ELEMENTARY MECHANICAL ENGINEERING

Exam : 3 Hrs. (Th)
Period Week : 4 (Th) End Exam: 80 Marks
Total Period : 60 I.A : 15 + 5
Total : 100 Marks

RATIONALE :

Metallurgical Engineering is intimately related with certain areas of mechanical engineering. It is therefore, essential for a metallurgical engineer to have basic knowledge of mechanical engineering.

OBJECTIVES :

On completion of this subject, students will have basic understanding of the major fields of mechanical engineering like Mechanisms, Machines, Thermodynamics and Heat Engines, Machine Tools and Maintenance Engineering.

COURSE CONTENTS (in terms of specific objectives) :

1.0 CHAPTER – 1
- 1.1 Define shear force and bending moment
- 1.2 Construct shear force and bending moment diagram of cantilevers, simple supported beam with point load and uniformly distributed load.
- 1.3 Determine stress and deflections of loaded beams

2.0 CHAPTER – 2
- 2.1 Define machine, mechanism, kinematics, link, kinematics pair, kinematics chain
- 2.2 Illustrate four – bar linkage, crank – connecting rod, quick return mechanism
- 2.3 Understand function of a cam and cam follower

3.0 CHAPTER – 3
- 3.1 Determine the length of open belt drive
- 3.2 Determine the ratio of tensions and power transmitted by belt drive
- 3.3 Discuss advantage of rope and chain drive
- 3.4 State working principle of simple breaks and dynamo meters
- 3.5 Define and classify bearings (bush and anti-friction)
- 3.6 Explain function of fly wheel and governors

4.0 CHAPTER – 4
- 4.1 Define heat and work and derive inter – relationship
- 4.2 Determine work done by compression and expansion of gases
- 4.3 Explain properties of steam (sensible, latent heat & dryness fraction)

4.4 Discuss use of steam tables.

5.0 CHAPTER – 5

5.1 Explain the mechanism of the boiler
5.2 Define fire tube, water tube, crank, crank shaft
5.3 Define IHP, BHP and mechanical efficiency
5.4 Define and classify steam turbines (impulse and reaction type)

6.0 CHAPTER – 6

6.1 Define and classify internal combustion (I.C.) engine
6.2 Explain Otto and Diesel cycles
6.3 Explain and compare 2 stroke and 4 stroke and I.C. engine
6.4 Define IHP, BHP and mechanical efficiency of I.C. engines

7.0 CHAPTER – 7

7.1 Define Refrigeration and Air – conditioning and state various application
7.2 Explain simple vapour compression refrigeration system
7.3 Explain function and working principle of a gas compressor
7.4 State types of refrigerants and explain their properties
7.5 Describe the basic concept of air – conditioning with reference to a room air conditioner

8.0 CHAPTER – 8

8.1 Define machine tools
8.2 Describe different machine tools and their functions (lathe, drill, shaper, milling machine and grinding machine)
8.3 Describe types of maintenance (breakdown, preventive, planned)

RECOMMENED BOOKS :

1. Applied Mechanics : R. S. Khurmi
2. Engineering Thermodynamics : P. L. Ballenny
3. Refrigeration and Air – Conditioning : P. L. Ballenny
4. Theory of Machine : R. S. Khurmi
5. Industrial Engineering and Management : O. P. Khanna
6. Elements of Workshop Technology : Hazra Chaudhury , Vol . I & II

MINERAL DRESSING

Exam: 3 Hrs. (Th)
Period Week: 4 (Th) End Exam: 80 Marks
Total Period: 60 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Various Mineral Resources in India	2
2.	Ore Dressing	5
3.	Unit Operation	7
4.	Grinding	7
5.	Laboratory Sizing	6
6.	Industrial Screening Classification	6
7.	Gravity Concentration	7
8.	Heavy Media Separation	6
9.	Flotation	8
10.	Magnetic and Electrostatic Separators	6
	Total:	60

RATIONALE:

Ores and minerals are the sources of all metals and alloys. Ores and minerals, as available in nature are mixed with various other substances and of odd sizes which are not suitable for various extraction processed. Useable quality and size of ores / minerals are obtained by different process called mineral dressing. Thus this subject is of great important in the study of metallurgy.

OBJECTIVES:

After the completion of the course students should have the idea about the following:

1. Ores and minerals of the metals and their resources.
2. Size reduction operation of the minerals
3. Concentration methods based on the different physical and chemical / surface properties of ores.

COURSE CONTENT (in terms of specific objectives) :

1.0 List various mineral resources in India

2.0 Ore dressing :

2.1 Explain the Scope and Objectives of ore dressing

2.2 Explain the different physical & chemical properties of ores with their application to mineral dressing

3.0 Unit Operations :
- 3.1 Describe crushing operations
- 3.2 Explain the types of crushers : Blake and Dodge jaw crushers
- 3.3 Describe capacity and reduction ratio of crusher
- 3.4 Explain angle of nip of a crusher
- 3.5 Explain in details gyratory and roll crushers
- 3.6 Explain the principle of operation of gyratory and roll crushers

4.0 Grindings :
- 4.1 Classify different types of grinding equipment : ball mill
- 4.2 Explain the ball mill operations
- 4.3 State the difference between open circuit and close circuit grinding
- 4.4 State the difference between dry grinding and wet grinding

5.0 Laboratory Sizing Technique :
- 5.1 Explain the methods of size analysis
- 5.2 Describe different types of standard screens with screening techniques
- 5.3 Explain in details Rotap sieve shaker

6.0 Industrial Screening :
- 6.1 Explain the principle of screening
- 6.2 Classify types of screening
- 6.3 Explain the effectiveness, capacity, efficiency of Industrial screens
- 6.4 Explain different types of classifiers and their applications

7.0 Gravity Concentration :
- 7.1 Describe the general principles of flowing film concentration
- 7.2 Describe in details the operations and application of wilfley table
- 7.3 Define jigging
- 7.4 Describe the factors affecting stratification in jigs
- 7.5 Explain the types of jigs and their uses

8.0 Heavy Media Separations :
- 8.1 Explain the fundamental principle of heavy media separations
- 8.2 Explain the different industrial process using heavy liquid and heavy suspensions, Du - Pont process, chance process

9.0 Flotation :

- 9.1 Define are froth and skin flotation
- 9.2 Explain the elementary principle of froth flotation
- 9.3 Explain the practical utility of frother, collector, modifier, activators, depressant (without physic – chemical Principle)
- 9.4 Describe the application with practical examples of froth flotation process
- 9.5 Describe different types of flotation cells

10.0 Magnetic & Electrostatic Separator :

- 10.1 Explain the principles of magnetic and Electrostatic separator with their application to mineral dressing

RECOMMENDED BOOKS :

1. Principle of Mineral Dressing by Gaudin A. M.
2. Non – Ferrous Metallurgy by H. S. Roy, Shridhar & Abrahom
3. Hand book of Mineral / dressing Ores & Minerals by A. E. Taggart
4. Mineral Processing Technology by B. A. Wills

FUELS AND REFRACTORIES

Exam: 3 Hrs. (Th)
Period Week: 4 (Th) End Exam: 80 Marks
Total Period: 60 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Fuels	4
2.	Solid Fuels	12
3.	Liquid Fuels	10
4.	Gaseous Fuels	10
5.	Combustion	8
6.	Refractories	8
7.	Special Refractories	3
8.	Selection of Refractories	5
	Total:	60

RATIONALE:

For different metallurgical processes starting from extraction of metals from ores down to shaping and treating of metals, heating is an essential operation for which fuel is used. To allow all these thermal processes in a furnace, use of refractory is a must to contain heat and protect the furnace structure. Study of fuels and refractories is thus a very important topic in Metallurgy.

