

Diploma in Metallurgical Engineering

V Semester

TEACHING AND EXAMINATION SCHEME

Sl No	Course Code	Course Name	Teaching Scheme					Examination Scheme						
			instruction periods per week			Total Periods per semester	Credits	Continuous internal evaluation			Semester end examination			
			L	T	P			mid sem 1	mid sem 2	internal evaluation	Max Marks Min Marks	total marks	Min marks for Passing including internal	
1	18MET-501C	Steel Making	3	1	0	60	3	20	20	20	40	14	100	35
2	18MET-502C	Metal Casting Technology	3	1	0	60	3	20	20	20	40	14	100	35
3	18MET-503C	Mechanical Metallurgy	3	1	0	60	3	20	20	20	40	14	100	35
4	18MET-504E	Elective - I	3	1	0	60	3	20	20	20	40	14	100	35
5	18MET-505E	Elective - II	3	1	0	60	3	20	20	20	40	14	100	35
6	18MET-506P	Physical Metallurgy Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
7	18MET-507P	Non Destructive Testing Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
8	18MET-508P	CAD Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
9	18MET-509P	C-Programming Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
10	18MET-510P	Project Work	0	0	3	45	1.5	20	20	20	40	20	100	50
11		Skill Up gradation	0	0	7	105	2.5	0	0	Rubrics			--	-
			19	5	18	630	25	200	200	200	400	150	1000	450
12	Activities: student performance is to be assessed through Rubrics													
		18MET504A Non Ferrous Extractive Metallurgy						Program Elective						
		18MET504B Industrial Management and Entrepreneurship						Program Elective						
		18MET505A Welding Technology						Program elective						
		18MET505B Corrosion Engineering						Program elective						

Steel Making

Course title:	Steel Making				Course Code:	18MET-501C
					Course group:	Core
Semester:	V				Credits:	3
Teaching scheme in Periods (LTP):	45:15:0				Total contact Periods :	60 periods
Type of course: Lecturer+ Assignment:						
CIE:	60 Marks				SEE:	40 Marks

Pre requisites

Basic knowledge of Iron making

Course outcomes

At the end of the course the student should be able to:

CO1 :	Explain the conventional steel making processes and list raw materials
CO2 :	Explain the oxygen steel making processes
CO3 :	Explain electric arc and induction furnace steel making
CO4 :	Explain various vacuum treatment methods for purification of steel
CO5 :	Classify and explain secondary steel making processes
CO6:	Explain various casting processes

Course Contents:

UNIT-1: Conventional steel making **Duration: 8 Periods**

Wrought Iron, Bessemer process, Mixers, Raw Materials, Chemistry of Steel Making, Acid and Basic steel Making. Open Hearth process General principles, Regeneration principle, Classification, construction, Lining, operation, Reactions.

UNIT-2: Oxygen steel making

Duration: 10 Periods

L-D process -Principles, Raw Materials, Lining of the converter, Blow period, lance, carbon steel Making; stainless steel Making, Advantages and uses. Developments in LD – LDAC – KALDO.

UNIT-3: Electric furnaces

Duration: 8Periods

Principles of arc Furnace, classification, Raw materials sequence of charging, Electrode Material, construction of arc furnace, Melting practice, single and double slag practice carbide slag, Melting practice in Induction furnace, Advantages of induction Furnace.

UNIT- 4: vacuum treatment of liquid steel

Duration: 12Periods

Gases dissolved in liquid steel, Function of degassing plant Ladle degassing, stream degassing, circulation degassing, (R.H&D.H process)

UNIT- 5: Secondary steel making process

Duration: 9Periods

Need for production of high quality steels, Objectives of secondary steel making, classification of secondary steel making. AOD process, Ladle furnace, ESR process, vacuum Arc melting

UNIT- 6: Casting pit practice

Duration: 13Periods

Classification of Ingot moulds, Mould materials, methods of teeming, killed, semi-killed, Rimmed, capped steels, Ingot defects. Continuous casting of steel: Principle, Advantages, Junghan's principle, Curved type; Vertical type – Horizontal discharge CCM

COURSE LEARNING OUTCOMES:

After the completion of the course student will be able to

- 1.1 Explain wrought iron making process
- 1.2 Know principle and raw materials required for steel making
- 1.3 Know different mixers for holding of molten steel
- 1.4 Differentiate between Bessemer process and open hearth processes
- 1.5 Know recent trends in open hearth process
- 2.1 Know oxygen steel making process
- 2.2 Explain construction of lining in LD converter
- 2.3 Explain production of steel and stainless steel from LD converter
- 2.4 Explain elimination of impurities during LD process in steel making
- 2.5 Know advantages and limitations of LD converter steel making
- 2.6 Explain developments in LD converter LD-AC and Kaldo processes
- 3.1 Classify electric furnaces and principle of steel making from electric arc furnace
- 3.2 Explain sequence of charging materials in electric arc furnace
- 3.3 Explain construction of lining in electric arc furnace
- 3.4 Explain production of steel and stainless steel from electric arc furnace
- 3.5 Know importance of carbide slag
- 3.6 Explain melting practice in induction furnace
- 4.1 Know gases dissolved in liquid steel
- 4.2 Classify degassing processes
- 4.3 Explain different degassing processes
- 5.1 Know purpose of secondary steel making
- 5.2 Classify secondary steel making processes
- 5.3 Explain different secondary steel making processes

- 6.1 Classify ingot moulds
- 6.2 Explain various teeming methods
- 6.3 Classify steels based on gas evolution
- 6.4 Define continuous casting
- 6.5 Explain different continuous casting machines
- 6.6 Know problems in the production of ingots by continuous casting machine

Suggested Student Activities

1. Student inspects the available equipment in the Lab to identify the components
2. Quiz
3. Group discussion
4. Surprise test
5. Seminars

Recommended Books

- | | |
|---|-------------------------|
| 1. Introduction of modern steel making -- | R.H. Tupkary |
| 2. Manufacture of iron and steel Vol.II -- | G.R.Bashforth |
| 3. Elements of metallurgy -- | Dr. Swaroop |
| 4. Iron and steel making theory and practice -- | AhindraGhosh&Chatterjee |

Suggested E-Learning references

1. <https://www.youtube.com/watch?v=hTw9LVMBLns>
2. <https://www.youtube.com/watch?v=IbaK50ETiV0>
3. <https://www.youtube.com/watch?v=pUihWqHb4GQ>
4. <https://www.youtube.com/watch?v=EZVa7XwieA8>

CO-PO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	Mapped POs
CO1	3	3			2	2		1		2	1,2,5,6,8,10
CO2	3	3			2	2		1		2	1,2,5,6,8,10
CO3	3	3			2	2		1		2	1,2,5,6,8,10
CO4	3	3			2	2		1		2	1,2,5,6,8,10
CO5	3	3			2	2		1		2	1,2,5,6,8,10
CO6	3	3			2	2		1		2	1,2,5,6,8,10

MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
6	VI				7,8	11(a)	
		11(b)				15(b)	
					10(b)	14(b)	
				12(a)	16(a)		
				12(b)	16(b)		
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID SEMESTER EXAMINATIONS (C-18)
D.MET.E V SEMESTER EXAMINATION
18 MET-501C STEEL MAKING

Time: 1 Hour

Maximum Marks: 20Marks

PART-A

Answer **ALL** questions. Each question carries **ONE** mark

4X1 =4

1. Define wrought iron.
2. Define mixer.
3. Define principles of LD converter.
4. List out raw materials for LD converter.

PART-B

Answer **ALL** questions. Each question carries **THREE** marks

2X3 =6

- 5(a). Explain acid Bessemer steel making.
(OR)
5(b). Explain regeneration principle.
- 6(a). Explain lining details of LD converter.
(OR)
6(b). Explain blow period in LD converter.

PART-C

Answer **ALL** questions. Each question carries **FIVE** marks

2X5 =10

- 7(a). Explain steel making in open heath furnace.
(OR)
7(b). Explain sequence of impurities removed in basic Bessemer steel making.
- 8(a). Explain Stainless steel making by LD converter.
(OR)
8(b). Write the advantages and uses of LDAC steel making.

MODEL QUESTION PAPER
BOARD DIPLOMA SEMESTER END EXAMINATIONS (C-18)
D.MET.E V SEMESTER EXAMINATION
18 MET-501C STEEL MAKING

Time: 2 Hours

Maximum Marks: 40Marks

PART-A

Answer **ALL** questions. Each question carries **ONE** mark

8X1 =8

1. Define steel.
2. List out electrode materials for EAF.
3. Define secondary steel making.
4. Define continuous casting
5. List out secondary steel making process.
6. Write purpose of secondary steel making
7. List out ingot moulds.
8. List out the steels based on gas evolution.

PART-B

Answer **ALL** questions. Each question carries **THREE** marks.

4x 3 = 12

- 9(a). Explain the construction and lining details of LD converter.
(OR)
- 9(b). Explain AOD process.
- 10(a). Explain stream degassing.
(OR)
- 10(b). Explain steel based gas evolution.
- 11(a). Explain ESR process.
(OR)
- 11(b). Explain advantages of secondary steel making.
- 12(a). Explain two ingot defects and causes and remedies.
(OR)
- 12(b). Explain principle involved in continuous casting of steel.

PART-C

Answer **ALL** questions. Each question carries **FIVE** marks

4x5=20

- 13(a). Explain KALDO process.
(OR)
- 13(b). Explain degassing in Laddle furnace
- 14(a). Explain double slag practice in EAF.
(OR)
- 14(b). Explain different teeming methods.
- 15(a). Explain VAR process.
(OR)
- 15(b). Explain advantages and limitations of secondary steel making.
- 16(a). Explain vertical type horizontal discharge continuous casting with neat diagram.
(OR)
- 16(b). Explain any five ingot defects causes and remedies.

Metal Casting Technology

Course title:	Metal Casting Technology			Course Code:	18MET-502C	
				Course group:	Core	
Semester:	V			Credits:	3	
Teaching scheme in Periods (LTP):	45:15:0			Total contact Periods :	60 periods	
Type of course: Lecturer+ Assignment:						
CIE:	60 Marks			SEE:	40 Marks	

PREREQUISITES

Basic knowledge of mathematics, Physical metallurgy and foundry technology

Course outcomes

At the end of the course student should be able to:

CO1 :	Explain the melting procedures of various cast irons in furnaces
CO2 :	Explain the gray iron w.r.t. graphitization
CO3 :	Explain the ductile iron with addition of magnesium
CO4 :	Explain the malleabilization of white cast iron for the production of malleable iron with Microstructural changes
CO5 :	Explain copper and aluminium alloy castings production
CO6:	Explain the steel casting production and cleaning of castings

Course Contents:

UNIT-1: Melting of cast irons

Duration: 8Periods

Definition of Cast Iron – Types of Cast irons, Introduction, Cupola – Advantages & limitations, Mechanical structure, Steps in operation, Principles of cupola operation; melt control tests, induction melting, advantages & disadvantages, types, principle, operation.

UNIT-2: Grey iron

Duration: 10Periods

Introduction, properties, uses, classification, Fe-C-Si system, chemical composition requirements, solidification w.r.t Graphitisation, method of moulding, additives, Gating & Feeding, foundry properties, heat treatment, alloy grey iron.

UNIT-3: Ductile iron

Duration: 8Periods

Introduction, properties & uses, chemical composition requirements, role of Mg, Mg treatment methods, inoculation, metallurgical process control, heat treatment.

