

TEACHING & EVALUATION SCHEME

DISCIPLINE: Metallurgical Engineering

SEMESTER: VI

Subject Code	Subject	Teaching Scheme (Hours/Week)			Evaluation Scheme						Total Marks
		L	T	P	Theory			Practical			
					End Exam	Internal Assessment		End Exam	Sessional		
						Class Test	Assignment				
BST -501 OR HMT 601	Environmental Studies or Entrepreneurship & Management	5	-	-	70	20	10	-	-	100	
MTT-601	Foundry Engineering	5	-	-	70	20	10	-	-	100	
MTT-602	Mechanical Metallurgy	4	1	-	70	20	10	-	-	100	
MTT-603	Metal Joining	4	-	-	70	20	10	-	-	100	
MTT-604	Electives: Any One (I) Corrosion and its Prevention (II) Electro Metallurgy (III) Selection of Materials	4			70	20	10	-	-	100	

Practical

MTP-601	Foundry Engineering	-	-	6	-	-	-	50	50	100
MTP-602	Project Work & Seminar	-	-	8	-	-	-	50	100	150
	Library Study			2						
	TOTAL	22	01	16	350	100	50	100	150	750

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:

- a) 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.
- b) Role of individual in conservation of natural resources.
- c) 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:

- a) Air pollution.
- b) Water pollution.
- c) Soil pollution
- d) Marine pollution
- e) Noise pollution.
- f) Thermal pollution
- g) 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**
 - 1.1. Meaning, features and components of Business
 - 1.2. Different forms of Business Organizations with features
 - 1.3. Meaning, definitions and importance of management
 - 1.4. Difference between Management & Administration
 - 1.5. Functions of management- Planning, Organizing, Staffing, Directing (including Motivation, Leadership & Communication), Coordinating and Controlling.
 - 1.6. Principles of Scientific Management.
- 2. Entrepreneurship & Management of MSME: 12 periods**
 - 2.1. Meaning & Need of Entrepreneurship
 - 2.2. Qualities of an Entrepreneur
 - 2.3. 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
 - 2.4. Micro, Small and Medium Enterprises. (investment limits of MSME)
 - 2.5. Project Report- PPR & DPR. (Preparation of a PPR)
 - 2.6. Incentives available to MSME as per the latest IPR
 - 2.7. Role of DIC, OSFC, OSIC, IDCO, SIDBI, IPICOL and Commercial Banks in the context of MSME.

- 3. Financial Accounting & Cost Control: 12 periods**
- 3.1. Double- entry System of Book –keeping and types of accounts
 - 3.2. Journal, Ledger, Cash Book (different types), Trial balance
 - 3.3. Components of Final Accounts- Trading A/c, Profit & Loss A/c and Balance Sheet
 - 3.4. Elements of Cost and Preparation of Cost Sheet
 - 3.5. Break-even Analysis
- 4. Financial Management: 04 periods**
- 4.1. Meaning & Importance
 - 4.2. Finance Functions
 - 4.3. Types of Capital- Fixed & Working Capital
 - 4.4. Components of Working Capital, Working Capital Cycle
- 5. Stores & Purchase Management: 05 periods**
- 5.1. Inventory Control : Importance & Techniques
 - 5.2. Purchase management-Principles & Procedures
 - 5.3. Important Store Records (Bin Card, Stores Ledger & GRN)
- 6. Production Management: 04 periods**
- 6.1. Production & Productivity
 - 6.2. Production , Planning & Control- (meaning & steps)
- 7. Sales & Marketing Management: 08 periods**
- 7.1. Sales & Marketing Management- Meaning & Importance
 - 7.2. Selling Methods
 - 7.3. Product Policy- (Branding, Packaging, Labeling)
 - 7.4. Product-mix, Pricing methods and Sales Promotion including its techniques.
 - 7.5. Advertising & its media
- 8. Human Resource management: 06 periods**
- 8.1. Need & Importance
 - 8.2. Recruitment & its sources
 - 8.3. Selection- Methods
 - 8.4. Training- Need, & Methods
 - 8.5. Need of Performance Appraisal
- 9. Industrial Sickness: 04 periods**
- 9.1. Meaning & Symptoms of Sickness

- 9.2. Causes of Industrial Sickness
- 9.3. Remedial measures of Sickness

10. Industrial Legislation:

08 periods

- 10.1. Major Provisions of Factories Act relating to Health, Welfare, Safety, Accidents, Hours of Work, employment of Women
- 10.2. Duties and Power of Factory Inspector
- 10.3. 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)

