STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

TEACHING AND EVALUATION SCHEME FOR 6TH Semester (Metallurgy)(wef 2019-20)

Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional:	End Sem Exams	Exams (Hours)	Total
		Theory							
Th.1		Foundry Technology	5		-	20	80	3	100
Th.2		Mechanical Metallurgy	4		-	20	80	3	100
Th.3		Industrial Metallurgy	5		-	20	80	3	100
Th.4		Elective: 1.CorrosionEngg. 2.Metallurgical Thermodynamics	4			20	80	3	100
		Total	18			80	320	-	400
		Practical							
Pr.1		Foundry Lab..	-	-	6	50	50		100
Pr.2		Non Destructive Testing & Pyrometry Lab.	-	-	3	25	50		75
Pr.3		Project Phase II		-	7	50	100		150
Pr.4		Life skills			2	25	-	-	25
		Student Centred Activities(SCA)			3				
		Total	*18*	-	*21*	*150*	*200*	-	*350*
		Grand Total			**39**	**230**	**520**	**-**	**750**

Abbreviations: L-Lecturer, T-Tutorial, P-Practical. Each class is of minimum 55 minutes duration

Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%

SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM/Idea Tinkering and Innovation Lab Practice etc., Seminar and SCA shall be conducted in a section.

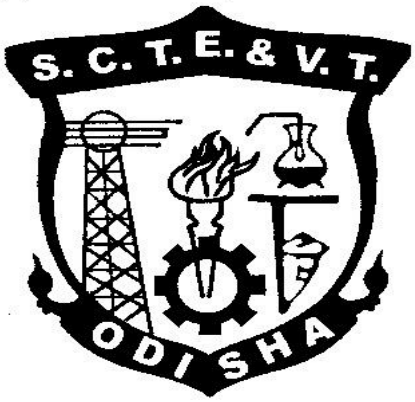
There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional: Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester

CURRICULLUM OF 6TH SEMESTER

For

DIPLOMA IN METTALURGY ENGINEERING

(Effective FROM 2020-21 Sessions)



STATE COUNCIL FOR TECHNICAL EDUCATION & VOCATIONAL TRAINING, ODISHA, BHUBANESWAR

FOUNDRY TECHNOLOGY (Th-01)

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	75	Examination :	3 hrs
Theory periods:	5P / week	Internal Assessment:	20
Maximum marks:	100	End Semester Examination	80

A.RATIONALE:

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

B.OBJECTIVES:

On completion of the subject the students will have idea about:-

1. Casting process
2. Preparation of various types of pattern, cores & molds.
3. Melting practices in different furances.
4. Defects in casting & remedial measures.
5. Special techniques casting.
6. Polution in foundry industry

C. 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

D.COURSE CONTENTS :

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 merits of pattern colours giving 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 molding 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 molding processes
7.3 Explain the molding method in permanent mould
7.4 Describe the method of shell molding giving sketch
7.5 Give the essential feature of investment mould.
7.6 Describe the carbon dioxide molding 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 molding 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 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 molding box.
b. Defects caused by improper molding and core making.
c. Defects caused by improper mixing and distribution.
d. Defects caused by improper molding 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

Syllabus to be covered up to I.A.

Topics :1,2,3,4,5 & 6

Learning Resources:			
Sl.No	**Title of the Book**	**Name of Authors**	**Name of Publisher**
1.	Foundry Technology	Lal & Khanna	Khanna Publishers
2.	Foundry	Goel	Standard Publishers
3.	Foundry Practice	Salman and Simons	PHI
4.	Principle at Metal casting	Heine and Rosenthal	Mc Graw Hill
5.	Foundry Technology	Raghu Vansi	PHI

MECHANICAL METALLURGY (Th-02)

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	60	Examination :	3 hrs
Theory periods:	4P / week	Internal Assessment:	20
Maximum marks:	100	End Semester Examination	80

A.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.

B.OBJECTIVES:

Upon the completion of the course the students will 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.