OBJECTIVES:

After completion of this subject students will have knowledge about solid, liquid and gaseous fuels. He will acquire idea about the manufacturing process and uses of the above fuels. They will also acquire idea about Refractories as these Refractories are essential for metallurgical furnaces. On completion of study the students will have knowledge about fuels and refractories.

COURSE CONTENT (in terms of specific objectives):

1.0 Fuels :
- 1.1 Define the Fuel
- 1.2 Classify the types of fuel
- 1.3 State the importance of Solid, Liquid and Gaseous fuels

2.0 Solid Fuels :
- 2.1 COAL :
  - I. Explain the origin of coal
  - II. State the composition of coal

III. Discuss the characteristics and significance of constituents
IV. Distinguish between proximate and ultimate analysis
V. Define the calorific value of coal

2.2 COKE :

I. Discuss the scope and objectives of carbonization of coal
II. Explain the carbonization of coal
III. Differentiate between high temperature carbonization and low temperature carbonization
IV. State the merits and demerits of H.T.C and L.T.C
V. Discuss the criteria of selection of metallurgical coal

2.3 Coke Testing

I. Define and explain shatter and mecum index

3.0 Liquid Fuels

I. Explain origin and constitution of petroleum
II. Discuss the properties of petroleum products
III. Discuss the distillation process of crude petroleum
IV. Explain the production and uses of coal tar.

3.1 Testing of liquid Fuels:

I. Define specific gravity, viscosity, flash point, cloud point & pour point, aniline point, octane number and cetane number.
II. Discuss the methods of testing of following properties:

Specific gravity, viscosity, flash point, cloud point and pour point

4.0 Gaseous Fuels

Explain the production and utilization of following gaseous fuels:
Methane, water gas, producer gas, carbureted water gas, coke oven gas, blast furnace gas, natural gas, mixed gas.

5.0 Combustion

I. Discuss the elementary principle of combustion, Hess's law of constant heat summation, Kirchoff's law.
II. Work out simple combustion calculation.

6.0 Refractories :

I. Classify different types of Refractories basing on acid, base and neutral

II. Explain the desirable properties of Refractories in details

III. Discuss the raw – materials, methods of manufacturing and properties of silica, fire clay, magnesia, dolomite, chrome magnesite, graphite and magnesia carbon bricks.

7.0 Special Refractories

Discuss about the special refractories like high alumina, mullite, SIC, Zirconia

8.0 Give criteria for selection and types of refractories selected for blast furnace, L.D., open hearth, arc furnace, ladle, soaking pit, coke oven, reheating furnaces, copper smelting flash and reverberatory furnaces.

RECOMMENDED BOOKS:

1. Refractories by Cheisty
2. Refractories by M. L. Mishra
3. Refractories by Gill Christ
4. Fuels & Combustion by Samir Sankar
5. Fuels by Himus

APPLIED ELECTRONICS AND CONTROL

	Exam: 3 Hrs. (Th), 4Hrs. (Pr)
Period /Week: 4 (Th), 4 (Pr)	End Exam: 80 Marks
Total Period: 120	I.A: 15 + 5 Marks
	Practical: 25 Marks
	Sessional: 25 Marks
	Total: 150 Marks

RATIONALE:

This state of the metallurgical plants and equipment require a precision control over all the process parameters. So most of the metallurgical equipments are equipped with electronics sensor and control systems. A little malfunctioning of these electronics sensor may lead to deliver a futile situation and result in the worthless products. Hence it has become essential to acquire basic knowledge about all these electronic control systems. This paper will enlighten the student of the III semester diploma about the principle, working and uses of electronic sensors and devices.

OBJECTIVES:

On completion of course the student will be able to develop understanding and uses of

1. Special semiconductor devices
2. Opto- electronics devices
3. Regulated power supply
4. Principle of digital electronics
5. Sensors and transducers
6. Microprocessor
7. PLC

DISTRIBUTION OF PERIODS		PERIODS
Unit - 1	Special semiconductor devices	6
Unit - 2	Opto - electronics devices	3
Unit - 3	Regulated power supply	9
Unit - 4	Principle of digital electronics	8
Unit - 5	Sensors and transducers	15
Unit - 6	Microprocessor	12
Unit - 7	PLC	7
Unit - 8	Laborating	60
	TOTAL:	120

COURSE CONTENT (in terms of specific objectives):

UNIT-1 Special Semiconductor Devices

Explain characteristics and principle of operation and applications of

1.1 FET
1.2 MOSFET
1.3 UJT
1.4 SCR
1.5 TRIAC
1.6 DIAC

UNIT-2 Opto – Electronics Devices

Explain the operation and use of

2.1 LED
2.2 LCD
2.3 Opto – Coupler
2.4 LASER

UNIT-3 Regulated Power Supply

3.1 Explain the function of ordinary DC power supplier
3.2 Classified different unit of DC series voltage regulators
- 3.2.1 Sampling Units
- 3.2.2 Reference Units
- 3.2.3 Comprising Units
- 3.2.4 Amplifier units
- 3.2.5 Control units
- 3.2.6 Complete series and shunt voltage regulator

3.3 Explain the operation of switching mode power supply (AC, DC)

UNIT-4 Principles of Digital Electronics

4.1 Explain types of Flip-Flop and its use
4.2 Describe briefly about memory element
4.3 Explain the function of shift registers
4.4 Describe the function and use of MOD-10 and ring counter

UNIT - 5 Sensors and Transducers :

5.1 Describe sensors for sensing pressure, temperature, moisture, humidity, flow, level
1) Explain temperature measurement using resistance, thermometer, thermocouple, thermister.

2) Explain pressure measurement using manometer, U-tube, Elastic type, pressure gauge (Bourdon tube, diaphragm, bellows etc.)
3) Classification of flow – meter, variable heat flow meter, principle of operation, advantage and disadvantage of orifice plate, venture tube, nozzles.

