 Extraction of Metals from Halides.**

4.1 Extraction of Titanium

4.1.1 Describe extraction of titanium

4.1.2 Explain the type of treatment given to titanium ore.

4.1.3 Explain the process of chlorination and mag. reduction for titanium extraction.

4.1.4 Explain the process of refining of titanium (distillation)

4.1.5 State the uses of titanium

**5.0 Extraction of Precious Metals**

5.1 Explain extraction of gold.

5.2 Explain the process of cyanidation for gold extraction

5.3 State the uses of gold.

**6.0 Production of Secondary Metals.**

Explain the process of production of copper, lead, zinc &. aluminum metals from scraps.

**RECOMMENDED BOOKS:**

1. Non Ferrous Production Metallurgy by Bray J.L.

2. Non-Ferrous Metallurgy of Metal by Dannis W.H.

3. Extraction or Non- Ferrous Metal by Roy, Sridhar & Abraham.

4. Rare Metal Extraction by W. D. Jamrack.

**Heat Treatment Laboratory (MTP-501)**

Exam: 4 Hrs.

Period /Week: 7 End Exam: 100 Marks

Total Period: 105 Sessional: 25 Marks

Total: 125 Marks

*(Students are required to perform atleast 8 experiments and study the resultant structure)*

1. Common practices of heat treatment for plain carbon steel

a. Annealing

b. Normalizing

c. Hardening

d. Tempering study of resultant microstructures.

2. Hardenability measurement of steel by Jominy End Quench method.

3. Heat treatment of high speed steel and stainless steel.

4. Spheroidizing treatment of high carbon steel

5. Case hardening treatment and study of case hardened structures.

6. Photomicrography of atleast two structures of’ Heat treated samples.

7. Arc welding of steel plates and study of microstructure of weldment before heat treatment and after heat treatment.

8. Micro hardness measurement of various heat treated steel samples.

8. Image Analysis of various heat treated steel samples.

**Books:**

1. Principles of Metallographic practice by Khel
2. Heat Treatment by Rajan &Sharma.
3. Physical Metallurgy by Raghavan.
4. Physical Metallurgy: Avner

**LIST OF EQUIPMENTS (for batch of 10-15 students):**

1. **Sample cutter -----------------01**
2. **Power hacksaw --------------01**
3. **Belt polisher ------------------ 01**
4. **Wheel grinder ----------------01**
5. **Polishing machine ( two disc type)------------ 01**
6. **Metallurgical Microscope-----------------------01**

**METALLOGRAPHY LAB (MTP-502)**

Exam: 4 Hrs.

Period /Week: 7 End Exam: 100 Marks

Total Period: 105 Sessional: 25 Marks

Total: 125 Marks

*(Students are required to perform atleast eight experiments out of the followings)*

1. Study of metallurgical microscope.

2. Preparation of metallic specimen for metallographic study by grinding, polishing and etching

3. Study of specimen mounting press and preparation of mounted specimen.

4. Study of microstructure of different steels

5. Study of microstructure of different cast iron

6. Study of microstructure of non ferrous metals and alloys e. g. copper, aluminum, brass and bearing metals.

7. Grain size measurement.

8. Image analysis of various ferrous and non ferrous alloys.

9. Microhardness testing of various ferrous and non ferrous alloys.

10. Photomicrography and image storing of various ferrous and non ferrous alloy using digital camera, scanner and computer using high magnification inverted microscope.

RECOMMENDED BOOKS

1. Principles of Metallographic practice by Khel

2. Physical metallurgy: Avner

**LIST OF EQUIPMENTS(Common to both H/T Lab and Metallography lab))**

1. Muffle F/C 800 -----------------01no

2. Muffle F/C 1000 -----------------01no

3. Muffle F/C 1200 -----------------01no

3. Vaccum F/C 800 -----------------01no

4. Gradiant Muffle F/C 1200 -----------------01no

5. Salt Bath F/C 1000 -----------------01no

6. Oil quenching Bath -----------------01no

7. Sample Cutter -----------------02nos

8. Metallurgical Microscope (student)up 400Xwith digital recording facility -----------------

01nofor each 10 students

9. Belt Polisher ---------------------------------02 nos

10. Disc Polisher dual disc----------01nofor each 10 students

11. Inverted Microscope with Image analysis facility. Up to 1000X,

12. Micro hardness tester 1000gm for measuring case thickness and grain size. Supported by software as per ASTM standards.

13. Specimen Mounting Press (hot)------------------------01no

14. Radiation Pyrometer.------------------------------01

15. Pt - Pt-Ro thermocouple with calibration curve. ---02 no.

16. Tools for sample handling during heat treatment.

17. Electrolytic etching machine ------------------ 01

18. Hot air drier-----------------------------------------01