C. TOPIC WISE DISTRIBUTION OF PERIODS		
SL.NO.	**TOPIC**	**PERIODS**
1	Introduction	08
2	Deformation of metals	08
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 working metal	04
	TOTAL	75

D.COURSE CONTENTS :

1.0 Introduction

1.1 Dislocation, types, its basic behavior & role in deformation.

1.2 Dislocation in various crystals

1.3 Source of dislocation

1.4 Twinning & deformation.
1.5 Slip & Deformation.

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 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

Syllabus to be covered up to I.A.

Topics :1,2,3 & 4

Learning Resources:			
Sl.No	**Title of the Book**	**Name of Authors**	**Name of Publisher**
1.	Mechanical metallurgy	Dieter	Mc Graw Hill
2.	Introduction to physical metallurgy	Avner	Mc Graw Hill
3.	Physical metallurgy principles	Reed Hill	EWP
4.	Mechanical Treatment of metals	R.N. Parkins	Geoge Allen &Unuin
5.	Mechanical Testing of Materials	C.Mohapatra	JJTP,Bhubaneswar

INDUSTRIAL METALLURGY (Th-03)

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	75	Examination :	3 hrs
Theory periods:	5P / week	Internal Assessment:	20
Maximum marks:	100	End Semester Examination	80

A.RATIONALE:

Metals and alloys are 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 of shaping metals and alloys.

B.OBJECTIVES:

On completion of the subject the students will have idea about:-

1. Various welding process & their techniques.
2. Metal joining process like brazing & soldering.
3. Powder metallurgy & its application
4. Various method of powder production.
5. Production of metal powder articles.

C. TOPIC WISE DISTRIBUTION OF PERIODS		
SL.NO.	**TOPIC**	**PERIODS**
1	Classification of Welding Processes	04
2	Gas Welding	05
3	Arc Welding	05
4	Thermit Welding	04
5	Resistance Welding	04
6	Welding of Steel C.I & Cu. Alloys	05
7	Metallurgy of Welding	04
8	Brazing & soldering	04
9	Scope of Powder Metallurgy	04
10	Methods of Powder Production	10
11	Compaction of Metal Powders	06
12	Sintering of Metal Powders	10
13	Flow Sheets of Production of P/M Components	10
	TOTAL	75

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 nonferrous metals.

8.3 Define soldering and explain various types of solders.

8.4 Describe the basic steps of soldering of common metals.

POWDER METALLURGY

9.0 **Scope of Powder Metallurgy**.

9.1 Define powder metallurgy.

9.2 Depict the historical development of powder metallurgy.

9.3 Mention advantages disadvantages and applications of P/M

9.4 Briefly describe primary and secondary characteristics of powders.

10.0 **Methods of Powder Production**

10.1 Name different methods of powder production.

10.2 Describe the mechanical, physical, chemical and electro chemical methods.

11.0 **Compaction of Metal Powders**

11.1 Give the significance and different methods of conditioning.

11.2 Explain different die-compaction techniques,

11.3 Describe isostatic pressing with advantages, limitation applications.

11.4 Give brief outline on continuous compaction.

12.0 **Sintering of Metal Powder**.

12.1 Define sintering and Explain its various stages.

12.2 Explain briefly mechanism of sintering process.

12.3 Explain the process variables and furnaces used for sintering

12.4 Give a note on liquid phase sintering.

13.0 **Flow Sheets of Production**

13.1 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

Syllabus to be covered up to I.A.