5.2 Describe the function of Limit Switch, Proximity, Switch, Alarm announciato and its use

UNIT - 6 Microprocessor

6.1 Describe introduction to Intel 8085
6.2 Explain register organization of 8085
6.3 State instruction Sets of 8085
6.4 Describe assembly language concepts
6.5 Explain preparation small programmes using 8085
- i) Data Bus
- ii) Address Bus
- iii) Control Bus
- iv) Interrupt Time
- v) Multi – Planning busses

UNIT - 7 PLC

7.1 Explain basic structure and operation of PLC
7.2 Describe simple ladder logic
7.3 Right simple ladder programme (implement only OR,AND,NOR &NAND logic)

UNIT-8 LABORATORY

8.1 Study of different types of Thermometer
8.2 Study of different types of Pressure gauge
8.3 Study of Orifice plate, Venturi meter, Nozzles
8.4 Implementation of AND, OR, NAND, NOR, XOR, NOT gate and verification of truth table
8.5 Verification of R-S flip- flop and J-K flip-flops
8.6 Verification of performance of Mod-10 Counter
8.7 4-bit up/ down counters
8.8 Study of 8085 based Microprocessor kit
8.9 Simple programs using 8085 Microprocessor kit
8.10 Study the performance of electronic on-off temperature controller

RECOMMENDED BOOKS

1. Integrated Electronics, Analog and digital systems by J Millman, Christos C. Halkius
2. Electronic Devices and Circuit by Motor Shed
3. Electronic Devices and Circuits by G. K. Mithal
4. Power Electronics by Rashid
5. Digital circuits and system by Doughlas V. Hall Mc. Graw Hill Publication
6. Digital Electronics by Gour
7. Digital System Design by Mano
8. Microprocessor by Gaonkar
9. Microprocessor by B. Ram
10. Industrial Electronics by Paul B. Zaber
11. Mechanical Measurement & Measuring Circuit By S. Khedhar
12. Instrumentation by Nakara Choudhary
13. Industrial Electronics by S. N. Biswas
14. Mechanical and Industrial Measuring Circuit by R. K. Jain
15. Industrial Instrumentation by Fibrace
16. Electrical and Electronic Instrumentation by A. K. Sawhney
17. Industrial Electronics by G. K. Mithal
18. Thyristors by P. C. Sen

MATERIAL TESTING

Exam: 3 Hrs. (Th)
Period Week: 4 (Th) End Exam: 80 Marks
Total Period: 60 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Hardness Test	10
2.	Tensile Test	10
3.	Impact Test	6
4.	Fatigue Test	8
5.	Creep Test	6
6.	Non – destructive Testing	11
7.	Temperature Measurement and Calibration	6
	Total:	60

RATIONALE:

Selection and use of various metals and alloys depend on their mechanical properties. Mechanical properties largely depend on various metallurgical processes these materials undergo. It is important for a metallurgical engineer to understand and measure these mechanical properties.

OBJECTIVES:

On completion of course the student will have thorough knowledge and basic skill of measuring different mechanical strengths like tensile strength, fatigue strength, creep strength, impact strength and also different hardness values. They will also have knowledge about different non-destructive test, pyrometers, thermocouples etc.

COURSE CONTENT (in terms of specific objectives):

1.0 Hardness Test
- 1.1 Explain and derive expressions for Brinell, Vickers and Rockwell hardness test
- 1.2 Discuss rebound hardness with reference to shore’s seeleroscope.
- 1.3 Describe scratch hardness and explain mho’s scale.
- 1.4 Discuss the imperical relationship of hardness with strength.

2.0 Tensile Test :
- 2.1 Draw and explain stress-strain curve
- 2.2 Explain modulus of elasticity, proof stress

2.3 Discuss with sketch about yield point phenomenon.
2.4 Explain true stress and true strain curve.
2.5 Define ductility and toughness

3.0 Impact Test:
3.1 Define impact strength
3.2 Discuss about Charpy and Izod impact tests
3.3 Discuss about transition temperature and ductility, brittle fracture

4.0 Fatigue Test:
4.1 Explain different stress cycles
4.2 Describe S.N curve and endurance limit
4.3 Explain the procedure of fatigue testing and fatigue testing machine
4.4 Mention different metallurgical factors that affect fatigue behavior

5.0 Creep Test:
5.1 Define creep and claborate its importance
5.2 Discuss engineering creep curve, constant stress creep curve and Andrade concept
5.3 Explain equicohesive temperature
5.4 State various factors that affect creep
5.5 Describe creep testing machine
5.6 Describe stress rupture test

6.0 Non – destructive Testing:
6.1 Discuss the scope and elementary idea about different NDT and their significance
6.2 Give brief description of the following NDT
(a) Visual testing
(b) Leakage test
(c) Magnetic particle testing
(d) Dye penetration test
(e) Acoustic methods and ultrasonic testing
(f) Eddy current testing
(g) X – ray diffraction

7.0 Temperature Measurement and Calibration:
7.1 Analysis the basic principle of pyrometry
7.2 Explain different types of pyrometer and thermocouples.

RECOMMENDED BOOKS :

1. Testing of Metallic Material by Surya Narayan
2. Mechanical Metallurgy by Dicter
3. Introduction to Physical Metallurgy by Avner
4. X – ray diffraction by BD Culity
5. Experimental Technique in Physical Metallurgy by V. T. Cherepis & A. K. Mallick

MATERIAL TESTING LAB.

Exam: 4 Hrs.
Period Week: 6 — End Exam: 50 Marks
Total Period: 90 — Sessional: 50 Marks
Total: 100 Marks

(Student are required to perform atleast five experiments)

1. Study the operation of different hardness testers such as brinell, Rockwell & Vicker hardness testers.
2. Determination of BHN of metals & alloys
3. Determination of VHN of metals & alloys
4. Determination of RB & RC hardness values for metals & alloys
5. Study the operation of impact tester
6. Determination of impact value of a steel specimen by Charpy & Izod machine
7. Study of fatigue testing machine and determination of fatigue limits
8. Study of U.T.M. & determination of tensile & compression strength values.
9. Study the operation of NDT equipment such as ultrasonic flow detector & magnetic crack detector
10. Inspection of defects by above equipment (UFD or MCD)
11. Measurement of temperature by pyrometer & thermo-couples

LIST OF EQUIPMENTS :

1. Brinell hardness tester ---------- 02nos.
2. Rockwell hardness tester ---------- 02nos.
3. Vicker hardness tester ---------- 02nos.
4. Cherpy impact tester ---------- 02nos.
5. Izod impact tester ---------- 01nos.
6. Fatigue testing m/c ---------- 01nos.
7. Universal testing m/c ---------- 01nos.
8. Magnetic particle tester kit ---------- 01nos.
9. Ultrasonic flow detector ---------- 01nos.
10. Optical pyrometer ---------- 02nos.
11. Thermocouple (with accessories potentio meter) -------- 02nos.

RECOMMENDED BOOKS

1. Testing of Engineering Materials
2. Practical Experimental Metallurgy by Rawlings

MINERAL DRESSING LAB.

Exam: 4 Hrs.
Period Week: 5 — End Exam: 25 Marks
Total Period: 90 — Sessional: 25 Marks
Total: 50 Marks

11.1 Crushing:
- (i) Reduction Ratio
- (ii) Determination of capacity

11.2 Grinding:
- (i) Grinding Index
- (ii) Performance of Ball Mill

11.3 Screening & size analysis
11.4 jigging
11.5 Fabling
11.6 Flotation
11.7 Magnetic separation
11.8 Electrostatic separation

LIST OF EQUIPMENT:

1. Jaw crusher----------01nos.
2. Ball mill----------01nos.
3. Sieve shaker with set of siever ---------01nos.
4. Jigging m/c ----------01nos.
5. Wilfley table ----------01nos.
6. Flotation cell ----------01nos.
7. Magnetic separator ----------01nos.
8. Electrostatic separator ----------01nos.