FOUNDRY ENGINEERING

MTT-601
Period /Week: 5
Total Period: 75

Exam: 3 Hrs.
End Exam: 70 Marks
I.A : 20 +10 Marks

Total : 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL. No.	Topic	Periods
1.	Introduction of Foundry	03
2.	Pattern Making	04
3.	Moulding Materials	11
4.	Binders	04
5.	Core and Core Making	04
6.	Mould and Mould Making	09
7.	Special Moulding Process	04
8.	Melting Practices	09
9.	Methods of Pouring & Feeding	10
10.	Cleaning of Casting	04
11.	Special Casing Techniques	07
12.	Casting Defect	06
		<hr/>
		Total : 75

RATIONALE:

Casting is by far the most important manufacturing process converting metals and alloys into useable shapes. It is therefore, a very important subject for a metallurgical engineering.

OBJECTIVES:

Main objective to have the thorough knowledge regarding preparation of mold core preparation, melting practice in different furnaces, to obtain sound, defect free & qualitative casting, different types of castings and pollution control.

COURSE CONTENTS (in terms of specific objectives):

- 1.0 Introduction to Foundry as a Manufacturing Process
 - 1.1 Define casting as a process of manufacturing.
 - 1.2 State principles of casting
 - 1.3 State the basic steps involved in making a casting.
 - 1.4 Mention advantages & disadvantages of metal casting.

2.0 Pattern and Pattern Making

- 2.1 Define pattern
- 2.2 Differentiate between pattern and casting.,
- 2.3 State the reason for selection of pattern materials.
- 2.4 Describe different pattern materials.
- 2.5 Explain different types of pattern giving examples.
- 2.6 Explain different types of pattern allowances.
- 2.7 State the basis and me its of pattern colours given examples.
- 2.8 Mention the utilities of storing and preservation of patterns.

3.0 Moulding Materials.

- 3.1 State different sources of moulding sand.
- 3.2 State different types of moulding sand
- 3.3 Give different ingredients of moulding sand.
- 3.4 State the classification of moulding sand in two different ways namely:
 - 3.4.1 Classification based upon grain size
 - 3.4.2 Classification base upon grain shape.
- 3.5 State the properties desired for moulding sand.
- 3.6 Differentiate between facing sand and backing sand.
- 3.7 Differentiate between sand preparation and sand conditioning.
- 3.8 State the functions of sand preparation/conditioning
- 3.9 State the reasons of sand reclamation.
- 3.10 Explain different sand reclamation techniques.
- 3.11 Testing of moulding sand.
- 3.12 Describe the procedure f moisture content test of molding sand.
- 3.13 Derive an expression for AFS grain fineness number of moulding sand
- 3.14 Describe the procedure for clay content test of moulding sand.
- 3.15 Describe the procedure for mould hardness test.
- 3.16 Derive an expression for permeability number of moulding sand.
- 3.17 Describe the procedure for compression strength of moulding sand.

4.0 Binders and Additives.

- 4.1 State the functions of binder
- 4.2 Explain different types of clay binders

- 4.3 State the function of additives
- 4.4 State the different types of additives.
- 4.5 Differentiate between facing materials and coarse materials.
- 4.6 Describe the utilities of different cushion materials giving examples.
- 4.7 Explain the functions of special additives giving examples.
- 5.0 Core and Core Making
 - 5.1 Define core
 - 5.2 State different functions of core
 - 5.3 State essential characteristics of core and explain different types of core with sketches.
 - 5.4 Describe the steps involved for core making.
 - 5.5 Explain various methods of core baking
 - 5.6 Explain different core baking machines.
- 6.0 Moulds and Mould Making
 - 6.1 Define mould
 - 6.2 State different characteristics of mould
 - 6.3 Explain with sketches different types of mould.
 - 6.4 Describe different moulding methods such as:
 - a. Bench Moulding
 - b. Floor Moulding
 - c. Pit Moulding
 - d. Machine Moulding.
- 7.0 Special moulding process
 - 7.1 Describe the different methods of ramming:
 - 7.1.1 Hard ramming
 - 7.1.2 Squeezing
 - 7.1.3 Jolting
 - 7.1.4 Sand slinging
 - 7.2 Name special moulding processes
 - 7.3 Explain the moulding method in permanent mould
 - 7.4 Describe the method of shell moulding giving sketch
 - 7.5 Give the essential feature of investment mould.