Topics :1,2,3 & 4

Learning Resources:

Sl. No	Title of the Book	Name of Authors	Name of Publisher
1.	Introduction to Powder Metallurgy	A.K.Sinha	L Hanpat Rai Publication
2.	Powder Metallurgy	R.L.Sande&C.R.Sha	Geore Newton Ltd. London
3.	Applied Metallurgy 1or Engineers	Curton.	Mc Graw Hill
4.	Manufacturing Process	Badman	
5.	The Metallurgy of Welding, razing and Soldering	J.Lankaster	George Allen &wnwin Ltd.
6.	Welding Technology	O. P. Khanna	Dhanpat
7.	Welding Technology	Richard Little	Mc Graw Hill
8.	Powder Metallurgy	R.L.Sande&C.R.Sha	Geore Newton Ltd. London
9.	Applied Metallurgy 1or Engineers	Curton	Mc Graw Hill

COROSSION ENGINEERING (Th-04-A)
(ELLECTIVE)

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	60	Examination :	3 hrs
Theory periods:	4P / week	Internal Assessment:	20
Maximum marks:	100	End Semester Examination	80

A.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.

B.OBJECTIVES:

On completion of the subject the students will have idea about:-

1. Different types of corrosion & It‘s Principle.
2. Can identify & analysis different types of corrosion.
3. Can apply corrosion prevention method at practical fields.

C. TOPIC WISE DISTRIBUTION OF PERIODS		
SL.NO.	**TOPIC**	**PERIODS**
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
	TOTAL	60

D.COURSE CONTENTS (in terms of specific objectives):

1.0 **Introduction toCorrosion:**
- 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
- 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

Syllabus to be covered up to I.A.

Topics :1,2,3 & 4

Learning Resources:

Sl. No	Title of the Book	Name of Authors	Name of Publisher
1.	Introduction to electrometallurgy and corrosion	Saran & Narayan	Standard
2.	Corrosion Engineering	M.G. Fontana and Green	Mc Graw Hill
3.	Hand book of corrosion	Uhlig	Wiley

METALLURGICAL THERMODYNAMICS (TH-04-B)

(ELECTIVE)

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	60	Examination :	3 hrs
Theory periods:	4P / week	Internal Assessment:	20
Maximum marks:	100	End Semester Examination	80

A.RATIONALE:

Metallurgical Thermodynamics is one of the core subjects of metallurgy and deals with fundamental aspects of any metallurgical reaction and / or processes. The possibility of a metallurgical reaction and its kinetics can only be known by studying the laws of thermodynamics. Hence study of thermodynamics is essential for proper understanding of metallurgical reactions.

B.OBJECTIVES:

1. Basic idea about thermodynamics & various laws of thermodynamics.
2. Feasibility of chemical reactions,
3. Reaction Kinetics
4. Various types of solution
5. How to calculate concentration of reactants and products.

C. TOPIC WISE DISTRIBUTION OF PERIODS		
SL.NO.	**TOPIC**	**PERIODS**
1	Introduction to Thermodyanmics	12
2	First Law of Thrmodynamics	12
3	Second Law of Thermodynamics	06
4	Free Energy	06
5	Third Law OF Thermodynamics,Statistical Thermodynamics	04
6	Fugacity	08
7	Thermodynamics of Solutions	08
8	Topochemical Reaction	04
	TOTAL	60

D.COURSE CONTENTS

1.0 **Introduction to Thermodynamics**

- 1.1 Thermodynamics
- 1.2 Process
- 1.3 Property
- 1.4 Equation of States
- 1.5 Simple Equilibrium
- 1.6 Thermodynamic Equilibrium
- 1.7 Internal Energy

1.8 Gibbs Phase Rule

2.0 **First Law of Thermodynamics**

2.1 First Law of Thermodynamics
2.2 Heat Capacity
2.3 Enthalpy
2.4 Hess's Law
2.5 Kirchhoff's Law
2.6 Thermo Chemistry & its Applications
2.7 Adiabatic & Isothermal Process

3.0 **Second Law of Thermodynamics**

3.1 Second Law of Thermodynamics
3.2 Entropy
3.3 Entropy of a Perfect Gas
3.4 Temperature Dependence of Entropy
3.5 Reversible & Irreversible Process

4.0 **Free Energy**

4.1 Combined Expressions of First & Second Law of Thermodynamics
4.2 Criteria of Thermodynamic Equilibria
4.3 Gibbs Helmholtz Equations
4.4 Maxwell's Relation