IRON MAKING

Exam: 3 Hrs. (Th)
Period Week: 5 (Th) End Exam: 80 Marks
Total Period: 75 I.A : 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Source of ferrous raw – materials in India and raw – materials for iron making	7
2.	Burden preparation	6
3.	Blast Furnace Fuels	9
4.	Blast Furnace operations	9
5.	Blast Furnace accessories	8
6.	Blast Furnace irregularities and blast furnace operational problems	12
7.	Chemistry of blast furnace operation & charge calculation	11
8.	Modern development of blast furnace operation	8
9.	Alternative methods of iron making	15

RATIONALE:
Pig Iron is by far the most important and maximum used engineering material. Therefore, ferrous metallurgy is one of the most important subjects in steel and cast iron maintenance under metallurgical engineering studies.

OBJECTIVES:
To know details about the raw materials and burden preparation, principle and process, different furnaces, accessories, irregularities and its remedies for making pig iron.

COURSE CONTENTS (in terms of specific objectives):

9.0 Sources of raw materials in India and raw materials for iron making
- 9.1 State different sources of raw materials for ferrous and non-ferrous in India.

10.0 Raw Materials for Iron Making
- 2.1 Different Raw Materials
- 2.2 Different types of iron ores
- 2.3 Evaluation of iron ore
- 2.4 Metallurgical coal

2.5 Difference between coal and coke
2.6 Required properties of coke for making iron
2.7 Flux and its types
2.8 Evaluation of Flux (available base & basicity)

11.0 Burden Preparation
11.1 Quality of burden (physical & chemical properties)
11.2 Different types of agglomeration required for burden preparation for blast furnace

12.0 Blast Furnace Fuel :
12.1 Function of coke
12.2 Quality requirement of coke
12.3 Preparation of B.F. fuel in India
12.4 Auxiliary fuels
12.5 Fuel Injection
12.6 Factors affecting fuel consumption in blast furnace

13.0 Blast furnace Operation
13.1 Charging methods and process
13.2 Blowing in
13.3 Drying
13.4 Filling
13.5 Blowing out
13.6 Banking in
13.7 Blowing down
13.8 Tapping
13.9 Fanning
13.10 Back draughting
13.11 Disposal of slags
13.12 Slags granulation & their utilization

14.0 Blast furnace Accessories :
14.1 Blast furnace refractories
14.2 Stack lining
14.3 Hearth lining
14.4 Hearth walls
14.5 Bosh lining
14.6 Blast furnace cooling arrangement
14.7 Shaft coolers
14.8 Hearth & bosh coolers

- 14.9 Tap holes and top hole drilling machine
- 14.10 Cast house
- 14.11 Tuyeres assembly
- 14.12 Raw materials section
- 14.13 Charge hosting appliances
- 14.14 Top charging system
- 14.15 Blowers, boilers, pumps
- 14.16 Gas cleaning plant
- 14.17 Blast furnace stoves

15.0 Blast Furnace irregularities and Remedies :

- 15.1 Hanging
- 15.2 Scaffolding
- 15.3 Slip
- 15.4 Chilled hearth
- 15.5 Pillaring
- 15.6 Break out
- 15.7 Chocking of gas off take
- 15.8 Flooding and coke ejection through tap hole
- 15.9 Leaking tuyers tap holes and coolers
- 15.10 Channeling

16.0 Chemistry of Blast Furnace operation :

- 16.1 Blast furnace profile
- 16.2 Thermal, physical and chemical profile
- 16.3 Physical chemistry of blast furnace process
- 16.4 Reactions in tuyere zone
- 16.5 Reaction in stack
- 16.6 Reaction in bosh
- 16.7 Reaction in hearth
- 16.8 Efficiency of B. F. process
- 16.9 Direct & indirect reduction
- 16.10 Silicon & sulphur reaction
- 16.11 Burden calculation for B/F operation

17.0 Modern Development of Blast furnace operation

- 17.1 Bell less charging
- 17.2 High top pressure operation
- 17.3 Humidification & oxygen enrichment of blast
- 17.4 External disiliconisation

17.5 desulphurization

RECOMMENED BOOKS :

7. Iron & Steel by Basforth. Vol –I
8. Ferrous production by Brick
9. Iron Making by Tupkaray R. H.
10. Iron Making by Frier
11. Iron & Steel Making by A. K. Biswal
12. Iron ore reduction by E. R. Rogers
13. An introduction to physical chemistry of iron & steel making by Ward
14. Physical Chemistry of Iron Making by A. K. Biswas

PHYSICAL METALLURGY

	Exam: 3 Hrs. (Th)
Period Week: 5 (Th)	End Exam: 80 Marks
Total Period: 75	I.A: 15 + 5
	Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Crystal Structure of metals	10
2.	Solidification of Pure metals and alloys	10
3.	Equilibrium Diagrams	20
4.	Solid Solution	12
5.	Cast Iron	15
6.	Metallurgical Microscope	8
	Total:	75

RATIONALE:

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

OBJECTIVES:

To know physical properties & related mechanical properties, solidification, crystal structures and equilibrium diagrams of metals and alloys; iron carbon equilibrium diagram, metallurgical and electron microscope.

COURSE CONTENT (in terms of specific objectives):

11.0 Crystal Structure of metals :

- 11.1 Define crystal and crystallography
- 11.2 Define space lattice and unit cell
- 11.3 Compare different types of crystal lattices, bravislattices and primitive lattices.
- 11.4 Define with sketch B.C.C., F.C.C & H.C.P.
- 11.5 Define Miller indices, planes and directions
- 11.6 Define isotropy and anisotropy in metallic materials
- 11.7 Define imperfections in metallic materials
- 11.8 Differentiate between types of imperfections : point defect, line defect, surface defect and volume defect (elementary idea)

12.0 Solidification of pure metals & alloys :

- 12.1 Define alloys and solid solution
- 12.2 Define solidification and crystallization
- 12.3 Explain role of free energy thermodynamic potential in conversion of liquid to solid
- 12.4 Define super cooling, under cooling, degree of super cooling
- 12.5 Explain mechanism of solidification/ crystallization, nucleation, critical size nucleus, spontaneous nucleation, relation between ration of nucleation and grain growth.
- 12.6 Discuss shape of crystals and solidification of ingot.

13.0 Equilibrium Diagram :

- 13.1 Define equilibrium diagram
- 13.2 Discuss the importance of equilibrium diagram
- 13.3 Draw equilibrium diagram of binary alloys
- 13.4 State types of equilibrium diagram
- 13.5 Explain isomorphous equilibrium diagram with examples
- 13.6 Explain eutectic type and eutectoid equilibrium diagram with example
- 13.7 Explain peritectic type and peritectoid equilibrium diagram with example
- 13.8 Define phase rule, lever rule
- 13.9 Apply phase rule, and lever rule in each equilibrium diagram.
- 13.10 Draw iron carbon equilibrium diagram and describe different phases and micro constituent in iron carbon diagram
- 13.11 Discuss role of carbon with iron to differentiate steel and cast iron
- 13.12 Apply lever rule in iron and carbon diagram
- 13.13 Differentiate between iron-carbon, iron-cementite, and iron-graphite diagram.