7.6 Describe the carbon dioxide moulding process.

8.0 Melting Practices

8.1 State different types of furnaces with sketches that are used in foundry for melting of ferrous and non-ferrous metals.

8.2 Describe Induction furnace of coreless high frequency type.

8.3 Explain the working principle of induction furnace.

8.4 Explain the construction and operation of cupola used for cast iron melting.

8.5 Estimate the different quantities of raw material to get a specific grade of C.I. with the help of simple charge calculation.

8.6 State the advantages and limitation of cupola.

8.7 Mention modern development of cupola. Explain different electric arc furnaces namely

a. Direct Arc type

b. Indirect Arc type

8.8 Highlight recent trends in melting techniques.

9.0 Methods of Pouring and Feeding

9.1 Explain gating system.

9.2 State elements of gating system with sketch.

9.3 State function of a riser.

9.4 Describe different types of riser with sketches.

9.5 Explain the importance of size and shape of riser in metal casting.

9.6 Justify the location of riser in the gating system.

9.7 Define directional solidification.

9.8 Describe progressive and directional solidification and use of chills.

9.9 State the factors which increase the efficiency of riser such as:

a. Use of insulating material

b. Use of exothermic materials

c. Use of chills

d. Use of padding

e. Use of chaplets

f. Use of moulding materials of different chill capacities.

g. Use of topping up

- h. Use of electric arc feeding
 - i. Riser head design
- 9.10 State Chvorinov's rule.
- 9.11 Mention the effects of pouring temp. on the quality of casting.
- 10.0 Cleaning of Casting
 - 10.1 Explain shake out.
 - 10.2 Explain fettling.
 - 10.3 Classify fettling operation in two stages namely
 - a. Removal of cores
 - b. Cleaning of casting surfaces.
 - 10.4 Compare between sand blasting and shot blasting
 - 10.5 Describe the process of chemical cleaning
 - 10.6 Explain different methods or removal of gates and risers etc. such as:
 - a. Chipping by hammers
 - b. Flogging
 - c. Sheering
 - d. Sawing
 - e. Abrasive wheel slitting
 - f. Machining
 - g. Flame cutting
 - h. Plasma cutting
 - i. Grinding
 - j. Gouging
 - k. Trimming and sizing.
- 11.0 Special Casting Techniques
 - 11.1 Explain the following die casting techniques and processes
 - a. Gravity die casting
 - b. Pressure die casting
 - c. Vacuum die casting
 - d. Cold chamber process
 - e. Hot chamber process
 - 11.2 Explain the following centrifugal casting techniques

- a. True centrifugal casting having
 - b. The De Lavaud process
 - c. Moore casting system
 - d. Semi centrifugal casting
 - e. Centrifuging
- 11.3 Mention the advantages of die casting
- 11.4 Mention the advantages of centrifugal casting
- 11.5 Explain investment casting process
- 12.0 Casting Defects
- 12.1 Mention different types of casting defects with example and their remedies
- a. Defects caused by patterns and moulding box.
 - b. Defects caused by improper moulding and core making.
 - c. Defects caused by improper mixing and distribution.
 - d. Defects caused by improper moulding core making and gating
 - e. Defects due to improper mold drying and core baking
 - f. Defects occurring while closing and Pouring in the moulds
 - g. Defects caused by molten metal
 - h. Defects occurring during fettling.
 - i. Defects due to faulty heat treatment
 - j. Solidification Shrinkage of cast metal.
 - k. Warpage

RECOMMENDED BOOKS:

1. Foundry Technology by Lal
2. Foundry by Goel
3. Foundry Practice by Salman and Simons.
4. Principle at Metal casting by Heine and Rosenthal.
5. Foundry Technology by Raghu Vansi

MECHANICAL METALLURGY

MTT-602
Period /Week: 4
Total Period: 60

Exam: 3 Hrs.
End Exam: 70 Marks
I.A: 20 + 10

Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

<u>SL.NO.</u>	<u>TOPIC</u>	<u>PERIODS</u>
1.	Dislocation	06
2.	Deformation of metals	10
3.	Strengthening mechanism	10
4.	Fundamentals of metal working	06
5.	Recovery Recrystallization & grain growth	04
6.	Rolling	06
7.	Forging	05
8.	Extrusion	05
9.	Wire drawing	04
10.	Elementary concept of deep drawing	
	Sheet metal working	04
		<hr/> Total: 60

RATIONALE:

Major bulk of metals and alloys are converted to useable shapes by a group of manufacturing processes utilizing plastic deformation. These processes are important for a metallurgical engineer and are the subject matter of this topic.