5.0 **Third Law OF Thermodynamics, Statistical Thermodynamics**

5.1 Third Law OF Thermodynamics
5.2 Debye & Einstein Concept of Heat Capacity

6.0 **Fugacity**

6.1 Escaping Tendency
6.2 Arrhenius Equation
6.3 Activity
6.4 Equilibrium Constant.
6.5 Use of S Function
6.6 Ellingham-Richardson Diagram

7.0 **Thermodynamics of Solutions**

7.1 Ideal & Non-Ideal Solutions
7.2 Partial & Integral Molar Quantities
7.3 Gibbs-Duhem Equation
7.4 Activity vs Mole Fraction (Henry's Law)
7.5 Regular Solutions
7.6 Sievert's Law

8.0 **Topochemical Reaction**

8.1 Topochemical Reaction
8.2 Johnson-Mehl's Equation
8.3 Differnce between Molecularity & Order of the Reaction

Syllabus to be covered up to I.A.

Topics :1,2,3 & 4

Learning Resources:			
Sl. No	**Title of the Book**	**Name of Authors**	**Name of Publisher**
1.	Engg. Thermodynamics	P.K.Nag	Mc Graw Hill
2.	Text book of Materials & Metallurgical Thermodynamics	Ghosh A.	PHI
3.	Physical chemistry of metals	Darken and Gurry	CBS
4.	Metallurgical Thermodynamics	Dubey and Upadhaya	PHI
5	Introduction to Metallurgical Thermodynamics	David Gaskel	Taylor & Francis

Pr1. FOUNDRY ENGINEERING LAB

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	90	Examination :	3 hrs
Theory periods:	6P / week	End Exam	50
TOTAL	100	Sessional	50

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

SECTION-A

1 Determination of moisture content of molding sand by speed moisture teller.
2 Determination of clay Content in molding sand.
3 Determination of A.F.S.grain fineness no. of molding sand
4 Determination of green permeability of molding sand and core sand.
5 Determination of green compression test of molding 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.

Pr2 NONDESTRUCTIVE TESTING & PYROMETRY LAB

Name of the Course: Diploma in Metallurgical Engineering			
Course code:		Semester	6th
Total Period:	60	Examination :	3 hrs
Theory periods:	3P / week	End Exam	50
TOTAL	100	Sessional	25

1. Study of ultrasonic flaw detector & inspection of defects by using UFD.
2. Study of magnetic crack detector and inspection of defects by using it.
3. Find defect using liquid penetrant
4. Inspection of defects of cast and welded specimen by using suitable NDT equipments.
5. Measurement of temperature by using pyrometer and thermocouples.

Pr3. PROJECT Phase - II

Name of the Course: Diploma in Mettalurgical Engineering			
Course code:		Semester	6th
Total Period:	150	Examination	3 hrs
Lab. periods:	10 P / week	Sessional	75
Maximum marks:	175	End Sem Examination	100

RATIONALE

Students' Project Work aims at developing innovative skills in the students whereby they apply the knowledge and skills gained through the course covered in many subjects and Labs, by undertaking a project. The prime emphasis of the project work is to understand and apply the basic knowledge of the principles of Mettalurgy engineering and practices in real life situations, so as to participate and manage a large Mettalurgy engineering projects, in future. Entire Project spreads over 5th and 6th Semester. Part of the Project covered in 5th Semester was named as *Project Phase-I* and balance portion to be covered in 6th Semester shall be named as *Project Phase-II*.