14.0 Solid solution :

- 14.1 Define solution, alloying
- 14.2 Explain different types of solid solution
- 14.3 Differentiate between substitutional and interstitial solid solution, chemical compound, mechanical mixture and intermetallic compounds.
- 14.4 Differentiate between ordered and disordered solid solution.
- 14.5 Define Hume Ruthory rule and describe the different factors governing the formation of solid solutions.

15.0 Cast iron :

15.1 Define cast iron, differentiate between steel and cast iron, alloy steel and alloy cast iron.

15.2 Discuss different types of cast iron with their composition

15.3 Define graphtisation and role of graphtisation in cast iron

15.4 Draw structures of cast iron

16.0 Metallurgical Microscope :

16.1 Differentiate between metallurgical microscope & biological microscope

16.2 Describe different types of metallurgical microscope

16.3 State working principle of metallurgical microscope

16.4 Define magnifying power & resolving power, spherical and chromatic aberration.

16.5 Explain with sketch principle of electron microscope

16.6 Prepare a sample for study of microstructures e.g. sampling, cutting, grinding, rough polishing, intermediate polishing, fine polishing and etching.

RECOMMENDED BOOKS:

5. Engineering Physical Metallurgy by Laktin
6. Physical Metallurgy by Reed Hill.
7. Material Science and Engineering By Raghaban
8. Physical Metallurgy by Smallman

PRINCIPLES OF EXTRACTIVE METALLURGY

Subject Code: MET 404 | Exam: 3 Hrs. (Th)
Period Week: 5 (Th) | End Exam: 80 Marks
Total Period: 75 | I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Definition of metallurgical terms	5
2.	Principles of pretreatment of ores for metal extraction	10
3.	General methods and principle of extraction	40
4.	Basic approaches to refining	3
5.	Principles of metal extractions	10
6.	Principles of metallurgical thermodynamics reaction kinetics	7
	Total:	75

RATIONALE:
This subject deals with different methods and principles of extraction of metals from their mineral/ores. It is therefore, a very important topic under metallurgical engineering.

OBJECTIVES:
On completion of the course, the students should know the followings:

1. Different types of extraction process – pyrometallurgical extraction, hydrometallurgical extraction, and electrometallurgical extraction.
2. Extraction process applications to different ores.
3. Refining operation of the extracted metal.
4. Application of metallurgical thermodynamics and kinetics in extraction processer.

COURSE CONTENT (in terms of specific objectives):

9.0 Definition of metallurgical terms :
- 9.1 Define ores and minerals
- 9.2 Define gangue, flux and slag
- 9.3 Define matte and speiss
- 9.4 Define metals and alloys

10.0 Principle of pre-treatment of ores for metal extractions :

- 10.1 Explain drying
- 10.2 Define and explain calculation
- 10.3 Explain different agglomeration process like briquetting nodulising, vacuum extrusion, sintering, palletizing.

11.0 General Methods of Extraction :

- 11.1 Pyrometallurgical processes
- 11.2 Explain roasting and different roasting methods
- 11.3 Explain Ellingham diagram (oxides) and predominance area diagram (sulphides)
- 11.4 Explain smelting and different smelting practices, Flash smelting, hearth smelting, matte smelting
- 11.5 Explain the method of distillation and sublimation
- 11.6 Explain the process of converting of matte and pig iron
- 11.7 Explain hydrometallurgical process
- 11.8 Explain different stages of hydrometallurgical process
- 11.9 Write the flow diagram of hydrometallurgical extraction
- 11.10 Explain leaching and different leaching methods, bacterial leaching and pressure leaching
- 11.11 Electrometallurgical process
- 11.12 Define electrolysis, ionic conductivity, EMF series, faraday's law of electrolysis
- 11.13 Explain electro wining, electro refining

12.0 Basic approaches to refining :

Explain refining, process – zone refining, fire refining

13.0 Principle of metal extractions :

- 13.1 Explain principles of metallurgical thermodynamics, zeroth law of thermodynamics
- 13.2 Review 1^{st}, 2^{nd}, and 3^{rd} law of thermodynamics, explain their application to metallurgical process.
- 13.3 Explain on details the concept of Internal Energy, enthalpy, entropy and entropy change, Free energy of a chemical reaction.
- 13.4 State Henery's law and Sivert's Law.

14.0 Reaction Kinetics :

- 14.1 Explain first order reaction and its significance.
- 14.2 Explain the application of first order reaction of metallurgical processes.

RECOMMENDED BOOKS :

6. Extraction of Non-ferrous Metals by H. S. Roy, Shridhar & Abraham
7. Introduction to Chemical Metallurgy by R. S. Parket
8. Extraction Metallurgy by J. Newton
9. Principle of Extractive Metallurgy by A. Ghosh & H. S. Roy
10. Metallurgy Thermodynamics by R. H. Trupkary.

MANUFACTURE OF SPONGE IRON AND FERRO ALLOYS

	Exam: 3 Hrs. (Th)
Period Week: 4 (Th)	End Exam: 80 Marks
Total Period: 60	I.A: 15 + 5
	Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Introduction to DR process	8
2.	Principles of reaction	4
3.	Factors affecting sponge Iron process	10
4.	Raw material and operational parameters	7
5.	Screening, sampling and chemical analysis	6
6.	Problem in sponge iron production	10
7.	Production of Ferro alloys	15
	Total:	60

RATIONALE:

Sponge iron and ferro alloys have lot of importance as raw materials for steel manufacture; sponge iron is gradually replacing pig iron due to scarcity of coke in India and its use in B. F. to produce pig iron.

OBJECTIVES:

To know about raw material, principle & process and different furnaces used for making sponge iron and ferroalloys.

COURSE CONTENTS (in terms of specific objectives):

1.0 Introduction to DR Process
- 1.1 Physical chemistry of Direct reduction process
- 1.2 Brief description of different processes viz, HyL, Midrex, Fluidised bed, Rotary kiln, Krupp-Renn process, SL/RN process
- 1.3 Sponge iron making in India

2.0 Principle and rate controlling factor
- 2.1 Principle of reactions
- 2.2 Rate Controlling Factors in the process

3.0 Factors affecting sponge iron production
- 3.1 Effect of temperature
- 3.2 Effect of raw materials
- 3.3 Effect of iron ore size and generation of fines
- 3.4 Carbon enrichment in sponge iron
- 3.5 Product Blending
- 3.6 Fragmentation of Solid iron ore in Kiln

4.0 Raw material and plant operation parameter
- 4.1 Raw materials used for sponge iron making (iron ore, coal, limestone)
- 4.2 Plant operation parameters

5.0 Screening and Chemical analysis
- 5.1 Screening of raw materials and product
- 5.2 Sampling and chemical analysis

6.0 Different problems in sponge iron production
- 6.1 Iron ore injection and hot spot in kiln shell
- 6.2 Accretion formation
- 6.3 Waste heat power generation
- 6.4 Shut down of the system

7.0 Production of Ferro alloys
- 7.1 Types of ferro alloys furnace
- 7.2 Preliminary knowledge about furnace, mechanical equipment, electrical equipment and electrode
- 7.3 Process and principle of production of Ferro-chrome
- 7.4 Process and principle of production of Ferro-silicon
- 7.5 Process and principle of production of Ferro-manganese
- 7.6 Process and principle of production of Ferro-vanadium