U NIT- 4: Malleable iron

Duration: 12Periods

Introduction, Properties & uses, composition of white iron, malleabilization treatment, micro structures, methods of black heart malleable iron production

UNIT- 5: Copper and Aluminium foundry practice Duration: 9 Periods

Introduction copper and aluminium, properties & uses, melting procedure, moulding, gating and risering

UNIT- 6: Steel foundry and cleaning of castings Duration: 13Periods

Introduction, moulding, zircon sands, gating and risering, common defects due to cores. Cleaning Operations

Course Learning Outcomes

Student will be able to

- 1.1 Define the terms different types of cast iron.
- 1.2 Identify & Know the Compositions of various cast iron.
- 1.3 List the Advantages & Limitations of Cupola.
- 1.4 Explain the operation and Chemical reactions occurs in Cupola during melting practice
- 1.5 Calculate molten metal Analysis from charge analysis.
- 1.6 List different types of Induction Furnaces
- 1.7 Explain principle of induction furnace
- 1.8 Explain the Melting practice of Cast Iron in Induction Furnace
 - 1.1 List the properties and applications of Grey Iron
 - 1.2 Explain effect of Silicon on iron –iron carbide diagram
- 2.3 Explain the Solidification Process of Grey Iron W.R.T Graphitisation.
- 2.4 Calculate the Pouring Temperature and Fluidity for a given Composition of grey Iron
- 2.5 List different heat treatments of Grey Iron
- 2.6 Explain the effect of alloying elements on the properties and structure of grey iron
- 3.1 List properties and uses of Ductile Iron.
- 3.2 Explain various magnesium treatment methods
- 3.3 Explain the Incolution Process.
- 3.4 List different heat treatments of Ductile Iron
- 3.5 Draw the microstructure and identify the Phases of Ductile Iron.
- 4.1 List the Properties and uses of malleable Iron.
- 4.2 Know the Composition, Microstructure and identify the Phases of White Iron.
- 4.3 Explain the Malleabilisation treatment of White Iron
- 4.4 Draw the microstructures of White & Black Heart malleable Iron.
- 4.5 Explain the Method of Producing Black Heart Malleable Iron.

- 5.1 List the uses of Copper & its Alloys.
- 5.2 Understand the Melting Procedure of Copper alloys.
- 5.3 Design the Gating System, Riser System in copper alloy Casting.
- 5.4 List the different Moulding methods used in an Aluminum foundry.
- 5.5 Explain the Melting Procedure of Aluminum alloys.
- 5.6 Explain the Methods of Gating & Riser of Aluminum alloys.
- 5.7 Explain the different Casting defects in copper and aluminum castings with remedies.
- 6.1 List the moulding Process used in Steel foundry.
- 6.2 know the importance of Zircon Sand & mould Coatings in steel foundry.
- 6.3 Identify the Defects caused due to Cores.
- 6.4 List out Various Cleaning operations.
- 6.5 Explain Various Surface Cleaning Techniques & Trimming Operations.

Suggested Student Activities

1. Student inspects the available equipment in the Lab to identify the components
2. Quiz
3. Group discussion
4. Surprise test
5. Seminars

Recommended Books

- | | |
|-------------------------------|--------------------------------|
| 1. Principle of Metal Casting | -- HEINE AND ROSENTAL |
| 2. Foundry Technology | -- P.L. JAIN |
| 3. Foundry technology | -- M.Lal, Khanna Publications. |
| 4. Foundry technology | -- N.SRINIVAS |

Suggested E-Learning references

1. <https://www.youtube.com/watch?v=7zgFW62en0o>
2. <https://www.youtube.com/watch?v=eTr8cscmx-M>
3. <https://www.youtube.com/watch?v=XDABv3DMYU4>

CO-PO Mapping Matrix

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	Mapped POs
CO1	3	3	3			1		3		2	1,2,3,6,8,10
CO2	3	3	3			1		3		2	1,2,3,6,8,10
CO3	3	3	3			1		3		2	1,2,3,6,8,10
CO4	3	3	3			1		3		2	1,2,3,6,8,10
CO5	3	3	3			1		3		2	1,2,3,6,8,10
CO6	3	3	3	2	1	2		3		2	1,2,3,4,5,6,8,10

MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
6	VI				11(a)	15(a)	
					11(b)	15(b)	
		7,8	10(b)	14(b)			
			12(a)	16(a)			
			12(b)	16(b)			
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID – SEMESTER EXAMINATIONS (C-18)
D MET E V SEMESTER EXAMINATION
18MET502C – METAL CASTING TECHNOLOGY

Time: 01 hour

Max. Marks: 20

Part A

Note: Answer **ALL** question each question carries **ONE** mark

MARKS: 4X1 =4

1. Define cast iron
2. Define gray iron
3. Define pouring temperature
4. Define fluidity

Part B

Answer **ALL** questions Each Question carries **THREE** marks

MARKS: 2X3 = 6

5(a) Mention the different types of cast irons

Or

5(b) List the advantages of cupola

6(a) List out the different heat treatments of gray iron

Or

6(b) What is graphatization

Part C

Answer **ALL** questions Each Question carries **FIVE** marks

MARKS: 2X5 = 10

7(a) Explain the principle of induction furnace

Or

7(b) Explain various steps in operation of cupola furnace

8(a) Explain the solidification process of gray iron

Or

8(b) Explain the effect of alloying elements on the properties of gray iron

MODEL QUESTION PAPER
BOARD DIPLOMA SEMESTER END EXAMINATIONS (C-18)
D MET E V SEMESTER EXAMINATION
18MET502C – METAL CASTING TECHNOLOGY

Time: 02 hours

Max. Marks: 40

Part A

Note: Answer **ALL** question each question carries **ONE** mark

MARKS: 8X1 =8

1. List out different types of cast iron
2. Define inoculation
3. Define white and black heart malleable iron
4. Define salvage
5. Mention gating ratio of aluminium casting
6. Define dressing
7. Mention the importance of zircon sand in steel foundry
8. What is trimming?

Part B

Answer **ALL** questions Each Question carries **THREE** marks

MARKS: 4X3 = 12

9(a) List the properties and applications of gray iron

Or

9(b) List out different moulding methods used in aluminium foundry

10(a) Mention the different heat treatments of ductile iron

Or

10(b) List out various casting defects

11(a) Explain the different casting defects in aluminium and copper castings

Or

11(b) Explain the defects caused due to cores

12(a) List out the moulding processes used in steel foundry

Or

12(b) List out various cleaning operations

Part C

Answer **ALL** questions Each Question carries **FIVE** marks

MARKS: 4X5 = 20

13(a) Explain the effect of silicon on iron – iron carbide diagram

Or

13(b) Explain importance of gating and risering of aluminium alloys

14(a) Explain the role of magnesium in ductile iron melting

Or

14(b) Explain the cleaning of castings by using shot blasting operation

15(a) Explain the melting procedure of aluminium alloy

Or

15(b) Explain the melting procedure of copper alloys

16(a) Explain various salvaging techniques for ferrous castings

Or

16(b) Explain various casting defects and mention their remedies

Mechanical Metallurgy

Course title:	Mechanical Metallurgy			Course Code:	18MET-503C	
				Course group:	Core	
Semester:	V			Credits:	3	
Teaching scheme in Periods (LTP):		45:15:0		Total contact Periods. :		60 periods
Type of course: Lecturer+ Assignment:						
CIE:	60 Marks			SEE:	40 Marks	

PREREQUISITES

Basic knowledge of mathematics and Physical metallurgy.

Course Outcomes (Cos)

At the end of the course, the student will be able to:

- CO1: Analyse the role of dislocations in the plastic deformation of metals
- CO2: Apply the concept of plastic deformation for metals and alloys to convert them in to useful shapes
- CO3: Classify various metal forming technology (forging, rolling, extrusion etc.)
- CO4: Differentiate the various metal forming technology and choose the appropriate one for required applications
- CO5: Explain various secondary sheet metal forming procedures and associated equipment

COURSE CONTENT

Unit - 1.0 Plastic deformation of Metals Duration: 08 periods

Elastic and plastic deformation of metals, Lattice Defects, Slip and Slip system, Slip systems for F.C.C., B.C.C. & H.C.P. crystals, Dislocation Climb & Cross slip, Critical Resolved Shear Stress, Low angle grain boundaries, stacking faults, Twinning, Twin planes of B.C.C., F.C.C and H.C.P.

Unit - 2.0 Mechanical working of Metals Duration: 10 periods

Hot working & Cold working, Necessity of annealing to cold worked metal, Recovery, Recrystallization and Grain Growth, Re-crystallization Temperature, Variables influencing the re-crystallization.

Unit - 3.0 Rolling Duration: 08 periods

Rolling Process, Forces and geometrical relationships involved in rolling, Limiting Condition for Rolling, Maximum Reduction in Rolling, Variables in rolling, Classification of rolling mills, Rolling defects and their remedies.

Unit - 4.0 Forging

Duration: 09 periods

Forging, Open die forging operations Edging, Fullering, Swaging, Drawing down, Punching & Piercing, Rotary swaging. Principles of upset forging, Process of manufacture of bolt head, cold heading process for the manufacture of Nails, closed - die forging operations, forging defects and their remedies

Unit - 5.0 Extrusion

Duration: 12 periods

Extrusion, Direct and Indirect extrusion process, extrusion equipment, variables in extrusion process, Extrusion of tubes, Extrusion defects and their remedies, Production of seamless pipes, Wire drawing process.

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Unit - 6.0 Sheet Metal Forming

Duration: 13 periods

Rubber forming, spinning, shearing and blanking, bending operations, stretch forming, uses of deep drawing process and their importance, deep drawing process, deep drawn product defects - orange peel effect, stretcher strains, earing and their remedy, redrawing process

COURSE LEARNING OUTCOMES

On completion of this subject, the student should be able to

- 1.1 Define elastic and plastic deformation
- 1.2 Define Lattice Defect.
- 1.3 Classify Lattice defects.
- 1.4 Define a) Point Defect b) Vacancy c) Substitutional impurity d) interstitial impurity
- 1.5 Explain the relation between number of vacancies and temperature
- 1.6 Define dislocation.
- 1.7 Define edge and screw dislocation.
- 1.8 Explain Edge Dislocation and Screw dislocation.
- 1.9 Explain burgers vector and burgers circuit.
- 1.10 Define slip and slip system.
- 1.11 Explain the slip systems for F.C.C., B.C.C. & H.C.P. crystals.
- 1.12 Explain Slip with both Edge & Screw Dislocations.
- 1.13 Explain Dislocation climb & Cross slip.
- 1.14 Differentiate Edge & Screw Dislocations.
- 1.15 Define Critical Resolved Shear Stress (C.R.S.S).
- 1.16 Derive C.R.S.S for a single crystal.

- 1.17 Solve numerical problems on CRSS
- 1.18 Explain the low angle grain boundaries
- 1.19 Explain Stacking faults.
- 1.20 Explain Twinning.
- 1.21 Identify twin planes and directions of B.C.C., F.C.C and H.C.P space lattices.
- 1.22 Differentiate Slip and Twinning.
- 2.1 Define Mechanical working of Metals
- 2.2 Define hot working & Cold working.
- 2.3 List out the advantages and disadvantages of hot working and cold working.
- 2.4 Explain the Necessity of annealing to cold worked metal.
- 2.5 Explain various stages of annealing treatment of a cold worked metal.
- 2.6 Explain recovery, re-crystallization and grain growth.
- 2.7 Define the re-crystallization temperature.
- 2.8 Explain the variables influencing the re-crystallization temperature.
- 3.1 Define Rolling.
- 3.2 Explain the rolling process.
- 3.3 Generalize the forces and geometrical relationships involved in rolling
- 3.4 Derive the Limiting Condition for Rolling (prove $\mu = \tan \alpha$)
- 3.5 Derive the Expression for Maximum Reduction in Rolling.
- 3.6 Numerical problems on maximum reduction in rolling
- 3.7 Summarize the main variables in rolling.
- 3.8 Classify the rolling mills with respect to a) number of rolls in each stand b) type of product manufactured
- 3.9 Explain various types of rolling defects and their remedies.
- 4.1 Define Forging.
- 4.2 Classify the forging operations.
- 4.3 Explain the open-die forging operations: Edging, Fullering, Swaging, Drawing down, Punching & Piercing.
- 4.4 Explain rotary swaging and its importance
- 4.5 Explain the principles underlying the upset forging.
- 4.6 Explain the process of manufacture of bolt head.
- 4.7 Explain the cold heading process for manufacture of Nails.
- 4.8 Explain in detail the closed - die forging operation.
- 4.9 Explain various forging defects and their remedies.
- 5.1 Define Extrusion
- 5.2 Classify the extrusion processes.
- 5.3 Differentiate the direct and indirect extrusion processes.
- 5.4 List the extrusion equipment.
- 5.5 Explain the variables in extrusion processes.
- 5.6 Explain the extrusion of tubes.
- 5.7 Explain the extrusion defects and their remedies.
- 5.8 Explain the production of seamless pipes.
- 5.9 Explain the wire drawing process.
- 6.1 Explain Rubber forming operation and its importance.
- 6.2 Explain the spinning process.
- 6.3 Explain the shearing and blanking processes.
- 6.4 Explain the bending process.
- 6.5 Explain stretch forming process.