OBJECTIVES:

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

1. Types of defects in crystal and their relation with plastic deformation.
2. Elastic and plastic behavior of metals with criteria for yielding.
3. Plastic deformation of single crystal and polycrystalline aggregate.
4. Strengthening mechanism
5. Working of metals - hot working and cold working.
6. Processes like rolling, forging, extrusion, drawing, sheet metal forming etc.

COURSE CONTENTS (In terms of specific objectives):

- 1.0 Basic behavior of metals: Types of Dislocation, Slip & Twinning
- 2.0 Deformation of metals:
 - 2.1 Explain the elastic & plastic behavior of metals.

- 2.2 Explain yielding criteria.
- 2.3 Derive critically resolved shear stress.
- 2.4 Explain deformation of polycrystalline aggregates.
- 3.0 Strengthening mechanism:
 - 3.1 Explain strengthening mechanism
 - 3.2 Describe the role of grain boundary in strengthening
 - 3.3 Define Hall Petch equation
 - 3.4 Describe yield point phenomenon.
 - 3.5 Explain strain-aging
 - 3.6 Explain solid solution strengthening from fine particles
 - 3.7 Describe fiber strengthening
 - 3.8 Describe martensitic strengthening
 - 3.9 Explain strain hardening
 - 3.10 Describe Bauschinger's effect.
- 4.0 Fundamentals of Metal working:
 - 4.1 Classify different metal working process.
 - 4.2 Explain hot working and cold working of metals and alloys
 - 4.3 State the advantages and disadvantages of hot and cold working
- 5.0 Recovery, recrystallization and grain growth
 - 5.1 Explain the following phenomena,
 - (a) Recovery
 - (b) Recrystallization
 - (c) Grain growth
- 6.0 Rolling:
 - 6.1 Explain principles of rolling
 - 6.2 Compare between hot rolling and cold rolling.
 - 6.3 Explain the types of roll pass-open pass and box pass.
 - 6.4 State different types of rolling defects and their control
- 7.0 Forging:
 - 7.1 Explain types of forging process
 - 7.2 Describe the properties of forged products
 - 7.3 Explain the defects of forged products and their control
- 8.0 Extrusion:
 - 8.1 Explain the elementary principle of extrusion
 - 8.2 Classify the defects in extruded product
 - 8.3 Explain the manufacturing of seamless pipes
- 9.0 Wire drawing:
 - 9.1 Explain the elementary principle of wire drawing
 - 9.2 Classify the defects of wire drawing

10.0 Forming methods

10.1 Describe the elementary concept of deep drawing

10.2 Explain different sheet metal forming - bending shearing and blanking

RECOMMENDED BOOKS:

1. Mechanical metallurgy by Dieter
2. Introduction to physical metallurgy by Avner.
3. Physical metallurgy principles by Reed Hill.
4. Mechanical Treatment of metals by R.N. Parkins.
5. Mechanical Testing of Materials: C.Mohapatra,JJTP,Bhubaneswar

- 4.0 Thermit Welding
 - 4.1 Discuss the principle, procedure, advantages and disadvantages of Thermit welding.
- 5.0 Resistance Welding
 - 5.1 Explain the principle and various types of resistance welding.
- 6.0 Welding of Steel, C.I. and Cu Alloys.
 - 6.1 Mention the precaution required for welding of steel.
 - 6.2 Explain the joint design and techniques required for C.I. welding.
 - 6.3 Describe the welding of copper and its alloys
- 7.0 Metallurgy of Welding.
 - 7.1 Explain the temperature distribution in welding of steel.
 - 7.2 Discuss the structural changes in weld metal and parent metal after welding.
 - 7.3 Define weldability.
 - 7.4 Mention different welding defects.
 - 7.5 Discuss various methods for testing welding joints.
- 8.0 Brazing and Soldering.
 - 8.1 Define brazing and explain its principle and procedure.
 - 8.2 Discuss various brazing methods of common ferrous and non ferrous metals.
 - 8.3 Define soldering and explain various types of solders.
 - 8.4 Describe the basic steps of soldering of common metals.