RECOMMENDED BOOKS:

1. Hand book of sponge iron making in Rotary kiln by P. C. Pradhan
2. TDR process of sponge iron making in Rotary kiln by Amit Chattergee
3. DRI Process and its relevance to india by S. Dasgupta, T. K. Ray & B. Ray
   M. N. Dastur & companies PVT. LTD
4. DRI Process in Rotary kiln by Alis Chalarners, USA
5. Production of ferro alloys by A. Riss, Y. Khodorrosky

MACHINE DRAWING

Subject Code: MET 408 | Exam: 3 Hrs. (Th)
Period Week: 4 (Th) | Sessional: 50 marks
Total Period: 60 | Total: 50 Marks

1. Isometric projection of solids and sections of solids
2. Drawing of Isometric views of Nuts, Bolts, Screws, Rivets and Locking devices
3. Drawing of different thread forms: left and right, single and multi start.
4. Assembly drawing of Knuckle and cotter joints
5. Assembly drawing of Plummer block and flange coupling
6. Drawing of machine components – stuffing box, crank, pulley and piston.
7. AutoCAD theory & practice

RECOMMENDED BOOKS:

1. Machine Drawing: N. D. Bhatt.

WORKSHOP PRACTICE – I I

(Common to MET., CHEM., CER.& T.T.),

Period / Week: 4 hrs. (pr.) End Exam: 50 Marks
Total Contact Hours: 60 Sessional: 50 Marks
Total: 100 Marks

UNIT TOPIC/ SUB TOPIC	HOURS. MARKS

1.0 MACHINE SHOP
- 1.1 Shop talk on different types of machine tools, their functions, different tools used and general safety precautions to be observed.
- 1.2 Study a centre lathe
- 1.3 Operate a centre lathe on a cylindrical ob and perform following operations turning, taper turning, facing, parting
- 1.4 Operate a drill machine to perform drilling and counter boring operation on a job
- 1.5 Observe milling, shaping and grinding operations during demonstration at the shop floor

2.0 FOUNDRY SHOP
- 2.1 Prepare a simple wooden pattern
- 2.2 Make a green sand mould using above pattern

3.0 WELDING SHOP
- 3.1 Observe demonstration of different type of welding electrodes and TIG & MIG welding

REFERENCE BOOKS:
1. Engineering Thermodynamics – P. L. Balleney
2. Workshop Technology – II , Hazra & Choudhury

N. B.

The Textile Tech. students will do the following practicals in addition to the above.
1. Study and sketching of I. C. Engines (two stroke, four stroke, Diesel and Petrol Engines)
2. Boiler and checking its different parts
3. Study and sketching of reciprocating pumps, rotary pumps
4. Air compressor

METALLURGICAL ANALYSIS LAB.

Subject Code: M 406 | Exam: 4 Hrs. (Th)
Period /Week: 6 | End Exam: 100 Marks
Total Period: 90 | Sessional: 50 Marks
Total: 150 Marks

(Students are required to perform atleast five experiments)

1. Proximate analysis of coal
2. Determination of flash point and fire point
3. Determination of Fe in iron ore
4. Determination of Mn in manganese ore
5. Determination of Calcium, Magnesium in Dolomite
6. Determination of Cu, Zn in Brass
7. Determination of Choromite ore

LIST OF EQUIPMENT:

1. Muffle furnace ----------02nos.
2. Open cup apparatus for flash Point & Fire point ----------05nos.
3. Close cup apparatus for flash Point & Fire point ----------05nos.
4. Digital balance ----------03nos.
5. Electro chemical analysis apparatus ----------02nos.
6. Metal spectroscope ----------01nos.
7. Redword viscose ----------03nos.
8. Strohlcin apparatus ----------01nos.
9. Thermometer ----------10nos.
10. Silica crucible ----------05nos

HEAT TRANSFER, FLUID FLOW & FURNACES

Exam: 3 Hrs. (Th)
Period Week: 5 (Th) End Exam: 80 Marks
Total Period: 75 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS:

SL.NO.	TOPICS	PERIODS
1.	Fluid Flow	20
2.	Heat Flow	20
3.	Classification of Furnace. & Examples of some Metallurgical Furnaces	15
4.	Principles of heat Generation in electric Furnaces	5
5.	Heat Losses, Heat Balance & Furnace Efficiency	7
6.	Waste heat Recovery System in Furnaces	8
	Total:	75

RATIONALE:

Furnace is one of the most important group of metallurgical equipment used for making, shaping and treatment of meta1s and alloys. These equipment 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):

1.0 FLUID FLOW

1.1 i) Discuss types of fluids (ideal and real).

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

1.2 i) State and explain Bernouli's equation.

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

1.3 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 radiation

ii) State the Steffan Boltzman'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

Exam: 3 Hrs.(Th), 4 Hrs.(Pr)
Period Week: 5 (Th), 6 (Pr)
End Exam: 80 Marks
Total Period: 75
I.A : 15 + 5
Practical: 50 Marks
Sessional: 50 Marks
Total: 200 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-Ferros 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 austenetic 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 austenetic 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 austenetic 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

Exam: 3 Hrs. (Th)
Period Week: 5 (Th) End Exam: 80 Marks
Total Period: 75 I.A: 15 + 5
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 themselves 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 decarbonisation 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

Exam: 3 Hrs. (Th)
Period Week: 4 (Th) End Exam: 80 Marks
Total Period: 60 I.A: 15 + 5
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.

METAL JOINING AND POWDER METALLURGY

Exam: 3 Hrs. (Th)
Period Week: 4 (Th) End Exam: 80 Marks
Total Period: 60 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SI. NO.	TOPICS	PERIODS
	POWDER METALLURGY	
1.	Scope of Powder Metallurgy	04
2.	Methods of Powder Production	05
3.	Compaction of Metal Powders	05
4.	Sintering of Metal Powders	08
5.	Flow Sheets of Production of P/M Compants	06
	Total:	28
	METAL JOINING	
1.	Classification of Welding Processes	
2.	Gas Welding	03
3.	Arc Welding	08
4.	Thermit Welding	02
5.	Resistance Welding	02
6.	Welding of Steel C.I & Cu. Alloys	05
7.	Metallurgy of Welding	06
8.	Brazing and Soldering	03
	Total:	32

RATIONALE:

Metals and alloys re converted into useable products of different shapes and Sizes by number of manufacturing processes. Powder metallurgy and metal Joining are two of the major manufacturing processes for shaping metals and alloys.

OBJECTIVES:

On completion of the course the students will be able to know techniques involved in powder metallurgy, various met.al joining processes welding, brazing and soldering.

COURSE CONTENTS (in terms of specific objectives):

POWDER METALLURGY

1.0 Scope of Powder Metallurgy.

- 1.1 Define powder metallurgy.
- 1.2 Depict the historical development of powder metallurgy.
- 1.3 Mention advantages disadvantages and applications of P/M
- 1.4 Briefly describe primary and secondary characteristics of powders.

2.0 Methods of Powder Production

- 2.1 Name different methods of powder production.
- 2.2 Describe the mechanical, physical, chemical and electro chemical methods.

