Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Elements of Electrical and Mechanical Engineering
Course Code : MS461

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**04**	**64**
Practical	**02**	**32**

Evaluation Scheme:

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

Course Rationale:

The metallurgical technicians working in different fields have to deal with various electrical /mechanical equipments and device. Very often technology is necessary for them to know basic aspects of electrical and mechanical engineering and operation of various machines with their controls.

Course Objectives:

After studying this course, the student will be able to

- Know the fundamental concept of various electrical and mechanical engineering
- Know instruments and equipment used for various Metallurgical industries

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
	SECTION I			
1	**Electrical installation, Electrical safety**			
	1.1	Wiring materials such as switches, holder, ceiling roses, socket etc, electrical wiring diagram of simple circuits.	**08**	**10**
	1.2	Determination of size and selection of- Main switch, Fuse/MCB, Wire and cable size for specific application such as motor circuit, furnace/ovens. Service connection.		
	1.3	Electrical injuries, electrical shock, action required after electrical shock, precautions to avoid an electrical shock, safe limits of current and voltages.		
	1.4	Circuit protections- Earthing, necessity and types of earthing. Fuses, types of fuses, comparison between MCB and fuses.		
2	**Motors**			
	2.1	D.C. motors:- Characteristics, Necessity of starters, 3-point starters, speed control of D.C. motors (flux control and voltage control).	**06**	**04**
	2.2	3phase Induction motors:- torque-speed characteristics, load test.		
3	**Instrumentation**			
	3.1	Introduction, mechanical sensors as primary sensors/detectors, pressure sensors, flow sensors, flow meters.	**08**	**10**
	3.2	Electrical transducers, advantages of electric transducers, types of transducers, electrical transducers for measurement of temperature, pressure and flow, LVDT.		

4	**Electric heating**			
	4.1	Mode of heat transfer, electric heating, advantages of electric heating, classification of electric heating methods. Construction and working of resistance oven/furnace. Heating element materials. Design of heating elements (numericals). Temperature control of resistance ovens/furnaces. Causes of failure of heating elements.	**10**	**16**
	4.2	Arc furnaces- Construction, working principle, types of arc furnaces and applications.		
	4.3	Induction heating- Working principle, types of induction heating (core and coreless), advantages of induction heating, numericals based energy requirements.		
	4.4	Eddy current heating- Principle of eddy current heating, its advantages and applications.		
	4.5	Power factor- Definition, causes of low power factor, advantages of improved power factor, power factor improvement by static capacitors, numerical examples based on heating and melting furnaces.		
Section II				
5	**Compressors**			
		Reciprocating, rotary, roots blower, vacuum pumps.	**06**	**10**
6	**Pumps**			
		Classification, Construction, Working, Application.	**06**	**10**
7	**Power Transmission Device**			
	7.1	Belt- Open and cross belt, Flat belt and V belt. Chain Drives.	**10**	**10**
	7.2	Gears- Spur, Helical, Bevel, Worm. Gear Terminology- circular pitch, module, addendum, dedendum, pressure angle.		
	7.3	Comparison, advantages & disadvantages of different drives.		
8	**Standard Mechanical Component**			
		Key, Coupling, bearings, power screws	**04**	**05**

9	**I.C.Engine working**			
		Classification of parts and working stresses.	**06**	**05**
		Total	**64**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
	Section I	
1	Study of wiring accessories.	02
2	Prepare 2 & half points switch board (one in one group).	02
3	Speed control of d.c. shunt motor by; (a) Voltage control (b) Field current	 02 02
4	Study of power factor improvement of 3Φ motor.	02
5	Study of measurement of temperature by RTD/ Thermocouple/ Thermistors.	02
6	Study of LVDT.	02
7	Study of resistance oven w.r.t. construction & temperature control.	02
	Section II	
1	Construction of Compressor.	01
2	Construction of pumps.	02
3	Demonstration of various Power Transmission devices.	04
4	Free hand sketches one sheet on Standard Mechanical Component.	04
5	Demonstration of I.C. engine parts.	05
	Total	**32**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
	Section I	
1	Electrical installation, Electrical safety	Lecture and practical
2	Motors	Lecture, practical and demonstration
3	Instrumentation	Lecture, practical and demonstration
4	Electric heating	Lecture, practical and demonstration