- 6.6 Explain the uses of deep drawing process and its importance.
- 6.7 Explain deep drawing process.
- 6.8 Explain various deep drawn product defects: orange peel effect, stretcher strains, earing and their remedy.
- 6.9 Explain the re-drawing process

Suggested Student Activities

1. Student inspects the available equipment in the Lab to identify the components
2. Visit nearby Industry to familiarize with mechanical working processes like Rolling, Forging, Extrusion and Sheet metal forming
3. Quiz
4. Group discussion
5. Surprise test
6. Seminars

TEXT BOOKS

1. Mechanical metallurgy - by G.E. Dieter.

REFERENCE BOOKS

1. Engineering metallurgy Volume - II - by Higgins.
2. Manufacture of Iron and Steel Volume - IV - by Bash forth.

LIST OF LEARNING WEBSITES

1. <http://nptel.ac.in/course.php>
2. <http://nptel.ac.in/courses/112107144/1>
3. http://www.nptel.ac.in/courses/112108150/pdf/Lecture_Notes/MLN_06.pdf
4. https://web.iit.edu/sites/web/files/departments/academic-affairs/academic-resource-center/pdfs/Material_Deformations_Workshop.pdf

CO-PO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	Mapped POs
CO1	2	3								2	1,2,10
CO2	2	2								2	1,2,10
CO3	3	3				1				2	1,2,10
CO4	3	3				1				2	1,2,10
CO5	3	3				1				2	1,2,6,10

CO6	3	3		2		1				2	1,2,4,6,10
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MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
					11(a)	15(a)	
		11(b)			15(b)		
6	VI		7,8	10(b)	14(b)		
				12(a)	16(a)		
				12(b)	16(b)		
Total Questions		8		8	8		

	Remembering (R)	1 Mark
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Legend:	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID – SEMESTER EXAMINATION (C-18)
D MET E V SEMESTER EXAMINATION
18MET503C – MECHANICAL METALLURGY

Time: 01 hour

Max. Marks: 20

Part A

Note: Answer **ALL** question each question carries **ONE** mark

MARKS: 4X1 =4

1. Define plastic deformation
2. Define lattice defect.
3. Define hot working
4. Define cold working

Part B

Answer **ALL** questions Each Question carries **THREE** marks

MARKS: 2X3 = 6

5(a) Explain slip and slip system.

Or

5(b) Explain dislocation motion by climb

6(a) Explain what is recrystalliasation temperature.

Or

6(b) Write any three differences between hot and cold working.

Part C

Answer **ALL** questions Each Question carries **FIVE** marks

MARKS: 2X5 = 10

7(a) List slip systems for FCC, BCC and HCP crystals

Or

7(b) Derive the equation for CRSS of a single crystal.

8(a) Explain annealing and its stages of a cold worked metal

Or

8(b) Explain the variables that influence recrystalliasation temperature.

MODEL QUESTION PAPER
BOARD DIPLOMA SEMESTER END EXAMINATIONS (C-18)
D MET E V SEMESTER EXAMINATION
18MET503C – MECHANICAL METALLURGY

Time: 02 hours

Max. Marks: 40

Part A

Note: Answer **ALL** question each question carries **ONE** mark

MARKS: 8X1 =8

1. Define Lattice defect.
2. Define hot working.
3. Define extrusion.
4. Define slip system.
5. Define direct extrusion.
6. Define indirect extrusion.
7. Define shearing.
8. Define blanking.

Part B

Answer **ALL** questions Each Question carries **THREE** marks

MARKS: 4X3 = 12

9(a) List the slip systems for BCC crystal.

Or

9(b) Classify the extrusion processes.

10(a) Explain Rolling with a neat sketch

Or

10(b) Explain Rubber forming with a neat sketch

11(a) Write the differences between direct and indirect extrusion.

Or

11(b) Explain any three extrusion defects with causes and remedies.

12(a) Explain spinning with a neat diagram

Or

12(b) Explain bending process.

Part C

Answer **ALL** questions Each Question carries **FIVE** marks

MARKS: 4X5 = 20

13(a) Derive the equation for CRSS of a single crystal.

Or

13(b) Explain the extrusion variables

14(a) Explain any five open die forging operations with neat sketches.

Or

14(b) Explain stretch forming with a neat sketch.

15(a) Explain the extrusion of tubes.

Or

15(b) Explain the production of seamless pipes with a neat diagram.

16(a) Explain deep drawing process with neat sketches

Or

16(b) Explain any two defects of deep drawn products with their causes and remedies.

Non Ferrous Extractive Metallurgy

Course title:	Non Ferrous Extractive Metallurgy			Course Code:	18MET-504A
				Course group:	Core
Semester:	V			Credits:	3
Teaching scheme in Periods (LTP):	45:15:0			Total contact Periods :	60 periods
Type of course: Lecturer+ Assignment:					
CIE:	60 Marks			SEE:	40 Marks

Prerequisites:

Basic knowledge of I semester mineral processing technology

Course outcomes

At the end of course student should be able to

CO1 :	Explain the zinc extraction by using various techniques
CO2 :	Explain the magnesium by different methods from the ores
CO3 :	Explain the titanium extraction and purification from raw ores
CO4 :	Explain the zirconium separation from ore and produce various forms of zirconium products
CO5 :	Explain the copper extraction by using pyro ,hydro, electrometallurgical methods
CO6:	Explain the production of aluminium by hydro and electrolytic methods

Course Contents:

UNIT-1: Zinc Extraction

Duration: 8Periods

Properties uses, ores, deposits, extraction plants in India, Extraction Methods, Roasting, distillation, Pyro metallurgical Extraction, Horizontal Retort, Vertical Retort process, Electro thermic reduction, Imperial smelting process, Hydro metallurgy; Galvanizing.

UNIT-2: Magnesium Extraction

Duration:10Periods

Properties, uses, ores, deposits, Pidgeon process, Dow process.

UNIT-3: Titanium Extraction

Duration: 8 Periods

Properties, Applications, ores, deposits, metallothermic reduction, Treatment of Ilmenite, chlorination, kroll's process, Vanarkell's process.

UNIT- 4: Zirconium Extraction**Duration: 12Periods**

Uses, ores, Treatment of Zircon, Solvent extraction, Fractional crystallization, production of pure zirconium oxide, Zirconium sponge, Zircalloy -2 Tubes, Zirconium Metal powder.

UNIT- 5: Copper Extraction**Duration: 9Periods**

Properties, uses, ores, Deposits, Extraction Plants in India, roasting, pyrometallurgical Extraction, reverberatory smelting, Flash smelting, converting, Fire refining, Electrolytic refining, Recovery of precious Metals, Hydrometallurgy of copper.

UNIT- 6: Aluminium Extraction**Duration: 13Periods**

Properties, uses, ores, Deposits, Extraction plants in India, Bayer process, Hall Heroult's process, refining of Aluminum, Hoopes process, Gleditsch process, Anodizing process

Course Learning Outcomes

Student will be able to

- 1.1 Know the properties, uses and extraction plants of zinc
- 1.2 Explain pyrometallurgical extraction of zinc
- 1.3 Define roasting and purpose of roasting
- 1.4 Distinguish between vertical retort and horizontal retort process.
- 1.5 Explain production of zinc from blast furnace
- 1.6 Explain hydrometallurgical extraction of zinc
- 1.7 Explain galvanizing
- 2.1 List the properties and uses of magnesium
- 2.2 Know extraction plants of magnesium metal
- 2.3 Explain the Dow's process of 'Mg' extraction
- 2.4 Explain the pig iron process for magnesium extraction
- 3.1 List the properties and uses of titanium
- 3.2 Know the ilmenite up gradation methods
- 3.3 Explain the production of titanium by reduction of titanium tetrachloride (Kroll's process)
- 3.4 Explain the purification of titanium by Van Arkel's iodide process
- 4.1 List the properties and applications of zirconium
- 4.2 Explain the production of Zirconium oxide and zirconium sponge
- 4.3 Explain the production of mill products from zirconium sponge metal
- 4.4 Explain the production of zirconium powder
- 5.1 List the properties and applications of copper
- 5.2 Know the extraction plants of copper
- 5.3 Explain pyrometallurgical extraction of copper
- 5.4 Know the smelting and converting of copper metal
- 5.5 Explain the refining process of copper
- 5.6 Explain hydrometallurgical extraction of copper

- 6.1 List the properties and applications of aluminium
- 6.2 Know the extraction plants of aluminium
- 6.3 Explain the purification of bauxite from Bayers process
- 6.4 Production of aluminium metal from Hall-Heroult process
- 6.5 Know the causes and remedies of anode effect
- 6.6 Know the different processs of refining of aluminium metal

Suggested Student Activities

1. Student inspects the available equipment in the Lab to identify the components
2. Quiz
3. Group discussion
4. Surprise test
5. Seminars

Recommended Books

1. Non-ferrous Extractive metallurgy – by Ray, Abraham & Sridhar
2. Non-ferrous extractive metallurgy – by Dennis
3. Elements of metallurgy – by Dr. Swaroop
4. Metal News – Magazine – for Economic & Status by I.I.M.

Suggested E-Learning references

- 1.<https://www.youtube.com/watch?v=EPOIAevJUNM>
- 2.<https://www.youtube.com/watch?v=ccfELRE1vMk>
- 3.<https://www.youtube.com/watch?v=jOKMkaqPZvc>

CO-PO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	Mapped POs
CO1	3	3			1	2		1		2	1,2,5,6,8,10
CO2	3	3			1	2				2	1,2,5,6,10
CO3	3	3			1	1				2	1,2,5,6,10
CO4	3	3			1	1				1	1,2,5,6,10
CO5	3	3			1	1				1	1,2,5,6,10
CO6	3	3			1	1				1	1,2,5,6,10

MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
6	VI				11(a)	15(a)	
					11(b)	15(b)	
				10(b)	14(b)		
	7,8	12(a)		16(a)			
				12(b)	16(b)		
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID SEMESTER EXAMINATIONS (C-18)
D.MET.E V SEMESTER EXAMINATION
18 MET-504A NON FERROUS EXTRACTIVE METALLURGY

Time: 1 Hour

Maximum Marks: 20Marks

PART-A

Answer **ALL** questions. Each question carries **ONE** mark

4X1 =4

1. Define roasting.
2. List out any two ores of Zn.
3. List out any two properties of Mg.
4. Write two extraction plants of Mg.

PART-B

Answer **ALL** questions. Each question carries **THREE** marks

2X3 =6

- 5(a). Explain roasting of Zn ores.
(OR)
5(b). Explain galvanizing.
- 6(a). write three properties and uses of Mg.
(OR)
6(b). Write three ores with chemical formula Zn.

PART-C

Answer **ALL** questions. Each question carries **FIVE** marks

2X5 =10

- 7(a). Explain horizontal retort process.
(OR)
7(b). Explain imperial smelting process.
- 8(a). Explain Dow's process.
(OR)
8(b). Explain Pidgeon's process.

MODEL QUESTION PAPER
BOARD DIPLOMA SEMESTER END EXAMINATIONS (C-18)
D.MET.E V SEMESTER EXAMINATION
18 MET-504A NON FERROUS EXTRACTIVE METALLURGY

Time: 2 Hours

Maximum Marks: 40Marks

PART-A Answer **ALL** questions. Each question carries **ONE** mark

8X1 =8

1. List out two ores of Zn with chemical formula.
2. Write two applications of Ti.
3. Mention two Cu extraction plants in India.
4. Write two uses of Zirconium.
5. Define pyrometallurgy.
6. Define fire refining.
7. Define anodizing.
8. Write the leachant for Bayer's process.

PART-B

Answer ALL questions. Each question carries THREE marks.