3.0 Compaction of Metal Powders.

- 3.1 Give the significance and different methods of conditioning.
- 3.2 Explain different die-compaction techniques,
- 3.3 Describe isostatic pressing with advantages, limitation applications.
- 3.4 Give brief outline on continuous compaction.

4.0 Sintering of Metal Powder.

- 4.1 Define sintering and Explain its various stages.
- 4.2 Explain briefly mechanism of sintering process.
- 4.3 Explain the process variables and furnaces used for sintering

4.4 Give a note on liquid phase sintering.

5.0 Flow Sheets of Production

5.1 Give Flow Sheets for the Production of the Following.

a. Porous bearing

b. Sintered friction materials

c. Sintered carbides

d. Magnetic Materials

e. Cermets

f. Dispersion strengthened materials

METAL JOINING

1.0 Classification of Welding Processes.

1.1 Classify different welding process such as pressure welding processes and non-pressure welding process.

2.0 Gas Welding

2.1 Explain different flames, equipments, steps, advantages, disadvantages and application of gas welding.

3.0 Arc Welding

3.1 Describe various arc welding process such as

a. Metallic Arc

b. Submerged Arc

c. TIG Welding

d. MIG Welding.

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 we1dng 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 1or Engineers by Curton.

4. Manufacturing Process by Badman.

5. The Metallurgy of Welding, razing and Soldering by J.Lankaster.

6. Welding Technology by O. P. Khanna.

7. Welding Technology by Richard Little.

HEAT TREATMENT LABORATORY

(Students are required to perform atleast 5 experiments and study the resultant structure)

01. Common practices of heat treatment for plain carbon steel

    a. Annealing

    b. Normalising

    c. Hardening

    d. Tempering study of resultant microstructures.

02. Hardenability by Jominy end quench method.

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

04. Spherodising treatment of high carbon steel

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

06. Photomicrography of atleast two structures of' Heat treated samples.

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

LIST OF EQUIPMENTS:

1. Muffle furnace - 1008^0C ---------- 02nos.
2. High temp. Furnace – 1500^0C ---------- 02nos.
3. Metallurgical microscope ---------- 06nos.
4. Abrasive cut off machine ---------- 01nos.
5. Specimen grinding machine ---------- 02nos.
6. Belt polisher ---------- 02nos.
7. Disc polisher ---------- 02nos.
8. Hardenability tester ---------- 01nos.
9. Metallic Arc welding with accessories ---------- 01nos.
10. Submerged Arc welding machine ---------- 01nos.

METALLOGRAPHY LAB.

Subject Code : MET 506
Period /Week : 6
Total Period : 90

Exam : 4 Hrs. (Pr)
End Exam: 50 Marks
Sessional : 50 Marks
Total : 100 Marks

(Students are required to perform atleast seven experiment 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. Micro study of metals by contact printing and sulphur print

8. Photomicrography of atleast two structures

LIST OF EQUIPMENT:

1. Specimen mounting machine ----------02nos.
2. Metallurgical optical microscope with camera attachment ----------03nos.
3. Metallurgical inverted microscope ----------02nos.
4. High resolution scanning electron microscope ----------01nos.
5. Belt polisher
6. Disc polisher
7. Photography unit (with developer silver paper, dark room) ----------01set.
8. Micro hardness taster – (10gF to 1000gF) ----------01nos.
9. Specimen of mild steel, Medium “C” steel, High “C” steel, S.G iron, Grey C.I, Martensitic Steel, Cupper ----------01nos.

RECOMMENDED BOOKS

1. Principles of Metal1ography practice by khel

N.B. The Selection of experiments will be decided by the faculty members concerned depending upon the facility in the Laboratory.

ENTREPRENEURSHIP AND INDUSTRIAL MANAGEMENT

Period Week: 5 (Th)
Total Period: 75

Exam: 3 Hrs. (Th)
End Exam: 80 Marks
I.A: 15 + 5
Total: 100 Marks

(COMMON TO ELECT, ETC, AE&I, MECH, AUTO, CSE, CPA, MET, CHEM, TEX, CER)

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPICS	PERIODS
1.	Concept of Organisation & Enterprise Management	08
2.	Entrepreneurship & Management of S.S.Is	14
3.	Financial Accounting & Cost Control	09
4.	Stores & Financial Management	09
5.	Production Management	03
6.	Sales & Marketing Management	03
7.	Human Resource Management	04
8.	Industrial Sickness	04
9.	The Factories Act 1948	05
10.	Workmen's Compensation & Payment of Wages Act	08
11.	Industrial Dispute Act	04
12.	Trade Union Act	04

RATIONALE:

The course intends to provide the fundamental aspects of entrepreneurship as a means for self employment. Management functions, in an organisation, coordinates various resources to allow the manufacturing activities to continue on a sustained basis. It is essential that the diploma engineers are given exposure industrial activities.

Various statutory rules acts and regulations have been instituted in India by Central/State Govt. to ensure that the workmen are not exploited and they can earn their livelihood with respect. As a supervisor/manager has to work in an industry under binding of such rules and acts, they should have a fair idea of such rules/acts/regulations.

OBJECTIVES

On Completion of the course the student will be able to:

1. Understand the concept of different forms of organization & Management function.

2. Explain the role of an entrepreneur in industrial environment & detailed idea on SSI and venous related aspects.

3. Learn about financial accounting and cost control

4. Know the different areas of management relating to stores & finance, production, sales & marketing and human resource in the organization.

5. Understand about the industrial sickness & its remedies

6. Have a comprehensive idea on some important legislations relating to factory, workmen's compensation, payment of wages, industrial disputes and trade union.

COURSE CONTENT

1.0 Concept of Organisation & Enterprise Management

1.1 Define & state the features of Business

1.2 Explain the components of Business

1.3 State the feature of different forms of Business Organisation

1.4 Define Management & different Management with Administration

1.5 Discuss the functions of Management

1.6 Discuss the principles of 'Scientific Management'

1.7 Explain organization structure and delegation of authority & responsibility

1.8 State the principles of a sound organization.

2.0 Entrepreneurship & Management of S.S.I.s

2.1 Define and state the meaning of 'Entrepreneurship'.

2.2 Discuss the entrepreneurial characteristics

2.3 Explain the role of an entrepreneur in industrial development.

2.4 Define S.S.I., Ancillary, Tiny, Cottage, Medium, & Large scale Industries

2.5 Explain the features of SSI.

2.6 Discuss the criteria for selection of SSI.

2.7 Prepare a preliminary & detailed project report of SSI

2.8 Enumerate the incentives available to SSI as per IPR.

2.9 State the inputs required for setting up a SSI.

2.10 Discuss the institutional support to SSI at State and National level. (OSFC, OSIC, IPICOL, IDCO, SIDBI, IDBI, ICICI, & Commercial Banks)

3.0 Financial Accounting & Cost Control.

3.1 State the different types of Accounts & explain the double entry system of book keeping.

3.2 Explain Journal, Ledger, and Trial Balance& Cash Book.

3.3 Explain the components of Final Accounts and Balance-sheet.

3.4 Define Cost and explain its element

3.5 Prepare a simple cost sheet.

3.6 Explain cost – volume – profit relationship & break-even-point.

4.0 Stores & Financial Management

4.1 State the procedures involved in purchasing

4.2 Explain the centralized & decentralized purchasing.

4.3 State the meaning & importance of Inventory control

4.4 Explain the different stores records- Bin Card, Stores Ledger & Goods Received Note etc.

4.5 State the meaning & importance of financial Management in context with S.S.I.

4.6 Explain the types of capital - Fixed & Working.

4.7 Discuss briefly the Components of Working Capital Management.

5.0 Production Management

5.1 State the importance of Production, Planning, & Control

5.2 Discuss the steps involved in Production Planning & Control

6.0 Sales & Marketing Management

6.1 Discuss the importance of sales & marketing management

6.2 Mention & explain different selling methods.

6.3 Explain the product policy briefly

(Types of Product, Packaging, Branding, Pricing, Cost plus pricing, Variable Pricing policy, Price strategy.)