Section II		
5	Compressors	Lecture and practical
6	Pumps	Lecture and practical
7	Power Transmission Device	Lecture and demonstration
8	Standard Mechanical Component	Lecture and practical
9	I.C.Engine working	Lecture and demonstration

Text Books: Nil

Reference Books:

Sr. No	Author	Title
		Section I
1	B.L.Therahja	Electrical Technology
2	Surjit Singh	Electrical Estimating & Costing
3	A.K.Sauhney	Electrical Measurement & Instrumentation
4	J.B.Gupta	Electrical Power & Traction
		Section II
1	Ratan	Theory of Machine
2	Modi & Seth	Hydraulic Machinery
3	Mahajan	Mechanism
4	Patel & Karam chandani	Heat Engine
5	N.D.Bhatt	Machine Drawing

Learning Resources: O.H.P / Transparencies, Charts.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
Section I					
1	Electrical installation, Electrical safety	04	04	02	10
2	Motors	04	--	--	04
3	Instrumentation	06	--	04	10
4	Electric heating	03	03	10	16
Section II					
5	Compressors	04	02	04	10
6	Pumps	04	--	06	10
7	Power Transmission Device	04	02	04	10
8	Standard Mechanical Component	03	--	02	05
9	I.C.Engine working	03	--	02	05
	Total	**35**	**11**	**34**	**80**

(Prof.S.S.Bhusare & Prof.R.R.Godbole)
Prepared By

(Prof.S.B.Kulkarni)
Secretary, PBOS

(Prof.P.B.Kamble)
Chairman, PBOS

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Basic Metallurgy
Course Code : MT461

Teaching Scheme:

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

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	**20**	**80**	--	**50**	**25**

Course Rationale:

Basic metallurgy mainly deals with basic topics required for understanding metallurgical subjects. The subject is a collection of widely different basic topics such as fuels, refractories, vacuum technology, conceptual understanding of structure of solid materials and their properties.

Course Objectives:

After studying this course, the student will be able to
Metallurgical industries require use of high temperature equipment and materials for its productions. Therefore the students are required to be well conversant with materials and fuels involved in furnace technology. Besides metals, many non-metallic materials are now used in the field. A basic understanding of their structure, properties and uses is therefore necessary.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Introduction**			
	1.1	Importance of metallurgy, branches of metallurgy and scope under Indian condition.	**01**	**--**
2	**Nature of Solids**			
	2.1	States of matter, types of structures, atomic structure of metals, allotropy, miller indices for planes and directions.	**06**	**08**
	2.2	Imperfections in the crystals of point, line and surface.		
		Polymorphism.		
3	**Plastic Deformation**			
	3.1	Grain structure, cold working, annealing, recrystallisation, recovery and grain growth.	**06**	**10**
	3.2	Structures of silicates, carbon, glasses.		
	3.3	Polymeric structure. Ceramics and their comparison with metals (Strength to weight ratio).		
4	**Solid Fuels**			
	4.1	Classifications of fuels, solid fuels, occurrence of coal with reference to Indian conditions.	**10**	**18**
	4.2	Classifications of coal, carbonization of coal, properties of coke, bi-products of coke. Use of pulverized and briquetted coal or coke.		
	4.3	Selection of fuel for particular application. Combustion calculation.		
5	**Liquid and Gaseous Fuels and Furnace Technology**			
	5.1	Important properties and uses of liquid fuels.	**10**	**18**
	5.2	Manufacture of gaseous fuels. Gaseous fuels composition. Properties and uses of Natural gas. Blast furnace gas, coke oven gas and liquefied petroleum gases.		
	5.3	Study of types of flames. Burners required for combustion of liquid and gaseous fuels and their working principles. Regenerators & recuperators.		