RECOMMENDED BOOKS:

1. Introduction to Powder Metallurgy by A.K.Sinha
2. Powder Metallurgy by R.L.Sande & C.R.Sha Published by Geore Newton Ltd. London.
3. Applied Metallurgy for Engineers by Curton.
4. Manufacturing Process by Badman.
5. The Metallurgy of Welding, brazing and Soldering by J.Lankaster.
6. Welding Technology by O. P. Khanna.
7. Welding Technology by Richard Little.

CORROSION AND ITS PREVENTION

MTT-604(I)
Period /Week: 4
Total Period: 60

Exam: 3 Hrs.
End Exam: 70 Marks
I.A: 20 +10

Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

<u>SL.NO.</u>	<u>TOPIC</u>	<u>PERIODS</u>
1.	Introduction to Corrosion	10
2.	Corrosion principles	08
3.	Types of electrochemical cells	06
4.	Electrodes potential	06
5.	Different forms of corrosions	15
6.	Corrosions preventions	15

RATIONALE:

Major cause of failure and/or deterioration with time of any metallic structure is corrosion. It is, therefore, of utmost importance to understand the causes of metallic corrosion and how to prevent such corrosions, which is the contents of this topic.

OBJECTIVES:

Failure of materials due to corrosion plays an important role in current technological scenario. After studying this subject students will be able to know about corrosion and its principles. They will have requisite knowledge for corrosion prevention and can identify and analysis the different types of corrosion.

COURSE CONTENTS (in terms of specific objectives):

1.0 Corrosion:

- 1.1 Define corrosion
- 1.2 Explain cost of corrosion, direct and indirect losses
- 1.3 State the importance of corrosion studies
- 1.4 Classify different types of corrosion
- 1.5 Differentiate between electrochemical corrosion and chemical corrosion.
- 1.6 State the corrosion rate

2.0 Corrosion principles:

- 2.1 Explain the electrochemical principle of corrosion (without kinetics)
- 2.2 State the Faraday's law and its causes and its deviation

3.0 Types of electrochemical cells —

3.1 Discuss in details galvanic cell, concentration cell and electrolytic cell

4.0 Electrode potential:

4.1 State its significance without experimental measurement.

4.2 Discuss in details electromotive force and galvanic series and their application with reference to corrosion and protection.

5.0 Different forms of corrosion:

5.1 Explain in details about factors affecting mechanism and prevention of following-corrosion:

i. Atmospheric corrosion

ii. Intergranular corrosion

iii. Pitting corrosion

iv. Corrosion fatigue

v. Galvanic corrosion

vi. Stress corrosion/cracking

vii. Cavitation corrosion

viii. Fretting corrosion

ix. High temperature oxidation corrosion

x. Stray current corrosion

6.0 Corrosion Prevention

6.1 Study the physical, mechanical and chemical characteristic of protective coating.

6.2 Explain corrosion prevention by inhibition and passivation by control of environment (without kinetics).

6.3 Discuss the cathodic and anodic protection

RECOMMENDED BOOKS:

1. Introduction to electrometallurgy and corrosion by Saran & Narayan
2. Corrosion Engineering by M.G. Fontana and Green.
3. Hand book of corrosion by Uhlig

ELECTRO METALLURGY

MTT-604(II)
Period/Week : 4
Total Period : 60

Exam : 3 Hrs.
End. Exam: 70 marks
I.A. : 20+10 marks
Total Maks:100

TOPIC WISE DISTRIBUTION OF PERIODS

<u>SL. NO.</u>	<u>Topic</u>	<u>Periods</u>
1.	Electro metallurgy	08
2.	Electro Chemical cells	05
3.	Electrolytic cell, electrode potential And electrolysis	08
4.	Polarization and passivation	05
5.	Anodic Electro metallurgical process	06
6.	Electro chemical extraction and refining of metal	10
7.	Electro plating of metal	06
	Elementary idea on electro polishing, Electrolytic etching, electrolytic machining	06
8.	Elementary idea on corrosion	06
	<hr/>	<hr/>
	Total	60

RATIONALE:

Metals and alloys are good conductor of electricity and form strong ions in metallic compounds. This electrical property of metals have been exploited in extraction and deposition of many metals. Electro metallurgy is thus an important subject for the metallurgical engineering.

OBJECTIVE:

On completion of the subject the student will know.