6.4 Enumerate the techniques of sales promotion.

6.5 Explain Advertising & its media.

7.0 Human Resource Management

7.1 Mention the different sources of recruitment

7.2 Explain the different methods of selection

7.3 Discuss the different training methods.

7.4 State the need of performance appraisal.

8.0 Industrial Sickness

8.1 Define & explain the meaning of Industrial sickness

8.2 State the causes of sickness

8.3 Explain the remedial measures to avoid Industrial Sickness.

9.0 The Factories Act.

9.1 State the meaning & objectives of Factories Act

9.2 Outline the various provisions related to Health, Safety, Welfare, Hours of Work, Holidays, Wage, Employment of Women, Accidents. Diseases, Penalties & Procedures.

9.3 Explain the duties of Factory Inspector

10.0 Workmen's Compensation & Payment of Wages Act.

10.1 State the rules regarding Workmen's Compensation

10.2 Explain the employees' liability for compensation

10.3 State the obligations and rights of employer.

10.4 Give the meaning of Payment of Wages Act.

10.5 State the different rules for payment of minimum wages.

10.6 State the provisions of E.P.F & E.S.I.

11.0 Industrial Dispute Act

11.1 Outline the objects & meaning of Industrial Dispute Act

11.2 State the causes of Industrial Disputes

11.3 Enumerate the machinery set up for settlement of Industrial Disputes

11.4 Explain the measures for prevention of Industrial Disputes.

12.0 Trade Union Act.

12.1 State the meaning & functions of Trade Union

12.2 Explain the features of Trade Union Act 1926.

BOOKS RECOMMENDED:

1. Industrial Engineering & Management - O.P. Khana

2. Entrepreneurial Development - Gupta & Srivastav.

3. Small Scale Industry - Vasant Desai

4. Business Organisation - Sharma & Gupta.

5. Principles & Practice of Management -L.M, Prasad.

6. Entrepreneurship for Engineers- B. Badhai

7. Industrial Law N. D. Kapoor.

FOUNDRY ENGINEERING

Period /Week: 5 (Th), 6 (Pr)
Total Period: 75

Exam: 3 Hrs. (Th), 4Hrs. (Pr)
End Exam: 80 Marks
I.A: 15 + 5 Marks
Practical: 100 Marks
Sessional: 50 Marks
Total: 250 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
		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 it's of pattern colors 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 ruie.

9.11 Mention the effects of poring 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 canting 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

6. Metal Working process by Longman.

7. Manufacturing process by Longman.

MECHANICAL METALLURGY

Exam: 3 Hrs. (Th)
Period Week: 5 (Th) End Exam: 80 Marks
Total Period: 75 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Dislocation	10
2.	Deformation of metals	10
3.	Strengthening mechanism	14
4.	Fundamentals of metal working	06
5.	Recovery Recrystallization & grain growth	04
6.	Rolling	09
7.	Forging	05
8.	Extrusion	08
9.	Wire drawing	04
10.	Elementary concept of deep drawing Sheet metal working	05
		Total: 75

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 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 recrystallisation and grain growth

- 5.1 Explain the following phenomena,
  - (a) Recovery
  - (b) Recrystallisation

(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 detects 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 aid 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

COROSSION AND ITS PREVENTION

(ELLECTIVE)

Exam: 3 Hrs. (Th)
Period /Week: 5 (Th) End Exam: 80 Marks
Total Period: 75 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Introduction to Corrosion	16
2.	Corrosion principles	08
3.	Types of electrochemical cells	08
4.	Electrodes potential	08
5.	Different forms of corrosions	20
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 Unlig

SELECTION OF MATERIALS

(ELECTIVE)

Exam: 3 Hrs. (Th)
Period /Week: 5 (Th) End Exam: 80 Marks
Total Period: 75 I.A: 15 + 5
Total: 100 Marks

TOPIC WISE DISTRIBUTION OF PERIODS

SL.NO.	TOPIC	PERIODS
1.	Classification and properties of materials, Engineering material selection criteria	16
2.	Study about corrosion, and Corrosion resistance materials	16
3.	High temperature and low temperature materials, Super alloys	15
4.	Wear resistance materials, friction and Impact resistance materials.	14
5.	Electrical, magnetic materials, Materials for Nuclear Engineering	14
	Total:	75

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 hysterisis, Curie temperature, Magneto-striction 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 polarisation, Formation of rust.

2.3 Prevention of Corrosion:

Galvanisation, 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, Babbits)
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. Aero Space Materials Vol.1,2 & 3, Balram Guptha, S.Chand & co, New Delhi.

8. Physical Metallurgical for Engineers, Clark & Vamey, Pub. East West Press Pvt Ltd., New Delhi/Madras. 1962.

FOUNDRY ENGINEERING LAB.

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

SECTION-A

1. Determination of moisture content of moulding sand by speed moisture teller.
2. Determination of clay Content in moulding sand.
3. Determination of A.F.S.grain fineness no. in moulding sand
4. Determination of green permeability of moulding sand and core sand.
5. Determination of green compression test of moulding sand and core sand.
6. Determination of dry strength of mould.
7. Determination of shear strength
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 EQUIPMENT:

1. Standard Sand Rammer ---------- 02nos.
2. Permeability Meter ---------- 02nos.
3. Universal Sand Testing Machine ---------- 01nos.
4. Sieve Shaker ---------- 01nos.
5. Clay Washer ---------- 02nos.
6. Speedy Moisture Teller ---------- 01nos.
7. Infrared Moisture Teller ---------- 01nos.
8. Mold Hardness Tester ---------- 01nos.
9. Core Hardness Tester ---------- 01nos.
10. Shelter Index Tester ---------- 01nos.
11. Sand Muller ---------- 01nos.
12. Weighing Balance ---------- 01nos.
13. Mold Boxes ---------- 15set
14. Core Boxes ---------- 04nos.
15. Peen Rammer ---------- 15nos.

16. Round Rammer ---------- 15nos.
17. Striker Bar ---------- 15nos.
18. Trowel ---------- 15nos.
19. Lifter/Cleaner ---------- 15nos.
20. Vent Rod ---------- 15nos.
21. Sprme Pin ---------- 30nos.
22. Dross Spike ---------- 15nos.

PROJECT WORK

AND

SEMINAR

Subject Code: MET 605
Period /Week: 11
Total Period: 75

Exam: 4 Hrs.
Practical: 100 Marks
Sessional: 100 Marks
Total: 200 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

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.