4x 3 = 12

- 9(a). Explain Vertical process
(OR)
- 9(b). Explain Reverbaratory smelting of Cu extraction.
- 10(a). Explain treatment of Ilmenite
(OR)
- 10(b). Draw the flow chart of Bayer's process.
- 11(a). Explain Flash smelting of Cu.
(OR)
- 11(b). Explain converting process of Cu extraction.
- 12(a). Explain Anodizing process of Al.
(OR)
- 12(b). Explain Geadau process.

PART-C

Answer ALL questions. Each question carries FIVE marks

4x5=20

- 13(a). Explain Hydrometallurgical extraction of Zn.
(OR)
- 13(b). Explain Fire refining of Cu extraction.
- 14(a). Explain Kroll's Process.
(OR)
- 14(b). Explain Bayer's process.
- 15(a). Explain electrolytic refining of Cu.
(OR)
- 15(b). Explain Hydrometallurgical extraction of Zn.
- 16(a). Explain Hall Heroult's process.
(OR)
- 16(b). Explain Hoope's process.

Industrial Management and Entrepreneurship

Course title:	Industrial Management and Entrepreneurship			Course Code:	18MET-504B	
				Course group:	Functional	
Semester:	V			Credits:	3	
Teaching scheme in Periods (LTP):	45:15:0			Total contact Periods :	60 periods	
Type of course: Lecturer+ Assignment:						
CIE:	60 Marks			SEE:	40 Marks	

Prerequisites: Enthusiasm to know industrial environment

Course Outcomes COs

At the end of the course, the student will have the ability to:

CO1: Explain the principles of management

CO2: Explain the management hierarchy

CO3: Explain the production and material management

CO4: Explain the marketing and sales methods

CO5: Explain the legal aspects of industries

CO6: Explain the ISO procedures.

COURSE CONTENTS

UNIT-1: Principles and functions of management.

Duration: 8 Periods

Definitions of Industry, Commerce and Business. Evolution of management theories. Principles of Scientific Management, functions of management. Difference of administration and management.

UNIT-2: Organisation Structure & organisational behaviour.

Duration: 10 Periods

Role of industry, Types of ownership – Sole proprietorship, Partnership, Private limited, Public limited company, Industrial Cooperatives, Philosophy, types of Organisations, Line and Staff and functional organisations. Advantages and limitations, departments in a large scale industry. Effective organisation. Job analysis, Assessing applicants, selection, motivation, different theories, Leadership in organisation, decision making, communication,

UNIT-3: Materials Management and Production Management.

Duration: 8 Periods

Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, Economic ordering quantity, purchasing procedures, purchase records,

Production, planning and control, relation with other departments, need for planning and its advantages, PERT and CPM, simple problems.

UNIT-4: Marketing, Sales & Feasibility Study

Duration: 12 Periods

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligarchy, perfect competition, Pricing Policies. Elements of Cost, Contribution, Break even analysis, Market Survey, Product and production Analysis, Materials input, Manpower, Location, Economic and Technical Evaluation, preparation of Feasibility study reports, - different products – Mechanical, Electrical, Electronics, consumer items, Consumer desires etc.

UNIT-5: Industrial Legislation

Duration: 9 Periods

Employer – Employee relations, Trade, Union Settlement of disputes, collective bargaining, Welfare activities, subsidies, Total Welfare concept, rights and responsibilities and Employers and employees. Salient features of Indian Factories Act

UNIT-6: Introduction to ISO 9000 and TQM

Duration: 13 Periods

Concept of quality, Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, quality control and quality assurance.

Elements quality systems: Management responsibility, Quality system, contract review, design control, document control, purchasing, purchaser – supplied product, product identification and traceability, process control, Inspection and testing.

Principles of quality assurance – Definition of quality assurance.

Indian standards on quality systems – Main features of IS 13999 : 1990, IS 14000 : 1990, IS 14004 : 1990, IS 14001: 1990, IS 14002 : 1990, IS 14003: 1990.

Know the necessity of International standards – Evolution of ISO. Various standards under ISO – Outstanding features of ISO 9000 series of standards – ISO 9000 Phenomenon ISO 9000 series of quality systems – Constituents of ISO 9000 series of standards for quality systems.

SPECIFIC LEARNING OUTCOMES

Student will be able to

- 1.1 Define industry, commerce (Trade) and business.
- 1.2 Know the need for management.
- 1.3 Understand the evolution of management
- 1.4 Explain the principles of scientific management.
- 1.5 Understand functions of Management.
- 1.6 Differentiate between management and administration.
- 2.1 Understand types of ownerships
- 2.2 Differentiate types of ownerships.
- 2.3 Understand salient features of joint stock companies.
- 2.4 Understand the philosophy and need of organisation structure of an industry.
- 2.5 Understand the line, staff and Functional organisations.
- 2.6 List the advantages and limitations of line, staff and functional organisations.
- 2.7 List different departments in a large scale industry.
- 2.8 Explain the factors of effective organisation.
- 2.9 Understand organisational behaviour.
- 2.10 State motivation theories.
- 2.11 State Maslow's Hierarchy of needs.

- 1.1 Explain the role of the materials in Industry.
- 1.2 Derive expression for inventory control.
- 3.3 Explain ABC analysis.
- 3.4 Define safety stock.
- 3.5 Define reorder level.
- 3.6 Derive an expression for economic ordering quantity.
- 3.7 Explain purchasing procedures.
- 3.8 List out purchase records.
- 3.9 Differentiate and integrate production, planning and control.
- 3.10 State the need for planning and its advantages.
- 3.11 Explain the stages of Production, planning and control.
- 3.12 Draw PERT/CPM networks.
- 3.13 Identify the critical path.
- 1.1 Explain marketing functions.
- 1.2 Explain Sales function.
- 1.3 List out market conditions.
- 1.4 Differentiate Sellers and Buyers' market.
- 1.5 Differentiate monopoly, oligarchy, and perfect competition.
- 1.6 Know market and demand surveys.
- 1.7 Differentiate product and production analysis.
- 1.8 Identify the input materials, i.e. Bill of materials
- 1.9 Explain the concept of cost.
- 1.10 List out the elements of cost.
- 1.11 Explain the concept of contribution.
- 1.12 Explain break-even analysis.
- 1.13 Define the main policy requirements.
- 1.14 Decide the location.
- 1.15 Evaluate Economic and Technical factors.
- 1.16 Preparation of feasibility study.
- 1.1 Describe employer and employee relations.
- 1.2 Describe the mechanics of Trade Unions.
- 1.3 Describe mechanics of settlement of in outs.
- 1.4 Explain the significance of collective bargain.
- 1.5 List out Welfare activities.
- 1.6 Explain the total welfare concept.
- 1.7 List out the rights and responsibilities of employees and employers.
- 1.8 List out the salient features of Indian Factories Act.
- 6.1 Understand the concept of quality.
- 6.2 Know the quality systems and elements of quality systems.
- 6.2 Know the principles of quality Assurance.
- 6.3 Know the Indian Standards on quality systems.
- 6.4 Know the evolution of ISO standards.
- 6.5 Discuss ISO standards and ISO 9000 series of quality systems.

Suggested Student Activities

1. Students go through business news
2. Visit nearby Industry to familiarize with the functioning of different departments
3. Quiz
4. Group discussion
5. Surprise test
6. Seminars

LIST OF LEARNING WEBSITES

1. <https://sloanreview.mit.edu/article/the-processes-of-organization-and-management/>
2. www.yourarticlelibrary.com/material-management/materials-management.../53156
3. <https://www.iso.org/standard/46486.html>

CO-PO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	Mapped POs
CO1	2	3			2	2					1,2,5,6
CO2	2	2	2					1			1,2,3,8
CO3	2	3			2	2					1,2,5,6
CO4	2	3		2							1,2,4
CO5	2	3	3				1				1,2,3,7

MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
6	VI				11(a)	15(a)	
					11(b)	15(b)	
		10(b)	14(b)				
7,8	12(a)	16(a)					
	12(b)	16(b)					
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID SEMESTER EXAMINATIONS (C-18)
D.MET.E V SEMESTER EXAMINATION

18 MET-504B INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Time: 1 Hour

Maximum Marks: 20Marks

PART-A

Answer **ALL** questions. Each question carries **ONE** mark

4X1 =4

1. Define industry.
2. Define business.
3. List out types of ownerships
4. Define line organization

PART-B

Answer **ALL** questions. Each question carries **THREE** marks

2X3 =6

- 5(a). Differentiate management and administration.
(OR)
- 5(b). What are the functions of management?
- 6(a). List out different departments in a large-scale industry
(OR)
- 6(b). List out the advantages and disadvantages of line organization.

PART-C

Answer **ALL** questions. Each question carries **FIVE** marks

2X5 =10

- 7(a). Explain the principles of scientific management.
(OR)
- 7(b). Explain the functions of management.
- 8(a). Explain the factors of effective organization.
(OR)
- 8(b). Explain the staff and functional organization.

MODEL QUESTION PAPER
BOARD DIPLOMA SEMESTER END EXAMINATIONS (C-18)
D.MET.E V SEMESTER EXAMINATION

18 MET-504B INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Time: 2 Hours

Maximum Marks: 40Marks

PART-A

Answer **ALL** questions. Each question carries **ONE** mark

8X1 =8

1. Define industry.
2. Define safety stock.
3. List out welfare activities.
4. Define line organization
5. Write two rights of employees.
6. List out the two responsibilities of employer.
7. Define quality policy.
8. Define quality control.

PART-B

Answer **ALL** questions. Each question carries **THREE** marks.

4x 3 = 12

- 9(a). Compare administration and management.
(OR)
- 9(b). Explain the significance of collective bargain.
- 10(a). Explain ABC analysis.
(OR)
- 10(b). Explain the management responsibilities.
- 11(a). Explain the salient features of Indian factories act
(OR)
- 11(b). Explain the Total welfare concept.
- 12(a). Explain quality system.
(OR)
- 12(b). Explain the product identification and traceability.

PART-C

Answer **ALL** questions. Each question carries **FIVE** marks

4x5=20

- 13(a). Explain the salient features of joint stock companies.
(OR)
- 13(b). Explain the employer and employee relationships.
- 14(a). Explain the stages of production, planning and control.
(OR)
- 14(b). Explain ISO 9000.
- 15(a). Explain the mechanics of trade unions.
(OR)
- 15(b). Explain the rights and responsibilities of employee and employer.
- 16(a). Explain TQM.
(OR)
- 16(b). Explain the evolution ISO standards.

WELDING TECHNOLOGY

Course title:	WELDING TECHNOLOGY			Course Code:	18MET-505A	
				Course group:	Core	
Semester :	V			Credits:	3	
Teaching scheme in Periods. (LTP):	45:15:0			Total contact Periods. :	60 periods	
Type of course: Lecturer+ Assignment:						
CIE:	60 Marks			SEE:	40 Marks	

Prerequisites: knowledge of welding process and welding metallurgy.

Course Outcomes COs

At the end of the course, the student will have the ability to:

CO1: Explain the different welding terms, welding joints and positions.

CO2: Explain briefly gas welding process.

CO3: Explain Arc welding process in detail.

CO4: Explain the inert gas welding process.

CO5: Explain the modern special welding process.

CO6: Explain the weld structures, post weld treatments and weld defect

COURSE CONTENTS

1.0 Basic concepts of Welding.

Duration: 8Periods

Def. and important types of Metal joining techniques. Important Welding Terms.

Edge Preparation and safety measures.

2.0 Oxyacetylene Welding:

Duration: 10 Periods

Introduction, Types and characteristics, Equipment used in oxy acetylene welding, pressure reduction regulators, Types of torches, different welding techniques, butt edge preparation, advantage and applications.

3.0 Electric Arc welding:

Duration: 8Periods

Introduction, Arc column theory, Arc blow, power supplies, Types of welding machines, Welding crater, burn off rate, electrode classification, function of flux coating, Methods of striking an arc and Arc length electrode movements, advantages and applications, submerged arc welding.

4. Gas shield arc welding (inert gas welding):

Duration: 12Periods

Introduction, Types of processes - TIG & MIG. Mode of heat liberation. Metal transfer mechanism, filler metal added to weld puddle in TIG. Advantages and application of TIG & MIG.

