Programme	:	**Diploma in MT**
Programme Code	:	**05/19**
Name of Course	:	**Advanced Physical Metallurgy**
Course Code	:	**MT585**

Teaching Scheme:

	Hours /Week	Total Hours
Theory	04	64
Practical	03	48

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Three class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	20	80	--	50	--

Course Rationale:

Metallurgical engineers often have to work in heat treatment shops or in design department to select a suitable material for required working condition. This subject deals with relationship between properties and selection of materials for such properties. This requires further detailed knowledge of physical metallurgy, so this course will be suitable to specialize in material selection.

Course Objectives:

After studying this course, the student will be able to

- Familiar with modern techniques to study crystal structure by X-rays and electron microscope.
- Have fundamental knowledge of physical properties of materials.
- Know theory of diffusion, which is required for understanding heat-treating processes like Carburising, Nitriding and various diffusion metalising processes.
- Study phase tranformation, which is important to understand various transformations.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
	SECTION I			
1	**X-Ray Diffraction**			
	1.1	X-ray technique, Bragg's law.	08	08
	1.2	Diffraction methods; Lauve method, rotating crystal method, powder method, calculation of lattice parameter.		
	1.3	Electron microscope.		
2	**Alloy Steels**			
	2.1	Classification of alloying elements.	12	16
	2.2	Effect of alloying elements on Iron-Carbon equilibrium diagram.		
	2.3	Effect of alloying elements on the shape of T.T.T. diagram of steels.		
	2.4	Effect on the properties of steels.		
	2.5	Classification of low alloy steels, high alloy steels.		
	2.6	Introduction to micro alloyed steels.		
3	**Physical Properties & Selection of Materials for Various Applications**			
	3.1	Magnetic properties, electrical properties, selection of materials for electrical application.	12	16
	3.2	Machinability– concept of machinability, measurement of machinability, machinability index of various metals and alloys.		
	3.3	Wear resistance, types of wear; metal to metal (lubricated and non lubricated), metal to non metal, dry friction– metal to non metal, particle impact, metal to fluid. Selection of materials for higher wear resistance.		

SECTION II				
4	**High Temperature Properties, Corrosion Resistance & Stainless Steels**			
	4.1	High temperature properties, selection of materials for use at elevated temperatures. Creep, creep resistant steels, super alloys.	10	16
	4.2	Chromium steels, role of chromium in stainless steels.		
	4.3	Classification of stainless steels, AISI specifications.		
	4.4	Applications of different types of stainless steels.		
	4.5	Carbide precipitation in stainless steels, stabilization treatment.		
5	**Tools Steels**			
	5.1	Tools steels, classification of tool steels on the basis of application.	10	12
	5.2	Properties required for different types of tool steels.		
	5.3	Heat treatment of HSS cutting tools, heat treatment of measuring instruments, heat treatment of dies and die moulds, heat treatment of machine parts, springs.		
	5.4	PVD, CVD.		
	5.5	Introduction to failure due to process deficiency and wrong selection of material.		
6	**Diffusion in Metals**			
	6.1	Fick's first law, mechanism of diffusion, diffusion in alloys, illustrative examples.	06	08
	6.2	Growth of oxide layer.		
	6.3	Carburizing- variables that influence diffusion; temperature, concentration, crystal structure, impurities, grain size.		
7	**Study Of Phase Transformation**			
	7.1	Nucleation and growth consideration, order-disorder changes.	06	04
	7.2	Precipitation hardening solution treatment, aging treatment.		
		Total	**64**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Study of electron microscope.	06
2	Study of X-ray diffraction and Bragg's law.	06
3	Study the effect of alloying elements on Iron – Carbon equilibrium diagram.	06
4	Study of machinability.	03
5	Study of wear-resistance.	03
6	Metallography of stainless steels.	06
7	Study of Tool steels.	06
8	Study of Fick's law i) Chromizing ii) Aluminizing	06
9	Study of nucleation and growth process.	06
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
	SECTION I	
1	X-Ray Diffraction	Class room teaching, visit.
2	Alloy Steels	Class room teaching, group discussion.
3	Physical Properties & Selection of Materials for Various Applications	Class room teaching, expert lecture.
	SECTION II	
4	High Temperature Properties, Corrosion Resistance & Stainless Steels	Class room teaching.
5	Tools Steels	Class room teaching.
6	Diffusion in Metals	Class room teaching, group discussion.
7	Study Of Phase Transformation	Class room teaching.