- i) Different types of electro-metallurgical process
- ii) Different types of electrochemical cells
- iii) Electrochemical extraction and refining of metals
- iv) Electro plating of metals

COURSE CONTENT (in terms of specific objectives):

1.0 Electro Metallurgy

1.1 Define electro metallurgy

1.2 Explain various electro metallurgical process

1.3 State the spontaneous and non spontaneous electro chemical effects.

2.0 Electro Chemical Cells

2.1 Explain the electrode Potential

2.2 Discuss about E.M.F. and Galvanic series- their application and limitation

3.0 Electrolytic Cell, Electrode Potential and Electrolysis

3.1 Define electrolysis

3.2 Explain electrode reaction

3.3 State Faraday's law and explain current efficiency

3.4 Discuss over voltage, decomposition potential, throwing and covering power.

3.5 Explain the electro crystallization

3.6 Discuss the structure of deposits

3.7 Explain the factors influencing the structure of deposit (without kinetics)

4.0 Polarization and Passivation :

4.1 Define polarization

4.2 Explain the mechanism and factors affecting passivity

5.0 Anodic Electro Metallurgical Process.

5.1 Explain anodizing of aluminium and its alloys.

5.2 State its purposes.

6.0 Electro Chemical Extraction and Refining of Metals

6.1 Define anode effect and metallic clouds

6.2 Difference between electro wining and electro refining.

6.3 Discuss the electro wining and electro refining of Al. And Mg. with reference to basic features, electrolyte and electrode reactions.

7.0 Electro Planting of Metal

7.1 Discuss electro plating of Cr. Ni. And brass

7.2 State the bath composition and operating conditions

7.3 Describe the precaution, advantage and limitation of the processes.

8.0 Elementary Idea on Electro polishing, Electrolytic Etching, Electrolytic Machining

8.1 Explain basic idea of the above processes

8.2 State the advantages and disadvantages of these processes

9.0 Elementary Idea of Corrosion :

9.1 Define corrosion

9.2 State and compare between different types of corrosion(without detailed study)

9.3 Discuss in brief the preventive measures such as inhibition, cathodic and anodic protection.

RECOMMENDED BOOKS:

1. Introduction to Electrometallurgy by Saran and Narayan
2. Introduction to Electrometallurgy by Glass Stone
3. Electrochemical Engineering by Mantell.
4. Introduction to metallic corrosion by Evans
5. Corrosion handbook by Uhlig.
6. Corrosion Engineering by Fontana and Green
7. Electro Chemistry by Kohler.

SELECTION OF MATERIALS

MTT-604(III)
Period /Week: 4
Total Period : 60

Exam: 3 Hrs.
End Exam: 70 Marks
I.A : 20 + 10

Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

<u>SL.NO.</u>	<u>TOPIC</u>	<u>PERIODS</u>
1.	Classification and properties of materials, Engineering material selection criteria	12
2.	Study about corrosion, and Corrosion resistance materials	12
3.	High temperature and low temperature materials, Super alloys	12
4.	Wear resistance materials, friction and Impact resistance materials.	12
5.	Electrical, magnetic materials, Materials for Nuclear Engineering	12
<hr/> Total:		60

RATIONALE:

Development of new material has new thrust towards nano technology which is the demands for modern world. Hence the study of properties of various materials used for society is required.

OBJECTIVES:

1. To know the properties of engineering materials
2. To know the selection criteria for engineering materials.
3. Study about corrosion — its types and prevention methods.
4. Learn about the corrosion resistant alloys.
5. Study about the high temperature and low temperature materials.
6. Learn about friction materials and its properties.
7. Learn about the impact and bearing materials.
8. Learn about the electrically conductive and resistance materials
9. Study about the magnetic materials.
10. To know about the materials used for Nuclear Engineering.

COURSE CONTENTS (in terms of specific objectives):

- 1.0 Classification and properties of materials, engineering material selection criteria
 - 1.1 Material Classification:
Metals, Ceramics, organics and their characteristics.
 - 1.2 Definition of Mechanical Properties:

- Strength, Stiffness, Ductility, Impact strength, hardness, toughness, Fatigue strength, creep strength
- 1.3 Definition of Thermal Properties:
Specific heat, thermal expansion, melting point, thermal conductivity
- 1.4 Electrical Properties:
Electrical conductivity, resistivity, semi-conductor, Dielectric strength, thermoelectricity
- 1.5 Magnetic properties:
Magnetic permeability, magnetic hysteresis, Curie temperature, Magneto-strict ion effect.
- 1.6 Criteria of selection of Materials:
Property, Cost, Manufacturing process, availability, legal factor, safety factor.
- 2.0 Study about corrosion and corrosion resistance materials
 - 2.1 Corrosion, Important types of Corrosion (Short brief only)
 - 2.2 Intergranular corrosion, galvanic corrosion, cathodic polarization, Formation of rust.
 - 2.3 Prevention of Corrosion:
Galvanization, Sacrificial anode, protective coatings, chromium coating, hot dipping- methods of preventing corrosion.
 - 2.4 Alloys used in Petroleum Industries (Short notes only)
 - 2.5 Corrosion resistant alloys:
 - 2.5.1 Chromium steel having low carbon
 - 2.5.2 Chromium steel having high carbon
 - 2.5.3 Monel
 - 2.5.4 Hastelloy
 - 2.5.5 Chromium coated steel
 - 2.5.6 Martensitic stainless steel
 - 2.5.7 Ferritic stainless steel
 - 2.5.8 Austenetic stainless steel
- 3.0 High temperature and low temperature materials. Super alloys
 - 3.1 High Temperature applications:
 - 3.2 High temperature situations (Examples)
 - 3.3 Creep (Brief description)
 - 3.4 Effect of high temperature on mechanical properties of materials.
 - 3.5 Hot hardness, scale resistance
 - 3.6 Heat resistance materials:
 - (i). Iron base alloys (Nickel - Chromium - Iron Alloys)
 - (ii). Nickel base alloys (Nickel - Chromium Alloys)
 - (iii). Cobalt base alloy (Stellite)
 - (iv). Metal ceramics (brief only)
 - 3.7 SUPER ALLOYS: (Brief only)

- 3.7.1 18/8 stainless steel - Sensitization, stabilisation.
- 3.7.2 Inconel alloy
- 3.8 LOW TEMPERATURE APPLICATIONS:
 - 3.8.1 Effect of low temperature on mechanical properties. (Allotropy change, BCC - Embrittlement, conventional properties)
 - 3.8.2 Low temperature situations
 - 3.8.3 alloys used in low temperature (Stainless steels)
- 4.0 Wear resistance materials, friction and Impact resistance materials.
 - 4.1 Wear resistant materials
 - a. Wear
 - b. White Cast iron
 - c. Had Field's Steel
 - d. Stellite
 - 4.2 IMPACT RESISTANT MATERIAL;

Impact strength, impact transition temperature, effect of grain size, effect of alloying elements (Nickel, Carbon, Silicon, Aluminium) effect of heat treatment.
 - 4.3 FRICTION MATERIALS:
 - a. Characteristics of friction materials
 - b. The materials required for manufacture of brakes and clutches (Wet and Dry)
 - 4.4 BEARING MATERIALS:

CLASSIFICATION:

 1. Lead or tin based (White metal, Babbitts)
 2. Cadmium based
 3. Aluminium based
 4. Silver based
 5. Copper based (Gun metal, Bronze)
 6. Sintered bearing material
 7. Non-metallic bearing materials (Nylon * Teflon)
- 5.0 Electrical, magnetic materials, Materials for Nuclear Engineering
 - 5.1 MATERIALS FOR TOOL APPLICATIONS:

Characteristics of tool material

CLASSIFICATION:

 - a) Carbon steels
 - b) Tool Steels (High Speed Steel) (W-HSS)
 - c) Cast Non-ferrous materials (Stellite)
 - d) Cemented carbides
 - e) Ceramic tools (Aluminium Oxide)
 - f) Diamond tools
 - 5.2 MATERIALS FOR ELECTRICAL APPLICATIONS:
 - 5.2.1 Low Resistivity metals: (Aluminium, Copper)

- 5.2.2 Electrical applications of copper
- 5.2.3 Electrical applications of Aluminium
- 5.2.4 Aluminium conductor steel reinforced (ACSR conductor)
- 5.2.5 High Resistivity Metals: (Tungsten and Nichrome)
- 5.2.6 Electrical applications of tungsten and Nichrome and platinum.
- 5.2.7 Super conductivity, applications
- 5.2.8 Semi conductor (Definition)
- 5.3 MATERIALS FOR MAGNETIC APPLICATIONS:
Classifications:
 - a) Ferromagnetic materials - Definition.
 - b) Paramagnetic materials - Definition.
 - c) Dia-magnetic materials - Definition.
 - d) Hard magnetic materials - Classification
(ALNICO ALLOY)
- 5.4 SOFT MAGNETIC MATERIALS:
Classification:
Permalloy, Ferrites, Silicon steel, Transformer steel.
- 5.5 MATERIALS FOR NUCLEAR ENGG APPLICATIONS (Brief Introduction only)
 - 5.5.1 List of metals used in Nuclear Reactors.
 - 5.5.2 Classification of Nuclear Reactors
(Fuel arrangements)
 - 5.5.3 Liquid sodium as coolant metal (Comparison with heavy water)