5.0 Other Welding processes:

Duration: 9Periods

Introduction, List of special welding processes, plasma Arc welding Resistance welding, Electro slag welding, electron beam welding, thermit welding and laser beam welding.

6.0 Metallurgy of Welds:Duration: 13Periods

Introduction, metallurgical aspects of welding, weld ability, HAZ. Micro structures of welds. PWHT. Welding defects and remedies.

COURSE LEARNING OBJECTIVES

After the completion, of course the student will be able

Basic concepts of Welding.

- 1.1 Explain the various metal joining techniques.
- 1.2 Define welding.
- 1.3 Classify the welding processes – fusion and pressure welding processes
- 1.4 List the important welding process
- 1.5 Explain the importance of welding as a fabrication technique.
- 1.6 Explain the important welding terms.
 - a. Weld bead b. Crater, c. Filler weld d. Penetration
 - e. Puddle f. Weld metal g. Weld pass
- 1.7 Explain the different types of weld joints.
 - a. Butt joint b. Lap joint c. Corner joint
 - d. T – joint e. Edge joint
- 1.8 Explain about the welding position.
 - a. Flat b. Vertical c. Horizontal d. Overhead
- 1.9 Explain the need for edge preparation in welding.
- 1.10 Mention the edge preparation Methods for butt joints.
 - a. V – type b. Bevel
 - c. U – type d. T – type
- 1.11 Explain the safety practices in welding.
- 2.1 List the steps involved in burning of Oxygen and acetylene.
- 2.2 Explain the characteristics of oxy acetylene flame.
- 2.3 Describe the types of oxy acetylene flames and state their applications.
 - a. Carburizing b. Oxidizing c. Neutral
- 2.4 List the equipment for oxy acetylene welding.
- 2.5 Explain different accessories of oxygen and acetylene cylinders
 - a. Regulators b. Torches c. Hose pipes d. Control valves.
- 2.6 Draw the sketch of oxyacetylene welding outfit and label the parts with color codes.
- 2.7 Explain the principles and operations of pressure reduction regulator, with line diagrams.
 - a. Single stage regulator. b. Two stage regulator
- 2.8 Explain the types of torches used in oxyacetylene welding with neat sketches.
 - a. Injector or low pressure torch b. Equal pressure torch
- 2.9 Explain the different welding techniques with neat sketches
 - a. Fore hand welding techniques b. Back hand welding technique
- 2.12 List the advantages and applications of oxyacetylene welding.
- 3.1 Define Arc Column
- 3.2 Explain arc column theory with typical Arc welding circuit.
- 3.3 Explain what are the major heat areas in the arc column
- 3.4 Define arc blow
- 3.5 Explain the Methods of reducing the arc blow, causes and effects on welding.
- 3.7 Explain straight and reverse polarity – DCSP and DCRP and differentiate.
- 3.8 Explain the metal transfer mechanism from electrode to the base metal with line sketches
- 3.9 Define burn off rate.
- 3.10 Explain the functions of flux coating on shield arc electrodes.
- 3.11 Explain the Methods of striking an arc
- 3.12 List the advantages and applications of Arc Welding
- 3.13 Explain the principle of submerged arc welding
- 3.14 List the advantages and applications of submerged arc welding.

- 4.1 Introduction
- 4.2 List different inert gas welding processes.
 - (a) Tungsten inert gas welding (TIG) or GTAW.
 - (b) Metal inert gas welding (MIG) processes
- 4.3 Explain the functions shielding gases.
- 4.4 Explain how heat is liberated in TIG & MIG processes
- 4.5 Explain the MIG welding technique
- 4.6 List the advantage and applications of MIG
- 4.7 Explain the metal transfer mechanism in MIG with line sketches.
- 4.8 Explain the TIG welding technique.
- 4.9 Explain how filler metal is added to the puddle
- 4.10 List the advantages and application of TIG.
- 5.1 List the special welding processes
 - a. Plasma arc welding
 - b. Resistance welding
 - c. Electro slag welding
 - d. Electro beam welding and laser beam welding
 - e. Thermit welding
- 5.2 Differentiate plasma gas and shielding gases.
- 5.3 Explain the plasma arc welding process (in brief)
- 5.4 List application and advantages of plasma arc welding
- 5.5 Define resistance welding
- 5.6 List the types of resistance welding
 - A. Spot welding
 - B. Seam welding
 - C. Projection welding
 - D. Butt welding
 - E. Flash welding
- 5.7 Explain in brief the above resistance welding processes and state its applications
- 5.8 Explain in brief the electro slag welding process and its applications.
- 5.9 Explain in brief the electron beam welding and its applications
- 5.10 Explain in brief the Thermit welding process and its applications
- 5.11 Explain in brief the laser beam welding and its applications.
- 6.1 Explain the metallurgical aspects of welding w.r.t weld puddle solidification
- 6.2 Explain the different heat affected zones in welding.
- 6.3 Draw the microstructure of a cross section of a weld joint and state the salient features
- 6.4 Define weldability
- 6.5 Explain the factors influencing weldability of Metals and Alloys.
- 6.6 Explain the necessity of post weld treatment
- 6.7 Explain in brief the post weld treatments
- 6.8 List the various welding defects and state their remedies
 - a) Under cut & overlap
 - b) Gas porosity
 - c) Slag inclusion
 - d) Poor penetration
 - e) Centre line cracking

Suggested Student Activities

1. Student inspects the available equipment in the Lab to identify the various furnaces.
2. Visit nearby Industry to familiarize with Heat treatment lab equipment like Muffle furnace, salt bath furnace and jominy end quench test. Gas carburizing and surface Hardening.
3. Quiz
4. Group discussion
5. Surprise test
6. Seminars.

REFERENCE BOOKS:

- | | |
|---------------------------------------|------------------------|
| 1. Welding and welding technology | -by R.Little |
| 2. Welding Engineering | -by Agarwal&Tahilani |
| 3. Welding Technology | -by O.P.Khanna. |
| 4. Manufacturing technology | -by P.N.Rao |
| 5. Engineering metallurgy part I & II | -by Raymond A. Higgins |

LIST OF LEARNING WEBSITES

<http://www.nptel.ac.in/course.php>
<https://www.msm.cam.ac.uk/ug-study/part-ia>
<https://www.youtube.com/watch?v=CoHVA7nr82A>
<https://www.youtube.com/watch?v=sWfMn2LVews>
<https://www.youtube.com/watch?v=U1GTgDQFE4A>
<https://www.youtube.com/watch?v=AwL1CAg43PU>
<https://www.youtube.com/watch?v=51Zs8iaydt0>
<https://www.youtube.com/watch?v=WW0wHHLX8cY>
<https://www.youtube.com/watch?v=WW0wHHLX8cY>.

MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
6	VI				11(a)	15(a)	
		7,8		10(b)	14(b)		
			12(a)	16(a)			
			12(b)	16(b)			
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID-SEMSTER EXAMINATIONS (C-18)
D.MET.E - V SEMESTER EXAMINATION
18MET-505A- WELDING TECHNOLOGY

TIME: 1 HOUR

MAX MARKS: 20

PART-A

MARKS: 4X1= 4 MARKS

NOTE: Answer ALL questions, each question carries ONE mark.

1. Define welding
2. Define weld penetration.
3. Define carburising flame.
4. Define fore hand welding technique.

PART-B

MARKS: 2X3= 6 MARKS.

NOTE: Answer ALL questions, each question carries THREE marks

- 5 (a) Write any four welding process.

Or

- 5(b) Draw a neat sketch of a edge joint.

- 6(a) Explain the characteristics of oxy acetylene flame.

or

- 6(b) Write any four application of oxyacetylene welding.

PART-C

MARKS: 2X5= 10 MARKS.

NOTE: Answer ALL questions, each question carries FIVE marks

- 7(a) Explain the different weld joints with neat sketch.

OR

- 7(b) Explain the different weld positions with neat sketch.

- 8(a) Explain the operation of a two stage pressure regulator with diagram.

OR

- 8(b) Explain the welding techniques with diagram.

MODEL QUESTION PAPER
BOARD DIPLOMA SEMSTER END EXAMINATIONS (C-18)
D.MET.E - V SEMESTER EXAMINATION
18MET-505A- WELDING TECHNOLOGY

TIME: 2 HOURS

MAX MARKS: 40

PART-A

MARKS: 4X1= 4 MARKS

NOTE: Answer ALL questions, each question carries ONE mark.

1. Write the various metal joining techniques
2. Write the different Inert gases in welding process.
3. Define Resistance welding.
4. Define Arc column
5. Define Thermit welding.
6. Define plasma arc welding.
7. Define weldability.
8. Write any three welding defects.

PART-B

MARKS: 4X3= 12 MARKS.

NOTE: Answer ALL questions, each question carries THREE marks

- 9(a) Write any four safety rules in welding.
Or
9(b) Write any four application of laser beam welding.
- 10(a) Draw the equipment of a oxyacetylene welding.
or
10(b) Write the different HAZ in welding.
- 11(a) Write the types of resistance welding process.
OR
11(b) Write any four applications of electro slag welding
- 12(a) Write the causes and remedies of gas porosity
OR
12(b) Write the causes and remedies of slag inclusions.

PART-C

MARKS: 4X5= 20 MARKS.

NOTE: Answer ALL questions, each question carries FIVE marks

- 13(a) Explain the need for edge preparation in welding.
OR
13(b) Explain the electron beam welding process.
- 14(a) Explain the operation of equal pressure welding torch with diagram.
OR
14(b) Explain the necessity of post weld treatments.
- 15(a) Explain the electro slag welding process.
OR
15(b) Explain projection resistance welding process.
- 16(a) Draw the cross section of a weld joint and state salient features.
OR
16(b) Explain the factors influencing the weldability of metals and alloys.

Corrosion Engineering

Course title:	Corrosion Engineering			Course Code:	18MET-505B
				Course group:	core
Semester:	V			Credits:	3
Teaching scheme in Periods (LTP):	45:15:0			Total contact Periods. :	60 periods
Type of course: Lecture + Assignment:					
CIE:	60 Marks			SEE:	40 Marks

Prerequisites: Basic knowledge of mathematics and engineering chemistry

Course Outcomes COs

At the end of the course, the student will have the ability to:

CO1: Classify corrosion and explain rate of corrosion

CO2: Explain various principles of corrosion

CO3: Explain various types of corrosion

CO4: Explain kinetics of oxidation of metals, nature and structure of oxides

CO5: Explain various methods of protection against corrosion

COURSE CONTENTS

Unit – 1.0 Introduction to Corrosion

Duration: 08 periods

Definition, Importance of corrosion studies, Classification of corrosion, Expression for corrosion rate. Electrochemical principles of corrosion, Faraday's laws, Types of electrochemical cells,

Unit 2.0 Corrosion principles

Duration: 10 periods

Thermodynamic principles of corrosion, Electrode potential of Metals, Nernst Equation for electrode potentials, Reversible Hydrogen electrode, Conversion of signs for electrode potentials, electromotive series/standard electrode potentials and thermodynamic corrosion theory. Galvanic series of Metals and alloys, extended thermodynamics – E/PH diagram.

Unit 3.0 Types of Corrosion – I

Duration: 08 periods

Atmospheric corrosion, Corrosion by mineral acids, Intergranular corrosion, Sensitization in austenitic stainless steels – Mechanism, Pitting corrosion, Exfoliation, De-alloying, Dezincification, Graphitization, Galvanic corrosion,

Unit 4.0 Types of Corrosion – II Duration: 12 periods

Crevice corrosion, Fill form corrosion, Water line attack, Stress corrosion cracking, Hydrogen embrittlement, Corrosion fatigue, Erosion corrosion, Cavitation corrosion, Fretting corrosion.

Unit 5.0 Oxidation of Metals Duration: 09 periods

Protective and non-protective scales, electrochemical nature of oxidation, Oxidation kinetics, Oxide structure, Effect of alloying, Oxidation Resistant alloys.

Unit 6.0 Protection against corrosion Duration: 13 periods

Design improvement, Change of metal, Change of composition, Change of microstructure, Change of environment, Use of inhibitors, Change of operating variability, Change of metal potential, Cathodic protection, Anodic protection, metallic coatings, Non-metallic coatings.