Text Books:

Sr. No	Author	Title	Publication
1	Avner	Introduction To Physical Metallurgy	McGraw-Hill International
2	Clark and Varney	Metallurgy For Engineers	CBS publishers and distributors

Reference Books:

Sr. No	Author	Title	Publication
1	Guy	Elements of physical metallurgy	Oxford Book Company
2	Zakharao	Heat treatment of metals and alloys	Foreign Language Publishing House, Moscow.
3	Robert E. Red-Hill	Physical Metallurgy Principles	Affiliated East-west Press Pvt. Ltd., New Delhi.

Learning Resources: Transparency – O. H. P.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
	SECTION I				
1	X-Ray Diffraction	4	4	--	8
2	Alloy Steels	8	4	4	16
3	Physical Properties & Selection of Materials for Various Applications	8	4	4	16
	SECTION II				
4	High Temperature Properties, Corrosion Resistance & Stainless Steels	8	4	4	16
5	Tools Steels	8	2	2	12
6	Diffusion in Metals	4	4	--	08
7	Study of Phase transformation	2	2	--	04
	Total	**42**	**24**	**14**	**80**

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Programme	:	**Diploma in MT**
Programme Code	:	**05/19**
Name of Course	:	**Modern Foundry Engineering**
Course Code	:	**MT586**

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**04**	**64**
Practical	**03**	**48**

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Three class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	20	80	--	50	--

Course Rationale:

To enable the Metallurgy engineer with various foundry practices such as ferrous and non-ferrous alloys, which are popularly cast. He should also understand the other important aspects of foundry apart from only the production processes.

Course Objectives:

After studying this course, the student will be able to be

- Specialized in the foundry engineering.
- Confident in entering foundry industry and career.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
	SECTION I			
1	**Flow of Metals and Gating system**			
	1.1	Laws of fluid dynamics governing the design of gating system. Equation of Continuity Bernoulli's theorem.	06	12
	1.2	Calculation of pouring time for Ferrous and Non Ferrous alloys.		
	1.3	Importance and determination of dimensions of passages i.e. gating ratio.		
2	**Risering of Casting**			
	2.1	Directional solidification, riser shape, size and location.	06	07
	2.2	Chvorinov's rule, Cain's method.		
	2.3	Use of padding, exothermic material, chills.		
3	**Fettling, Cleaning and H.T. of Castings**			
	3.1	Fettling, cleaning and H.T. of castings.	04	04
4	**Casting Inspection**			
	4.1	Specifications, ISO, quality aspect, inspection procedure, destructive and non-destructive testing of casting.	08	06
	4.2	Methods of surface finish measurements.		
5	**Casting Defect Analysis**			
	5.1	Faults arising in pouring, inclusion and sand defects, gas defect, shrinkage defect and contraction defect-free contraction and hindered contraction.	08	11
	5.2	Dimensional errors, Compositional errors and segregation.		

SECTION II				
6	**Melting Practice and Metallurgy of Cast Iron**			
	6.1	Classification of C.I., chemical composition, effect on structure and properties.	04	04
	6.2	Molding practice for Grey C.I.		
7	**S.G.Iron**			
	7.1	Chemical composition, various techniques of S.G. iron production, Mg recovery.	06	08
	7.2	Molding practice for S.G. iron.		
	7.3	Surface denodulization.		
	7.4	Austempered Ductile Iron.		
8	**Production of Steel Casting**			
	8.1	Specific characteristic of steel castings, melting practice, molding practice.	04	06
	8.2	Alloying practice for steel casting.		
9	**Foundry Practice for Non Ferrous Alloys**			
		Production of Al and Al alloys, Al casting alloys.	04	08
		Modification of Al-Si alloys.		
10	**Metal Treatment**			
	10.1	Degassing, fluxing, vacuum degassing.	04	04
		Ultrasonic treatment.		
11	**Production of Cu and Cu alloy Castings**			
	11.1	Metallurgical factors affecting foundry practice for Cu and Cu base casting alloys, melting furnaces, casting processes.	02	02
12	**Production of Mg base Casting Alloys**			
	12.1	Foundry techniques, melting of Mg-alloys, production of Zn and Zn alloy castings.	02	02
13	**Foundry Modernization, Mechanization and Lay out of Foundry**			
	13.1	Foundry modernization, mechanization and lay out of foundry.	04	04
14	**Foundry Planning**			
	14.1	Introduction to foundry planning.	02	02
		Total	64	80