Reference Book:

1. Metals Hand Book Vol .1 - ASM
2. Structure and Properties of Alloys III Edition, Brick, Gordon & Philips, Eurasia Pub .House Pvt Ltd., New Delhi. 1989.
3. Structure & Properties of light Alloys, A.M. Korol , KOV Pub. Amerind Publishing Co. Pvt Ltd., New Delhi. 1971.
4. Heat Treatment of Metals, T.V.Rajan, C.P.Shanna & Ashok Sharma, Prentice Hall Of India Pvt.ltd, New Delhi.
5. Metallurgy and Material Science, O.P.Khanna, Dhanpat Rai Pub, Delhi.
6. Powder Metallurgy, A.K. Sinha, Dhanpat Rai & Sons
7. Aerospace Materials Vol.1,2 & 3, Balram Guptha, S.Chand & co, New Delhi.
8. Physical Metallurgical for Engineers, Clark & Varney, Pub. East West Press Pvt Ltd., New Delhi/Madras. 1962.
9. Material Science and Engineering : D Callister,John Wiley ,NewDelhi.

FOUNDRY ENGINEERING LAB

MTP-601

Period /Week: 6

Total Period: 90

Exam: 4 Hrs.

End Exam: 50 Marks

Sessional: 100 Marks

Total: 150 Marks

(Students are required to perform at least five experiments from Section A & Section B in full)

SECTION-A

- 13.1 Determination of moisture content of moulding sand by speed moisture teller.
- 13.2 Determination of clay Content in moulding sand.
- 13.3 Determination of A.F.S.grain fineness no. in moulding sand
- 13.4 Determination of green permeability of moulding sand and core sand.
- 13.5 Determination of green compression test of moulding sand and core sand.
- 13.6 Determination of dry strength of mould.
- 13.7 Determination of shear strength
- 13.8 Determination of mould hardness.

SECTION-B

Students should prepare at least one ferrous or non ferrous casting from pattern making to finishing.

List of Equipments:

1. Rapid Moisture Teller -----1 no
2. Clay Content tester ----- 01 no
3. Permeability Tester ----- 01no
4. Core hardness Tester ----- 01no.
5. Sand UTM ----- 01 no.
6. Sand Muller ----- 01 no
7. Moulding Sand Sample Rammer. ----- 01no
8. Mould Boxes ----- 10 nos
9. Different patterns
10. Moulding kit Box ----- 1no for each 10 students.
11. Melting F/C for cast iron and aluminium (induction type) --- 01 no
12. Graphite Crucible,5 kg capacity -----05 nos
13. Stainless steel Crucible,10 kg capacity -----02 nos

PROJECT WORK AND SEMINAR

MTP-602
Period /Week: 11
Total Period: 165

Exam: 4 Hrs.
Practical: 50 Marks
Sessional: 100 Marks

Total: 150 Marks

(Students are required to perform 5 flow sheets and 5 drawings
from section A and section B in full)

SECTION – A

1. Process flow sheet of powder metallurgy
2. Process flow sheet of hot rolling, cold rolling, forging, Extrusion and wire drawing
3. Process flow sheet of extraction of ferrous and non ferrous metal
4. Phase diagram
5. Image analysis of various ferrous and non ferrous alloys.
6. Microhardness testing of various ferrous and non ferrous alloys.
7. Grain size measurement
8. Case thickness measurement during heat treatment and carburizing.

DRAWING

1. Cupola furnace
2. Blast furnace
3. Reverberatory furnace and air furnace
4. Converter
5. Open hearth furnace
6. Electric arc furnace
7. Induction furnace
8. It furnace
9. Low shaft furnace
10. Muffle furnace
11. Crucible furnace
12. Rotary kiln

SECTION – B

Students are required to do a small project work related to metallurgical engineering subject under the guidance of project guide.

SEMINAR

The student will present a talk on his project work.