COURSE LEARNING OUTCOMES

On completion of this subject, the student should be able to

- 1.1 Define corrosion.
- 1.2 Explain the importance of corrosion study.
- 1.3 Classify corrosion.
- 1.4 Explain the equation for corrosion rate.
- 1.5 Explain electro chemical principles of corrosion.
- 1.6 Explain Faraday's laws.
- 1.7 Explain types of electro chemical cells.
- 2.1 Explain thermodynamic principles of corrosion.
- 2.2 Explain electrode potential of Metals.
- 2.3 Derive Nernst equation for electrode potentials.
- 2.4 Explain reversible hydrogen electrode.
- 2.5 Explain important reference electrodes.
- 2.6 Explain signs for electrode potentials.
- 2.7 Explain electromotive series/ standard electrode potentials and thermodynamics corrosion theory.
- 2.8 Explain galvanic series of Metals and alloys.
- 2.9 Explain the applications and limitations of the galvanic series.
- 2.10 Explain E/PH diagrams and their applications and limitations.
- 3.1 Explain atmospheric corrosion.
- 3.2 Explain the factors effecting atmospheric corrosion.
- 3.3 Explain the remedial measures of atmospheric corrosion.
- 3.4 Explain corrosion by minerals and acids.
- 3.5 Explain Inter granular corrosion.
- 3.6 Explain sensitization in austenitic stainless steels.
- 3.7 Explain pitting corrosion and state general characteristics of pitting corrosion.
- 3.8 Explain pitting in stainless steels and its prevention.
- 3.9 Explain about exfoliation.
- 3.10 Explain general characteristics of exfoliation and its remedial measures.
- 3.11 Explain De alloying.

- 3.12 Explain about De zincification.
- 3.13 Explain about Graphitization.
- 3.14 Explain about galvanic corrosion.
- 3.15 Explain the factors effecting galvanic corrosion and its protective measures.
- 4.1 Explain Crevice corrosion.
- 4.2 Explain the factors effecting crevice corrosion and its remedial measures.
- 4.3 Explain filiform corrosion.
- 4.4 Explain the factors affecting fill form corrosion and its remedial measures.
- 4.5 Explain about water line attack.
- 4.6 Explain metal -ion concentration
- 4.7 Explain stress corrosion cracking.
- 4.8 Explain the factors affecting stress corrosion cracking and its remedial measures.
- 4.9 Explain about Hydrogen embrittlement.
- 4.10 Explain about corrosion fatigue.
- 4.11 Explain about erosion corrosion.
- 4.12 Explain cavitation corrosion.
- 4.13 Explain fretting corrosion.
- 5.1 Explain protective and non-protective scales.
- 5.2 Explain electrochemical nature of oxidation.
- 5.3 Explain oxidation kinetics.
- 5.4 Explain Oxide structure.
- 5.5 Explain the effect of alloying on oxidation.
- 5.6 Explain Oxidation resistant alloys.
- 6.1 Explain design improvements.
- 6.2 Explain protection against corrosion by change of metal composition, microstructure and environment.
- 6.3 Explain uses of Inhibitors.
- 6.4 Explain protection against corrosion by change of operating variables.
- 6.5 Explain protection against corrosion by change of metal potential.
- 6.6 Explain cathodic protection and anodic protection.
- 6.7 Compare between cathodic protection and anodic protection.
- 6.8 Explain metallic and non-metallic coatings and list out the uses of coatings.

Suggested Student Activities

- 1. Visit nearby Industry to familiarize with corrosion and protective measures against corrosion
- 3. Quiz
- 4. Group discussion
- 5. Surprise test
- 6. Seminars

TEXT BOOKS

1. An Introduction to metallic corrosion and its prevention - by Raj Narayan. (Oxford & IBH Publishing Co)

REFERENCE BOOKS

1. Corrosion Engineering - by Greene & Fortanna (Mc – Grawhill Publishing.)
2. Corrosion prevention and control P.J Jellings edition 2005
3. Theory of Corrosion and Protection of Metals, N. D. Tomashov, Macmillan, 1967
4. Corrosion and Corrosion Control, H. H. Uhlig, Wiley, 1985.

LIST OF LEARNING WEBSITES

1. <https://corrosion-doctors.org/Principles/Course.htm>
2. <https://www.icorr.org/souces-of-information/>
3. <https://www.nace.org/Training-and-Education/Training-Programs/Basic-Corrosion/>
4. <https://www.journals.elsevier.com/corrosion-science>

MID SEM-I EXAM

S.No	Unit Name	R	U	A	Remarks
1	Unit-I	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-II	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	
MID SEM –II EXAM					
S.No	Unit Name	R	U	A	Remarks
1	Unit-III	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Unit-IV	3, 4	6(a) 6(b)	8(a) 8(b)	
Total Questions		4	4	4	

Semester End Examination

Sl No	Unit No.	Questions to be set for SEE				Remarks	
		R		U	A		
1	I	4	1		9(a)	13(a)	
2	II						
3	III		2		10(a)	14(a)	
4	IV						
5	V		3	5, 6	9(b)	13(b)	
6	VI				11(a)	15(a)	
		7,8	10(b)	14(b)			
			12(a)	16(a)			
			12(b)	16(b)			
Total Questions		8		8	8		

Legend:	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

MODEL QUESTION PAPER
BOARD DIPLOMA MID – SEMESTER EXAMINATION (C-18)
D MET E V SEMESTER EXAMINATION
18MET505 B – CORROSION ENGINEERING

TIME: 01 HOUR

MAX. MARKS: 20

Part A

Note: Answer **ALL** question each question carries **ONE** mark

MARKS: 4X1 =4

- 1 Define corrosion
- 2 Define corrosion rate.
- 3 Define electrode potential
- 4 Write the Nernst equation

Part B

Answer **ALL** questions Each Question carries **THREE** marks

MARKS: 2X3 = 6

5(a) Classify corrosion

Or

5(b) Explain the importance of corrosion study

6(a) Explain reversible hydrogen electrode.

Or

6(b) Explain sign for electrode potentials

Part C

Answer **ALL** questions Each Question carries **FIVE** marks

MARKS: 2X5 = 10

7(a) Explain electro chemical principles of corrosion

Or

7(b) Explain Faraday's laws of electrolysis

8(a) Derive Nernst equation for electrode potential

Or

8(b) Explain galvanic series of metals and alloys.

MODEL QUESTION PAPER
BOARD DIPLOMA SEMESTER END EXAMINATIONS (C-18)
D MET E V SEMESTER EXAMINATION
18MET505B – CORROSION ENGINEERING

TIME: 02 HOURS

MAX. MARKS: 40

Part A

Note: Answer **ALL** question each question carries **ONE** mark

MARKS: 8X1 =8

1. Define corrosion
2. Write the equation for corrosion rate.
3. Define protective scale.
4. Define inhibitor
5. Define non-protective scale.
6. Write the role of Chromium on oxidation resistance.
7. Define cathodic protection.
8. Define anodic protection.

Part B

Answer **ALL** questions Each Question carries **THREE** marks

MARKS: 4X3 = 12

9(a) Explain Faraday's laws of electrolysis

Or

9(b) Explain electrochemical nature of oxidation.

10(a) Explain hydrogen embrittlement

Or

10(b) Explain protection against corrosion by change of composition

11(a) Explain oxidation kinetics

Or

11(b) Explain the effect of alloying on oxidation.

12(a) Explain protection against corrosion by change of microstructure

Or

12(b) Explain metallic and non-metallic coatings in protection against corrosion.

Part C

Answer **ALL** questions Each Question carries **FIVE** marks

MARKS: 4X5 = 20

13(a) Explain galvanic series of metals and alloys.

Or

13(b) Explain oxide structure w.r.t corrosion protection

14(a) Explain about de zincification.

Or

14(b) Explain the role of design improvement in combating corrosion.

15(a) Explain any two oxidation resistant alloys w.r.t their composition

Or

15(b) Explain any two oxidation resistant alloys w.r.t the maximum temperature up to which they can be safely exposed.

16(a) Explain protection against corrosion by change of operating variables

Or

16(b) Explain protection against corrosion by change of metal potential

Physical metallurgy Lab

Course Title :	Physical metallurgy lab	Course Code	18MET-506P
Semester	V	Course Group	Core
Teaching Scheme in Periods(L:T:P)	15:00:30	Credits	1.5
Methodology	Lecture + Practical	Total Contact Periods	45
CIE	60 Marks	SEE	40 Marks

Pre requisites

This course requires the basic skills of handling

Course Outcomes

Course Contents

1.0 To prepare the models of crystal structures.

Preparation of models of simple cubic SC, BCC,FCC and HCP.

2.0 Microstructures of stainless steel.

Identification of the phases present in Austenitic stainless steel, Ferritic stainless steel, precipitation hardenable stain less steels

3.0 Microstructures of Copper and Copper alloys.

Identification of the phases present in pure copper, muntz metal (alpha plus beta), Aluminum Brass, monel and gunmetal

4.0 Study of Microstructures of Aluminium alloys.

Identification of the phases present in Duralumin, Al-Si alloy, Al-Mg-Zn alloy

5.0 Study of Microstructures of Case hardened steels.

Identification of the phases present in case carburized steel, nitrided steel, surface hardened steel.

State Board of Technical Education and Training, Telangana

Mid Semester -1 Examination Model Question paper

D.MET.E V semester practical Examination

Corse Code: 18MET 506P

Duration: 01 hour

Course Name: Physical metallurgy Lab

Max.Marks:20

Instructions to the Candidate:

- (i) Answer any One of the following Questions.**
- (ii) Record the results on a graph sheet if required, and conclude your observation of the experiment**

1. Write the procedure to prepare the models of crystal structures and prepare the model of BCC crystals using marbles
2. Write the procedure to prepare the models of crystal structures and prepare the model of FCC and HCP crystals using marbles
3. Write the procedure to prepare a sample of austenitic stainless steel for metallographic observation and observe and draw the microstructure
4. Write the procedure to prepare a sample of ferritic stainless steel for metallographic observation and observe and draw the microstructure

State Board of Technical Education and Training, Telangana

Mid Semester -2 Examination Model Question paper

D.MET.E V semester practical Examination

Corse Code: 18MET 506P

Duration: 1 hour

Course Name: Physical metallurgy Lab

Max.Marks:20

Instructions to the Candidate:

(i) Answer any One of the following Questions.

(ii) Record the results on a graph sheet if required, and conclude your observation of the experiment

1. Write the procedure to prepare a sample of brass for metallographic observation and observe and draw the microstructure
2. Write the procedure to prepare a sample of pure copper for metallographic observation and observe and draw the microstructure
3. Write the procedure to prepare a sample of duralumin for metallographic observation and observe and draw the microstructure

State Board of Technical Education and Training, Telangana

Semester End Examination Model Question paper

D.MET.E V semester practical Examination

Corse Code: 18MET 506P

Duration: 2 hours

Course Name: Physical metallurgy Lab

Max.Marks:40

Instructions to the Candidate:

(i) Answer any One of the following Questions.