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Study of various types of gates.	08
2	Study of various types of risers.	08
3	Case study of design of gating system and riser.	08
4	Study of various casting defects.	08
5	Crucible Melting of Al.	08
6	Drawing a layout for Ferrous and Non-Ferrous Foundry.	08
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
	SECTION I	
1	Flow of Metals and Gating system	Lecture method, practical.
2	Risering of Casting	Lecture method, Practical.
3	Fettling, Cleaning and H.T. of Castings	Lecture method, industrial visit.
4	Casting Inspection	Lecture method.
5	Casting Defect Analysis	Lecture method, Video Cassettes.
	SECTION II	
6	Melting Practice and Metallurgy of C.I.	Lecture method, industrial Visit.
7	S.G.Iron	Lecture method, industrial visit.
8	Production of Steel Casting	Lecture method, industrial visit.
9	Foundry Practice for Non Ferrous Alloys	Lecture method, industrial Visit, practical.
10	Metal Treatment	Lecture method.
11	Production of Cu and Cu alloy Castings	Lecture method, industrial visit.
12	Production of Mg base Casting Alloys	Lecture method, industrial visit.
13	Foundry Modernization, Mechanization and Lay out of Foundry	Lecture method, industrial Visit.
14	Foundry Planning	Lecture method.

Text Books:

Sr. No	Author	Title	Publication
1	T.V.Ramana Rao	Metal Casting Principle and Practice	New Age International (P) Ltd., Publishers
2	P.L. Jain	Principles Of Foundry Technology.	Tata McGraw Hill Publishing Company
3	Richard W.Heine, Carl R.Loper, Philip C. Rosenthal	Principle Of Metal Casting.	Tata McGraw Hill Publishing Company

Reference Books:

Sr. No	Author	Title	Publication
1	--	Casting Design, AFS Hand Book	American Society Of Metals.

Learning Resources: OHP-Transparencies, charts, video cassettes.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
SECTION I					
1	Flow of Metals and Gating system	04	03	05	12
2	Risering of Casting	02	02	03	07
3	Fettling, Cleaning and H.T. of Castings	02	02	02	06
4	Casting Inspection	02	01	01	04
5	Casting Defect Analysis	05	02	04	11

SECTION II					
6	Melting Practice and Metallurgy of Cast Iron	02	--	02	04
7	S.G.Iron	03	02	03	08
8	Production of Steel Casting	02	02	02	06
9	Foundry Practice for Non Ferrous Alloys	03	02	03	08
10	Metal Treatment	02	01	01	04
11	Production of Cu and Cu alloy Castings	02	--	--	02
12	Production of Mg base Casting Alloys	02	--	--	02
13	Foundry Modernization, Mechanization and Lay out of Foundry	02	01	01	04
14	Foundry Planning	02	--	--	02
	Total	**35**	**18**	**27**	**80**

Pramble

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Programme	:	**Diploma in MT**
Programme Code	:	**05/19**
Name of Course	:	**Surface Protection Methods**
Course Code	:	**MT587**

Teaching Scheme:

	Hours /Week	Total Hours
Theory	04	64
Practical	03	48

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Three class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	20	80	--	50	--

Course Rationale:

Corrosion is one of the important phenomenons occurring in nature. Corrosion leads to loss of metals & its surface properties. If due care is not taken to prevent corrosion, it lead to failure of components. Therefore it is necessary to minimize the process of corrosion if not completely prevented. It is therefore necessary to know about the surface protection methods.

Course Objectives:

After studying this course, the student will be able to

- Know the importance of surface protection.
- Know various surface protection techniques & select a particular protection method under given conditions.
- Learn various testing and quality control methods involved in surface protection process.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
	SECTION I			
1	**Introduction**			
	1.1	Corrosion, nature of corrosion, preventive methods for corrosion.	08	10
	1.2	Importance of surface protection, various methods.		
	1.3	Classification & advantage of various methods of surface protection.		
2	**Surface Preparation**			
	2.1	Necessity of surface preparation.	08	10
	2.2	Types of surface preparation methods; mechanical, chemical & electrochemical methods.		
	2.3	Mechanical methods such as grinding, polishing, brushing, buffing etc.		
	2.4	Chemical methods, degreasing of metal surface, detergent cleaning, acid & alkali cleaning.		
	2.5	Electrolytic cleaning & ultrasonic cleaning.		
	2.6	Factors for selection of proper cleaning methods.		
3	**Electroplating**			
	3.1	Principles of electrodeposition.	16	20
	3.2	Process of electrolysis, Faraday's law of electrolysis, examples of faraday's law, degree of dissociation, rate of deposition, current efficiency, thickness of deposition, plating time determination.		
	3.3	Plating procedure for- Chromium plating, Copper plating, Nickel Plating, Gold Plating, Bath composition, Controls, application of platings.		
	3.4	Quality control in plating- chemical analysis & pH control of plating solution, testing for porosity, Hydrogen embrittlment, adhesion, hardness, thickness related tests, salt spray test.		
	3.5	Special Plating Processes- electroforming, immersion plating, anodizing of Aluminum, etc.		
	3.6	Plant layout of Electroplating.		