OBJECTIVES

After undergoing the Project Work, the student will be able to:

- Implement the theoretical and practical knowledge and skills gained through various subjects/courses into an application suitable for a real practical working environment, preferably in an industrial environment.
- Develop software packages or applications and implement these for the actual needs of the community/industry.
- Identify and contrast gap between the technological knowledge acquired through curriculum and the actual industrial need and to compensate it by acquiring additional knowledge as required.
- Carry out cooperative learning through synchronous guided discussions within the class in key areas, asynchronous document sharing and discussions, as well as prepare collaborative edition of the final project report.
- To achieve real life experience in Project design.
- To develop the skill of writing Project Report

Project Phase-I and Phase-II

The Project work duration covers 2 semesters(5th and 6th sem). The Grouping of students,

selection of Project, assignment of Project Guide to the Group was done in the beginning of 5th semester under Project Phase-I. The students were allowed to study literature, any existing system and then define the Problem/objective of the Project. Preliminary work and Design of the system also have to be complete in Phase-I. Development may also begin in this phase. Project Milestones are to be set so that progress can be tracked .

In Phase-II Development, Testing, Documentation and Implementation have to be complete. Project Report have to be prepared and complete in Phase-II. All Project reports should be organized uniformly in proper order, irrespective of group. Teacher Guides can make suitable alteration in the components of Task and schedule.

At the end of Project Phase-II in 6th semester there shall be one presentation by each group on whole Project work undertaken by them.

A suggestive criterion for assessing student performance by the external (preferably person from industry) and internal (teacher) examiner is given in table below:

Sl. No.	**Performance Criteria**
1.	Selection of project assignment
2.	Planning and execution of considerations
3.	Quality of performance
4.	Providing solution of the problems or production of final product
5.	Sense of responsibility
6.	Self expression/ communication/ Presentation skills
7.	Interpersonal skills/human relations
8.	Report writing skills
9	Viva voce

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations to such an exhibition.

The Project Report need to be prepared as per standard format and following is the indicative format. The Teacher Guide may make minor alteration keeping the sense in tact.

Organization of Project Report

1. Cover page:
   It should contain the following (in order)
   (i) Title of the Project
   (ii) “Submitted in partial fulfillment of the requirements for the Diploma in <Branch Name>”
   (iii) By Name of the Student(s)
   (iv) Logo of the Institution
   (v) Branch Name/Depart Name and Institution Name with Address
   (vi) Academic Year
2. 1st Inner page
   Certificate:
   It should contain he following
   “This is to certify that the work in this Project Report entitled <Project Title> by <Name of student(s)> has been carried out under my supervision in partial fulfillment of the requirements for the Diploma in <Branch Name>” during session <session > in <Branch /Department Name> of <Institute name> and this work is the original work of the above student(s).

   Seal and signature of the Supervisor/Guide with date
3. 2nd Inner Page
   Acknowledgement by the Student(s)
4. Contents.
5. Chapter wise arrangement of Reports
6. Last Chapter: Conclusion
   It should contain
   (i) Conclusion
   (ii) Limitations
   (iii) Scope for further Improvement
7. References

Pr-4 LIFE SKILL

(Common to All Branches)

Practical	**2 Periods per week**	**Sessional**	**25 Marks**
Total Periods	**30 Periods**	**Total Marks**	**25 Marks**

Objective: After completion of this course the student will be able to**:**

- Develop team spirit i.e. concept of working in team
- Apply problem solving skills for a given situation
- Use effective presentation techniques
- Apply task management techniques for given projects
- Enhance leadership traits
- Resolve conflict by appropriate method
- Survive self in today's competitive world
- Face interview without fear

DETAIL CONTENTS:

1. SOCIAL SKILL

Society, Social Structure, Develop Sympathy and Empathy
Swot Analysis – Concept, How to make use of SWOT
Inter personal Relation**:** Sources of conflict, Resolution of conflict ,
Ways to enhance interpersonal relation

2. PROBLEM SOLVING

Steps of Problem solving**:**

- Identify and clarify the problem,
- Information gathering related to problem,
- Evaluate the evidence,
- Consider alternative solutions and their implications,
- Choose and implement the best alternative,
- Review
- Problem solving techniques:

1) Trial and error, 2) Brain storming, 3) Lateral (Out of Box) thinking

3. PRESENTATION SKILL

Body language , Dress like the audience
Posture, Gestures, Eye contact and facial expression. STAGE FRIGHT,
Voice and language – Volume, Pitch, Inflection, Speed, Pause
Pronunciation, Articulation, Language, Practice of speech.
Use of AV aids such as Laptop with LCD projector, white board etc.