(ii) Record the results on a graph sheet if required, and conclude your observation of the experiment

1. Write the procedure to prepare the models of crystal structures and prepare the model of BCC Crystals using marbles
2. Write the procedure to prepare the models of crystal structures and prepare the model of FCC and HCP crystals using marbles
3. Write the procedure to prepare a sample of austenitic stainless steel for metallographic observation and observe and draw the microstructure
4. Write the procedure to prepare a sample of ferritic stainless steel for metallographic observation and observe and draw the microstructure
5. Write the procedure to prepare a sample of brass for metallographic observation and observe and draw the microstructure
6. Write the procedure to prepare a sample of pure copper for metallographic observation and observe and draw the microstructure
7. Write the procedure to prepare a sample of duralumin for metallographic observation and observe and draw the microstructure

Non – Destructive Testing Lab

Course Title :	Non – Destructive Testing lab	Course Code	18MET-507P
Semester	V	Course Group	Core
Teaching Scheme in Periods(L:T:P)	15:00:30	Credits	1.5
Methodology	Lecture + Practical	Total Contact Periods	45
CIE	60 Marks	SEE	40 Marks

Pre requisites

Basic awareness of safety precautions of a laboratory

Course Outcomes

At the end of the course, the student will have the ability to:

Course Outcome		Linked PO
CO1	Conduct the Dye penetrant test on the given component and detect the surface cracks	1,2,3,4,9
CO2	Conduct the fluorescent penetrant test on the given component and detect the surface cracks	1,2,3,4,9
CO3	Conduct the magnetic particle test and identify the surface and sub-surface flaws in the given component	1,2,3,4,9
CO4	Operate the ultrasonic flaw detector and can conduct the test to determine the flaws in the given component	1,2,3,4,9
CO5	Interpret the X ray and Gamma ray radiographs	1,2,3,4,9

Course Contents

1. Dye Penetrant test

Preparation of the sample for the test - Identification of the chemicals used - Distinguishing the chemicals employed – Conducting the test - Identifying the cracks and interpreting the results - industrial applications

2. Fluorescent Liquid Penetrant test

Preparation of the sample for the test - Identification of the chemicals used - Distinguishing the chemicals employed – conducting the test - Identifying the cracks and interpret the result - industrial applications

3. Magnetic particle test

Preparation of the equipment with relevant connections - Preparation of the sample for the test - Identifying the material suitability for the test - Setting the equipment for magnetization – conducting the test - Identifying the flaws

4. Ultrasonic test

Preparation of the equipment with relevant connections – Identifying different probes -
Preparation of the sample for the test - conducting the test - Identifying the flaws and interpretation of the results

5. Interpretation of X ray and Gamma ray radiographs

Collection of X ray and Gamma ray radiographs of different flaws in castings or heat treated components then interpreting the radiographs for the flaws

List of learning websites

1. <https://www.youtube.com/watch?v=xEK-c1pkTUI>
2. <https://www.youtube.com/watch?v=93sRATwdHo4>
3. <https://www.youtube.com/watch?v=l7CJ2SoRu0c>
4. <http://www.nde-ed.org/>

State Board of Technical Education and Training, Telangana
Mid Semester - 1 Examination Model Question paper
D MET E V semester practical Examination

Corse Code: 18MET507P

Duration: 1 hour

Course Name: Non – Destructive Testing Lab

Max.Marks:20

Instructions to the Candidate:

(i) Answer any One of the following Questions.

(ii) Record the results on a graph sheet if required, and conclude your observation of the experiment

1. Write the principle and procedure of dye Penetrant test and conduct the test to detect the surface cracks on the given component
2. Write the principle and procedure of fluorescent liquid Penetrant test and conduct the test to detect the surface cracks on the given component
3. Write the principle and procedure involved in the Magnetic particle test and conduct the test to detect the longitudinal surface cracks on the given specimen

State Board of Technical Education and Training, Telangana
Mid Semester -2 Examination Model Question paper
D MET E V semester practical Examination

Corse Code: 18MET507P

Duration: 1 hour

Course Name: Non – Destructive Testing Lab

Max.Marks:20

Instructions to the Candidate:

(i)Answer any One of the following Questions.

(ii)Record the results on a graph sheet if required, and conclude your observation of the experiment

1. Write the principle and procedure involved in the Magnetic particle test and conduct the test to detect the transverse surface cracks on the given specimen
2. Write the principle and procedure involved in the ultrasonic test and conduct the test to detect the flaws in the given specimen
3. Identify and interpret the flaws present in the given radiographs (I,e X-ray radio graphs and gamma - ray radio graphs)

State Board of Technical Education and Training, Telangana

Semester End Examination Model Question paper

D MET E V semester practical Examination

Corse Code: 18MET507P

Duration: 2 hours

Course Name: Non – Destructive Testing Lab

Max.Marks:40

Instructions to the Candidate:

(i)Answer any One of the following Questions.

(ii)Record the results on a graph sheet if required, and conclude your observation of the experiment

1. Write the principle and procedure of dye Penetrant test and conduct the test to detect the surface cracks on the given component
2. Write the principle and procedure of fluorescent liquid Penetrant test and conduct the test to detect the surface cracks on the given component
3. Write the principle and procedure involved in the Magnetic particle test and conduct the test to detect the longitudinal surface cracks on the given specimen
4. Write the principle and procedure involved in the Magnetic particle test and conduct the test to detect the transverse surface cracks on the given specimen
5. Write the principle and procedure involved in the ultrasonic test and conduct the test to detect the flaws in the given specimen
6. Identify and interpret the flaws present in the given radiographs (I,e X-ray radio graphs and gamma - ray radio graphs)

COMPUTER AIDED DESIGN LAB

Course Title :	COMPUTER AIDED DESIGN LAB	Course Code	18MET-508P
Semester	V	Course Group	Core
Teaching Scheme in Periods(L:T:P)	15:00:30	Credits	1.5
Methodology	Lecture + Practical	Total Contact Periods	45
CIE	60 Marks	SEE	40 Marks

Pre requisites

This course requires the basic knowledge of manufacturing process and Auto CAD

COURSE OUTCOMES

At the end of the course the students will have the ability :	
1	List the commands of 3D
2	Create three-dimensional entities using different methods
3	Practice on Primitives with 3d Basics
4	Apply edit tools on Primitives
5	Apply the selection of material from library
6	Create the part drawing with a given geometry using Solid Modeling software

COURSE CONTENT

Viewing entities in three dimensions

- setting a new viewing direction
- dynamically setting a view direction

Creation of three-dimensional entities using different methods

- Drawing of two dimensional entities in three dimensional space
- Converting two dimensional planar entities into three dimensional entities by applying elevation and thickness
- Converting two dimensional planar entities into three dimensional entities by revolving or extruding.

Creation of three-dimensional faces, rectangular meshes, ruled surface meshes, extruded surface meshes, revolved surface meshes, three dimensional entities such as boxes, Cylinders, Cones, Spheres, wedges, torus, Regions, extruded solids, revolved solids, composite solids, intersect solids.

Editing in three dimensions

Rotating in three dimensions, Array in three dimensions (Rectangular and polar)

Mirroring in three dimensions, Aligning in three dimensions

Editing of three dimensional solids

Sectioning and Slicing of solids, hiding, shading and rendering

Selection of material from library

Enable the material library, Editing materials and material library

The importance of Solid Modelling software like PRO-E / UNIGRAPHICS / CATIA

Use any of the solid modelling packages stated above and generate a solid model of a machine component for different 3D components

A) CAD 3D lab practice

COURSE LEARNING OBJECTIVES

1.0 Upon completion of the course the student shall be able to understand the concepts of 3D

- 1.1. View entities in three dimensions
 - To set a new viewing direction
 - To dynamically set a view direction

2.0 Create three-dimensional entities using different methods

- Draw two dimensional entities in three dimensional space
 - Convert two dimensional planar entities into three dimensional entities by applying elevation and thickness
 - Convert two dimensional planar entities into three dimensional entities by revolving or extruding.
- 1.1 Create three-dimensional faces
 - 1.2 Create rectangular meshes
 - 1.3 Create ruled surface meshes
 - 1.4 Create extruded surface meshes
 - 1.5 Create revolved surface meshes
 - 1.6 Create three dimensional entities such as boxes, Cylinders, Cones, Spheres, wedges, torus, Regions,
 - 1.7 Create extruded solids
 - 1.8 Create revolved solids
 - 1.9 Create composite solids
 - 1.10 Create intersect solids

2.0 Edit in three dimensions

- 2.1 Rotate in three dimensions
- 2.2 Array in three dimensions (Rectangular and polar)
- 2.3 Mirror in three dimensions
- 2.4 Align in three dimensions

3.0 Edit three dimensional solids

- 3.1 Practice Sectioning and Slicing solids
- 3.2 Practice hiding, shading and rendering

4.0 Practice the selection of material from library

- 4.1 Enable material library
- 4.2 Edit materials and material library

5.0 Appreciate the importance of Solid Modelling software like CREO (PRO-E) UNIGRAPHICS / CATIA

- 5.1 Use any of the solid modelling packages stated above and generate a solid model of a machine component for different 3D components

**CAD LAB PRACTISE
MODEL PAPER FOR MID -1 (CIE)**

TIME: 1hr**Marks: 20M****PART-A**

NOTE: Answer all questions
8marks

4 X 2 =

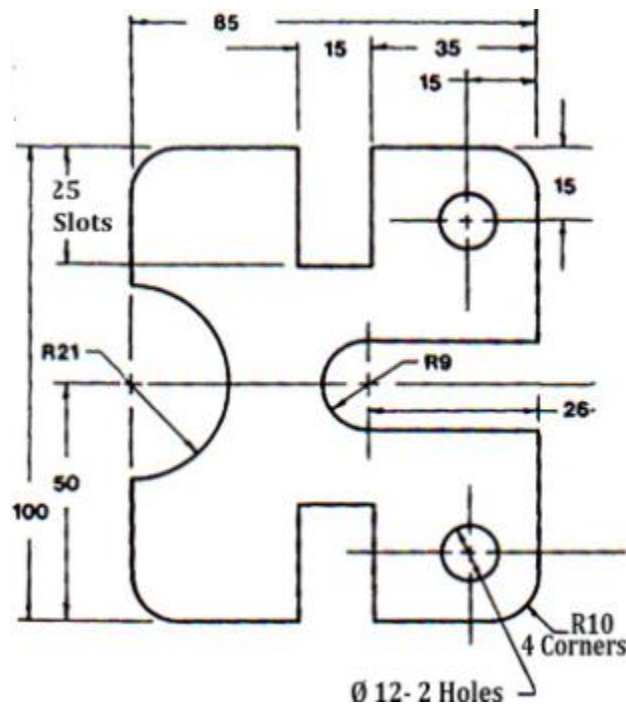
1. Create four layers, name the layers and assign different properties like line color, line type, line weight to different layers.
2. Write the procedure to create a block.
3. What is meant by attribute..
4. What do you mean by layer and what are the advantages of it.

PART-B

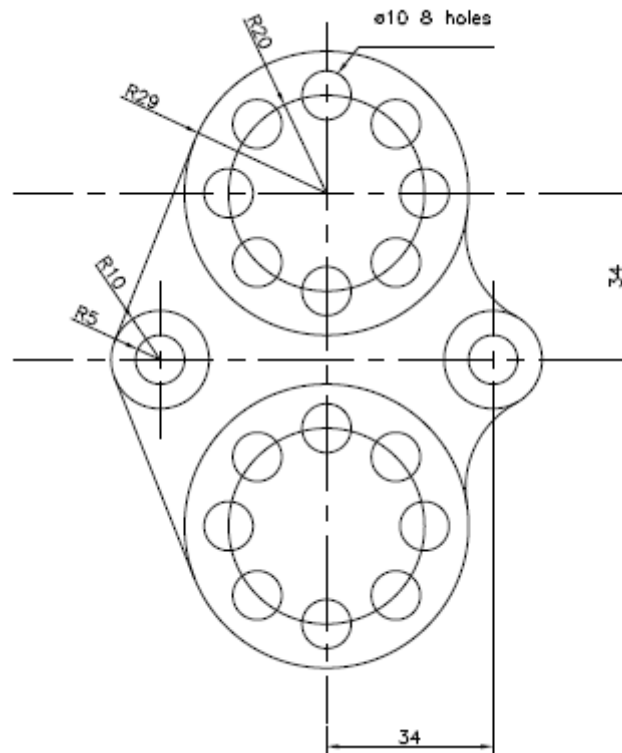
NOTE: Answer any one questions
12marks

1 X 2 =

5. Draw the following using Layers. Use different layers to different line types, text, dimension and main figure.



6. Draw the following using Layers. Use different layers to different line types, text, dimension and main figure.



**CAD LAB PRACTISE
MODEL PAPER FOR MID -2 (CIE)**

TIME: 1hr**Marks: 20M**

PART-A

NOTE: Answer all questions

8marks

4 X 2 =

1. Draw rectangle of 100x60 and extrude to a depth of 25mm.
2. Draw a cylinder of dia 50mm and height 100mm.
3. List various Boolean operations
4. Draw a cube of 100mm side and make a hole of 25mm.