SECTION II				
4	**Non-Metallic Coating**			
	4.1	Painting, surface preparation for painting.	**13**	**15**
	4.2	Primers.		
	4.3	Phosphate coatings, treatment before phosphating, mechanism of phosphate coating, formation methods of phosphate coating, advantage & application.		
	4.4	Vacuums metallizing.		
	4.5	Coloring of metals.		
5	**Allied Metallic Coating**			
	5.1	Galvanizing- surface cleaning, fluxing, molten metal bath temperature controls.	**13**	**15**
	5.2	Defect in galvanized coating.		
	5.3	Tinning- Terne Plating Commutation process -such as chromising , colorizing etc.		
	5.4	Metal spraying- surface preparation, spraying methods, applications.		
6	**Alloy Deposition**			
	6.1	General principles of alloy deposition, brass & bronze plating.	**06**	**10**
		Total	**64**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Preparation of surface for Electroplating.	09
2	Principles of Electroplating.	09
3	Copper plating on M.S. Component.	06
4	Nickel Plating on M.S. Surface.	06
5	Chromium Plating on M.S. Surface.	09
6	Study & testing of Phosphate coating on M.S.	09
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
	SECTION I	
1	Introduction	Lecture method.
2	Surface Preparation	Lecture method, practical, industrial visit.
3	Electroplating	Lecture method, practical.
	SECTION II	
4	Nonmetallic Coating	Lecture method, Transparencies-OHP.
5	Allied Metallic Coatings	Lecture method, demonstration.
6	Alloy Deposition	Lecture method.

Text Books:

Sr. No	Author	Title	Publication
1	Cartwrite	Hand book Of Electroplating	Blackie & Sons Ltd. London & Glasgow

Reference Books:

Sr. No	Author	Title	Publication
1	William Blaume	Electroplating & Electroforming	McGraw Hill Book Comp.
2	Lainer	Modern Electroplating	Israel Program For SC Franc. Jerusalem
3	Eric N. Simons	Surface treatment of Steel	Sir Isaac Pitman & Sons Ltd. London
4	Society For Manufacturing Engg.	Surface Preparation & Finish	MIR Publisher
5	A. Kenneth Graham	Electroplating Engineering Handbook	Van Nostrand Reinhold Co. New York.

Learning Resources: Books, Transparencies.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
	SECTION I				
1	Introduction	05	05	--	10
2	Surface Preparation	05	--	05	10
3	Electroplating	10	05	05	20
	SECTION II				
4	Non- Metallic Coating	10	--	05	15
5	Allied Metallic Coating	10	--	05	15
6	Alloy Deposition	05	--	05	10
	Total	**45**	**10**	**25**	**80**

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Programme	:	**Diploma in MT**
Programme Code	:	**05/19**
Name of Course	:	**Non-metallic Materials**
Course Code	:	**MT588**

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**04**	**64**
Practical	**03**	**48**

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Three class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	**20**	**80**	--	**50**	--

Course Rationale:

The total developments in science and technology depend to a considerable extent on materials technology. The properties and applications of non-metallic materials has been a very important topic in engineering and technology. It is often said that the rate of growth of technology is hindered by the limited availability of materials with the derived properties. The field of non-metallic materials has assured for itself the responsibility to discover and control properties of materials for fundamental research and applications.