4. GROUP DISCUSSION AND INTERVIEW TECHNIQUES

Group Discussion:

Introduction to group discussion, Ways to carry out group discussion,
Parameters— Contact, body language, analytical and logical thinking,
decision making

Interview Technique :

Dress, Posture, Gestures, facial expression, Approach
Tips for handling common questions.

5. WORKING IN TEAM

Understand and work within the dynamics of a groups.
Tips to work effectively in teams,
Establish good rapport, interest with others and work effectively with them
to meet common objectives,
Tips to provide and accept feedback in a constructive and considerate way ,
Leadership in teams, Handling frustrations in group.

6. TASK MANAGEMENT

Introduction, Task identification, Task planning ,
organizing and execution, Closing the task

PRACTICAL

List of Assignment: *(Any Five to be performed including Mock Interview)*

a. SWOT analysis:-

Analyse yourself with respect to your strength and weaknesses, opportunities and threats. Following points will be useful for doing SWOT.

a) Your past experiences,
b) Achievements,
c) Failures,
d) Feedback from others etc.

b. Solve the True life problem assigned by the Teacher.

3. Working in a Team

Form a group of 5-10 students and do a work for social cause e.g. tree plantation, blood donation, environment protection, camps on awareness like importance of cleanliness in slum area, social activities like giving cloths to poor etc.(One activity per group where Team work shall be exhibited)

4. Mock Interview

5. Discuss a topic in a group and prepare minutes of discussion.

6. Deliver a seminar for 5 minutes using presentation aids on the topic given by your teacher.

7. Task Management

Decide any task to be completed in a stipulated time with the help of teacher. Write a report considering various steps in task management (with Break up into sub tasks and their interdependencies and Time)

Note: -1. Please note that these are the suggested assignments on given contents/topic. These assignments are the guide lines to the subject teachers. However the subject teachers are free to design any assignment relevant to the topic.

Note: -2. The following Topics may be considered for Seminar/GD in addition to other Topics at the discretion of the Teacher.

(Comparison with developed countries, Occupational Safety, Health Hazard, Accident & Safety, First-Aid, Traffic Rules, Global Warming, Pollution, Environment, Labour Welfare Legislation, Labour Welfare Acts, Child Labour Issues, Gender Sensitisation ,Harassment of Women at Workplace)

METHODOLOGY:

The Teacher is to explain the concepts prescribed in the contents of the syllabus and then assign different Exercises under Practical to the students to perform.

Books Recommended:-

Sl.No	Name of Authors	Title of the Book	Name of the Publisher
01	E.H. Mc Grath , S.J	Basic Managerial Skills for All	PHI
02	Lowe and Phil	Creativity and problem solving	Kogan Page (I) P Ltd
03	Adair, J	Decision making & Problem Solving	Orient Longman
04	Bishop , Sue	Develop Your Assertiveness	Kogan Page India
05	Allen Pease	Body Language	Sudha Publications Pvt. Ltd.

LABORATORY WISE LIST OF EQUIPMENTS FOR 6TH SEMESTER

EQUIPMENTS OF FOUNDRY ENGINEERING LAB

(FOR 30 STUDENTS)

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

EQUIPMENTS OF NONDESTRUCTIVE TESTING & PYROMETRY LAB

(FOR 30 STUDENTS)

1. Magnetic particle tester kit ---------- 01nos.
2. Ultrasonic flow detector ---------- 01nos.
3. Optical pyrometer ---------- 02nos.
4. Thermocouple (with accessories potent meter) -------- 02nos.
5. Micro hardness Tester ---------- 01 no