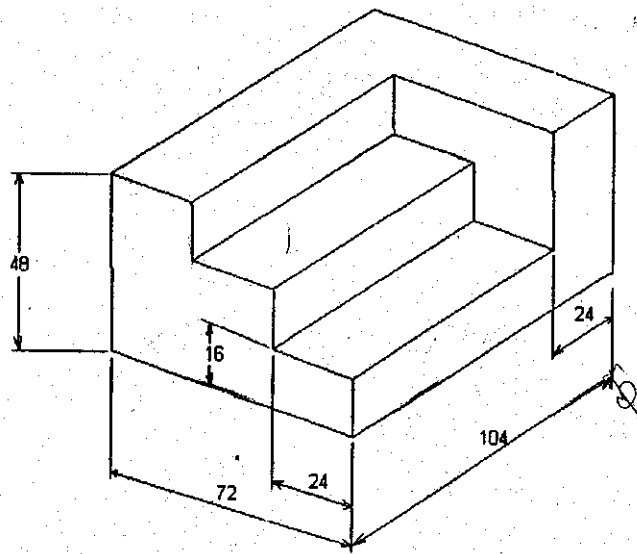
PART-B

NOTE: Answer any one questions

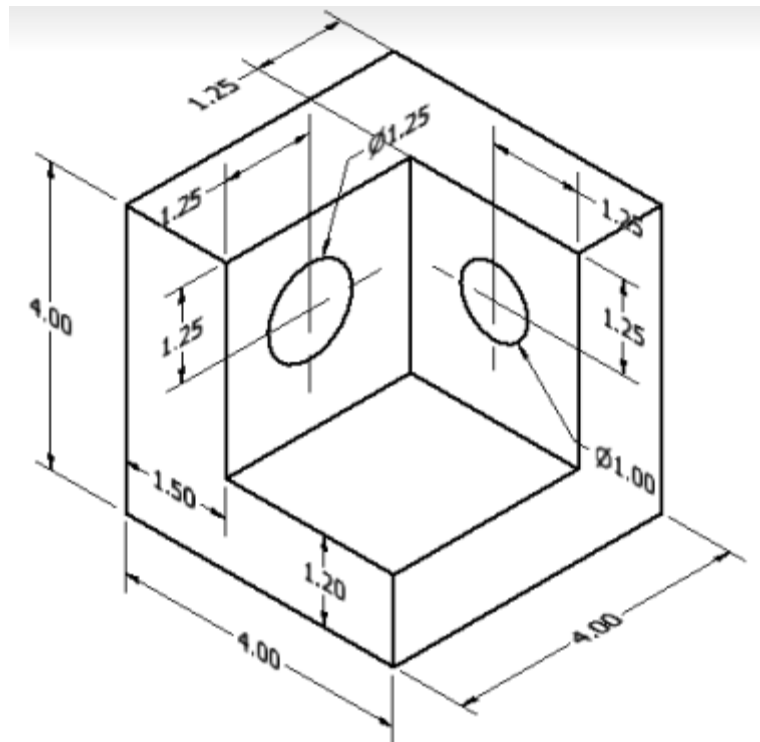
12marks

1 X 2 =

5. Draw the following using any CAD software and add dimensioning.



6. Draw the following using any CAD software and add dimensioning.



**CAD LAB PRACTISE
MODEL PAPER FOR SEE**

TIME: 2hr**Marks: 40M****PART-A**

NOTE: Answer all questions
16marks.

4 X 4 =

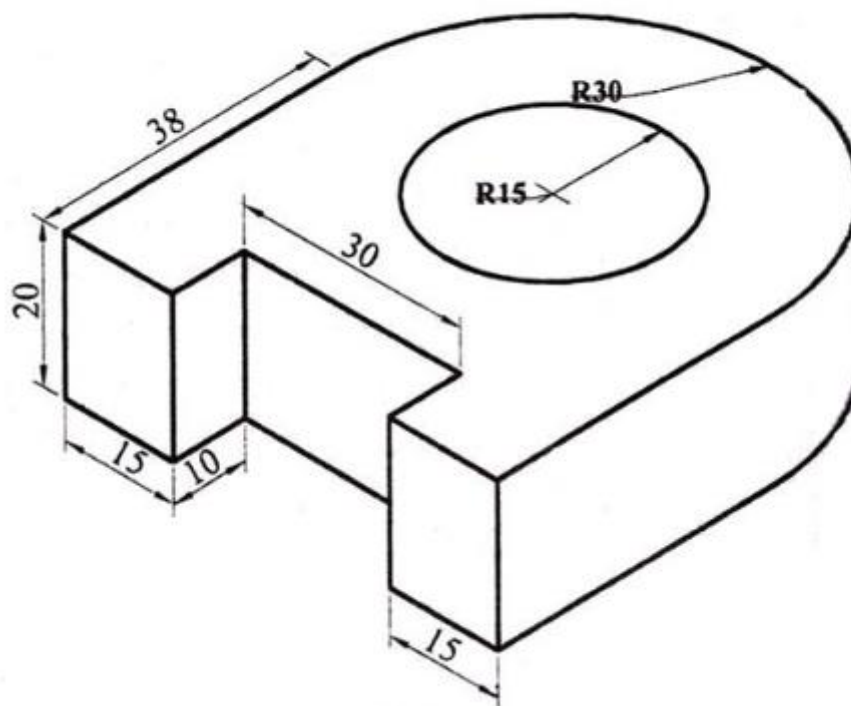
1. Write the procedure to create and insert a block.
2. Create four layers, name the layers and assign different properties like line color, line type, line weight to different layers.
3. Draw a 3D cone of base 30mm and height 50mm
4. Draw to 2 boxes of 50x30x20 and 30x50x20 mm and union them

PART-B

NOTE: Answer any one questions
24marks

1 X 24 =

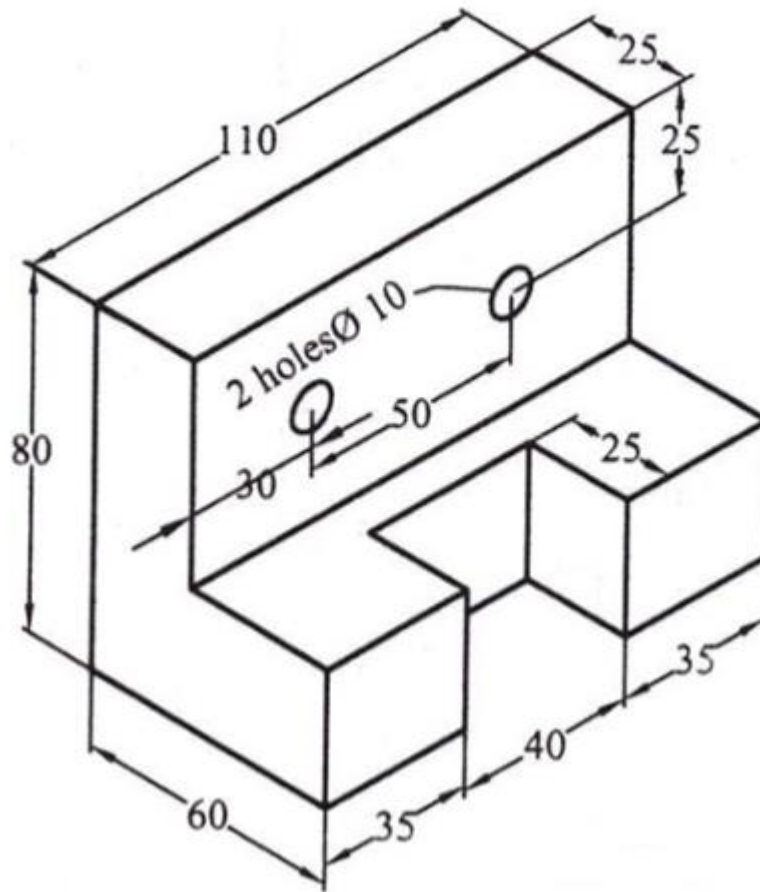
- 3 (a) Draw the following 3D object CAD software. 20+4 marks
- (b) List the commands in sequence and also write the procedure



4 (a) Draw the following 3D object CAD software.

20+4 marks

(b) List the commands in sequence and also write the procedure



C Programming lab

Course Title :	C Programming lab	Course Code	18MET-509P
Semester	V	Course Group	Core
Teaching Scheme in Periods(L:T:P)	15:0:30	Credits	1.5
Methodology	Lecture + Practical	Total Contact Periods	45
CIE	60 Marks	SEE	40 Marks

Pre requisites

Knowledge of Computer Operation.

Course outcomes

Course Outcome	
CO1	Write programs using input/output statements, variables and operators
CO2	Demonstrate decision making, branching and loop statements
CO3	Construct programs on arrays and strings
CO4	Develop programs using functions, structures and unions

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

COURSE CONTENTS:

List of Programmes:

1. Input/output statements, variables and operators

1. Exercise on structure of C program
2. Exercise on Keywords and identifiers
3. Exercise on constants and variables
4. Execution of simple C program
5. Exercise on operators and expressions
6. Exercise on special operators
7. Exercise on input and output of characters
8. Exercise on formatted input and output

2. Decision making, branching and loop statements

1. Exercise on simple if statement

- 2.. Exercise on if..else statement
- 3.. Exercise on else..if ladder statement
4. Exercise on switch statement
5. Exercise on conditional operator
6. Exercise on while statement
7. Exercise on for statement
8. Exercise on do...while statement

3. Arrays and strings

1. Exercise on one dimensional arrays
2. Exercise on two dimensional arrays
3. Exercise on strings

4.Functions, Structures and Unions

1. Exercise on user-defined function
2. Exercise on recursion
3. Exercise on structure
4. Exercise on array of structures

REFERENCE BOOKS

- | | | |
|-----------------------------|-----------------------|------------------|
| 1. Let Us C | -- Yeshwanth Kanetkar | BPB Publications |
| 2. Programming in ANSI C | -- E. Balaguruswamy | Tata McGrawHill |
| 3. C The complete Reference | -- Schildt | Tata McGraw Hill |

E-learning links

1. <http://www.tutorialspoint.com/cprogramming/>
2. <http://www.indiabix.com/online-test/c-programming-Test/>
3. <https://fresh2refresh.com/c-programming/>
4. <http://www.learn-c.org/>
5. <https://www.javatpoint.com/c-programming-language-tutorial>
6. <https://www.cprogramming.com/tutorial/c-tutorial.html>

CO-PO Mapping Matrix

Course Outcome		CL	Linked PO	Teaching periods
CO1	Write programs using input/output statements, variables and operators	R, U, A	1,2,3,4,8,9,10	5
CO2	Demonstrate decision making, branching and loop statements	R, U, A	1,2,3,4,8,9,10	15
CO3	Construct programs on arrays and strings	R,U, A	1,2,3,4,8,9,10	10
CO4	Develop programs using functions, structures and unions	U, A	1,2,3,4,8,9,10	15
CO5	Write programs using input/output statements, variables and operators	R, U, A	1,2,3,4,8,9,10	5
Total Sessions				45

DIPLOMA IN METALLURGICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATION
18MET-510P- PROJECT WORK

Sl. No	Subject	Items	Max Marks
1	Project work	CIE	
		1. Mid - I: Abstract submission – (Marks awarded by the Guide)	20
		2. Mid – II: Content development/ literature survey, data collection/prototype etc. - (Marks awarded by the Guide)	20
		3.Internal evaluation - (Marks awarded by the Guide)	20
		SEE	
		4.a) Final report Submission b) Seminar /Viva Voce (Marks awarded by the External Examiner, Head of Section (i.e. Internal Examiner) and Guide).	20 20
Total			100

SKILL UPGRADATION (RUBRICS)

- Download a research paper on steel making and explain
 - compare conventional and modern steel making processes and give power point presentation
 - collection of different types of cast iron samples and give a seminar on microstructures and its properties
 - download a research paper and explain
 - Preparation of leaching solution for the extraction of sulphide ores
 - Study the machining characteristics of different cast irons
 - prepare different weld joints
 - study weldability of different metals and alloys
 - Compare HAZ of different alloys
 - Attending yoga classes
 - Clean and green activities to protect the environment in the institute and near by places
 - Attending motivational classes given by experts
 - Visiting nearby public places and extending help to the needs as the part of social responsibility
 - Guiding junior students in academic affairs.
- Must register and study the courses offered by NPTEL/Swayam/MOOCs