Course Objectives:

After studying this course, the student will

- Be aware about the various non-metallic materials used in engineering applications.
- Know the basic principles necessary for understanding nature and properties of materials.
- Understand the relation between structure and properties of materials.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
	SECTION I			
1	**Structure of Solids**			
	1.1	Crystalline nature, types of structures, carbon, silica, silicate, glasses etc.	**04**	**05**
2	**Colloids and Polymers**			
	2.1	Classification of colloids, intermediate systems, gels and pastes, clay-water dispersions emulsions.	**12**	**20**
	2.2	Polymers- Introduction, polymerization and its mechanisms, formations of polymers, structure, physical properties and chemical resistance.		
	2.3	Specific polymeric materials, poly-ethylene, resins, foamed plastics, wood, natural resins, PVC, acrylic polymers.		
3	**Rubbers**			
	3.1	Occurrence, structure & properties of rubbers, important applications in engineering industry.	**06**	**05**
	3.2	Natural rubber, styrene, butadiene, bectyl rubber, nitrite rubber etc.		
	3.3	Vulcanization of rubber, forming & fabrication techniques for rubber.		
4	**Glasses**			
	4.1	Structure of glasses, silicate structure, composition, properties, glass production and processing.	**05**	**05**
	4.2	Important types- Vitreous fused silica-polycrystaline glass, soda lime, lead glass, borosllicate glass, glass ceramics.		
5	**Ceramics**			
	5.1	Nature & types of ceramics, general characteristics.	**05**	**05**
	5.2	Common oxides, clays, porcelain, insulating materials, abrasives carbides, enamels, ceramic lubricants, steatites etc.		

SECTION II				
6	**Adhesives**			
	6.1	Characteristics of adhesives, adhesive bonding, mechanism and applications of adhesives.	**08**	**08**
	6.2	Types of adhesives, use of adhesives, adhesive joints.		
	6.3	Advantages and disadvantages of adhesive bonding.		
7	**Lubricants**			
	7.1	Function and characteristics of lubricating oils.	**06**	**08**
	7.2	Theory of lubrication.		
	7.3	Organic liquids, synthetic lubricating oils– cutting fluids, lubricating greases, solid lubricants.		
8	**Composite Materials**			
	8.1	Introduction, classification of composites, manufacturing processes.	**06**	**08**
	8.2	FRP composite, protective coating on composites.		
	8.3	Concrete, prestressed concrete.		
9	**Insulating Materials**			
	9.1	Types of insulating materials.	**06**	**08**
	9.2	Properties and requirements of insulating materials.		
	9.3	Thermal, electrical and sound insulating materials.		
10	**Magnetic Materials**			
	10.1	Magnetism in solids.	**06**	**08**
	10.2	Magnetic properties, concepts of ferromagnetic, paramagnetic, diamagnetic properties and materials.		
	10.3	Ferrites, soft magnetic materials and hard magnetic materials.		
		Total	**64**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Study of silicate structure.	03
2	Hardness of plastic.	06
3	T.S. of plastic.	06
4	Tensile curve for rubber.	03
5	Hardness of rubber.	06
6	Impact property of ceramics.	06
7	Strength of an adhesive bond- tension & shear.	06
8	Study of lubricants.	06
9	Preparation of composites.	06
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
	SECTION I	
1	Structure of Solids	Lecture method.
2	Colloids &Polymers	Lecture method.
3	Rubbers	Lecture method.
4	Glasses	Lecture method.
5	Ceramics	Lecture method.
	SECTION II	
6	Adhesives	Lecture method.
7	Lubricants	Lecture method.
8	Composites	Lecture method.
9	Insulating Materials	Lecture method.
10	Magnetic Materials	Lecture method.

Text Books:

Sr. No	Author	Title	Publication
1	Zbigniew D. Jastrzebski	Nature And Properties Of Engg. Materials	Toppan Printing Company, Limited, Japan.
2	Lawerence H. Van Vlack	Elements of Material Science	Addison –Wesley Publishing Company, INC, London.

Reference Books:

Sr. No	Author	Title	Publication
1	Gupta A.K and Gupta R.C	Material Science	S. Chand and Company Limited.

Learning Resources: OHP-Transparencies, books.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
	SECTION I				
1	Structure of Solids	03	02	--	05
2	Colloids &Polymers	10	05	05	20
3	Rubbers	03	02	--	05
4	Glasses	03	--	02	05
5	Ceramics	03	--	02	05
	SECTION II				
6	Adhesives	03	03	02	08
7	Lubricants	05	--	03	08
8	Composites	05	--	03	08
9	Insulating Materials	05	--	03	08
10	Magnetic Materials	05	--	03	08
	Total	**45**	**12**	**23**	**80**

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