6	**Refractory Materials**			
	6.1	Classification, properties and application of fireclay, silica, magnesite, chromite, carbon and special refractories like insulation materials, fused silica, alumina, zirconia, insulation materials like cer-wool.	**10**	**18**
	6.2	Furnace Technology, basic types of furnaces, Use in industries.		
	6.3	Refractories used in furnaces, different fuels used in furnaces.		
	6.4	Types of furnaces – Shaft, reverbaratory, coke fired furnace.		
	6.5	Applications of Thermocouples and Pyrometers in Metallurgical Industries.		
7	**Vacuum Technology**			
	7.1	Management of vacuum production, equipments, its working principles. Application of Vacuum Metallurgy.	**05**	**08**
		Total	**48**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Crystal structures and planes – F.C.C., B.C.C., H.C.P., structures to be studied with the help of models, sketching structures and planes. Miller indices with the help of models.	06
2	Proximate analysis of coal and coke: Determination of moisture content volatile matter and ash content of coal and coke.	06
3	Calorific value of fuel: Determination of calorific value of coal and coke by using bomb calorimeter.	06
4	Study of flash point apparatus: Determination of flash point of liquid fuel such as furnace oil.	06
5	Study of burners.	06
6	Study of burners used for gas and liquid fuels.	06
7	Properties of refractories: Determination of cold crushing strength and porosity of different refractories.	06
8	Visual inspection of refractories identification of various types of refractories and physical defects such as chips, cracks etc.	06
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Introduction	Lecture method
2	Nature of Solids	Demonstration method
3	Plastic Deformation	Lecture method
4	Solid Fuels	Industrial Visit, Lecture method
5	Liquid and Gaseous Fuels and Furnace Technology	Demonstration & Lecture Method
6	Refractory Materials	Lecture method
7	Vacuum Technology	Lecture method

Text Books:

Sr. No	Author	Title	Publication
1	Francis	Fuel Technology Vol I & II	Pergaman Press, London
2	D Swarup	Elements of Metallurgy	Rastogi Publication, Meerut.

Reference Books:

Sr. No	Author	Title	Publication
1	Gilchrist J.D.	Fuels & Refractories	Perganson
2	Gupta	Elements of Fuels, Refractories	Oxford Press

Learning Resources: O. H. P., Charts and Models.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Nature of Solids	04	02	02	08
2	Plastic Deformation	05	05	-	10
3	Solid Fuels	10	04	04	18
4	Liquid & Gaseous Fuels & Furnace Technology	10	04	04	18
5	Refractory Materials	10	04	04	18
6	Vacuum Technology	04	02	02	08
	Total	**43**	**21**	**16**	**80**

(Prof.N.S.Kadam)
Prepared By

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Prof.P.B.Kamble
Chairman, PBOS

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Material Testing and Quality Assurance
Course Code : MT462

Teaching Scheme:

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

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	**20**	**80**	**50**	--	**25**

Course Rationale:

To expose the students to various tests that can be carried out on materials, their purpose and utility. To study the effect of various metallurgical parameters on test results.

Course Objectives:

After studying this course, the student should be able to

- Understand the general terms used in testing.
- Relate theoretical concepts to the results obtained.
- Get familiar with the machines and equipments used for testing.
- Use and apply test results to improve quality of material.
- Diagnose the reasons of poor quality and identify the remedial measures.
- Understand terms used in quality standards and different national and international existing quality standards used.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Mechanical properties of metals**			
	1.1	A brief introduction to bonding arrangement in materials and especially in metals and alloys i.e. metallic bond.	**10**	**16**
	1.2	Deformation of metals under various loading conditions i.e. tensile, compressive and shear.		
	1.3	Elastic and plastic deformation, various terms used i.e. stress, strain, elasticity, plasticity, toughness, resilience. Stress- Strain curves, Yield point and yielding phenomenon, percentage elongation and reduction in area, proof stress. Hook's law, Modulus of elasticity, Young's modulus.		
	1.4	Shear and torsion tests.		
	1.5	Fracture and its mechanism. Fracture of ductile and brittle materials. Study of different tensile testing machines, universal testing machine etc.		
2	**Hardness Tests**			
	2.1	Concept of hardness. Methods of hardness test, such as indentation, scratch and rebound.	**08**	**14**
	2.2	Types of indentation hardness tests, such as Brinell, Vicker, Rockwell and Knoop, their indenters and measurements of hardness number.		
	2.3	Rebound hardness test. Shore Scleroscope. Dynamic hardness tester. Poldi Hardness Tester.		
	2.4	Scratch hardness test: Moh's scale of hardness. File test. Brief introduction to hardness machines and their operations.		
3	**Impact Tests**			
	3.1	Significance of impact test.	**06**	**12**
	3.2	Izod and Charpy impact tests. Their specimen details, mounting of specimens in each case. Effect of variables on the impact test values such as variation in striking velocity, size and shape of specimen, temperature, grain size and composition.		

	3.3	Embrittlement phenomena: temper and hydrogen embrittlement.		
	3.4	Impact strength- Temperature relationship and transition temperature range.		
4	**Fatigue Test**			
	4.1	Concept of fatigue. Repeated loadings, their types.	**08**	**12**
	4.2	Fatigue test, fatigue strength, and endurance limit. Orowan's and Wood's theories explaining fatigue failure. Effect of composition, stress concentration, size and surface conditions on fatigue strength.		
	4.4	Measures to be taken to improve fatigue life.		
5	**Creep Test**			
	5.1	Concept of creep. Creep Test. Standard creep curve with explanation of various stages. Effect of temperature on creep test, equi-cohesive temperature.	**06**	**10**
	5.2	Factors affecting creep such as composition, grain size, method of steel making and heat treatment.		
	5.3	Relation between creep rate, stress and temperature.		
6	**Non-Destructive Testing**			
	6.1	Need for non-destructive tests. Concept of non-destructive tests.	**06**	**12**
	6.2	Comparison between destructive and non-destructive tests.		
	6.3	Introduction to various non-destructive tests such as: Visual examination, Leakage testing, Penetrant test, Magnetic methods, Acoustic methods, Ultrasonic test, Radiography, Thermal tests, Electrical methods.		
7	**Quality Aspects**			
	7.1	Concept of quality. Brief introduction to various quality standards, such as ISI, BIS and ISO. Brief introduction to ISO 9000 series standards.	**04**	**04**
		Total	**48**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	To carry out tensile test on mild steel and aluminum.	06
2	To draw stress-strain curve. To interpret the curve with respect to applicability of materials.	06
3	To acquaint with various tensile test machines.	06
4	To carry out hardness tests on samples using Vicker, Brinell, Rockwell and Poldi Hardness Testers.	06
5	To carry out impact tests on brass, aluminum and copper specimens.	06
6	To carry out fatigue tests on mild steel and aluminum specimens.	06
7	To study creep test. Interpretation of test results.	06
8	To carry out dye penetrant test and magnetic particle test.	06
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Mechanical properties of metals	Lecture and practical
2	Hardness tests	Lecture and practical
3	Impact tests	Lecture and practical
4	Fatigue test	Lecture and practical
5	Creep test	Lecture and practical
6	Non-destructive testing	Lecture and practical
7	Quality aspects	Lecture

Text Books:

Sr. No	Author	Title	Publication
1	George E. Dieter	Mechanical Metallurgy	Mc Graw-Hill Book Company
2	Davis, Troxell and Wiskonell	Testing and Inspection of Engineering materials	Mc Graw-Hill Book Company
3	A.V.K. Suryanarayan	Testing of Metallic Materials	Printice-Hall of India Pvt Ltd
4	Dr. V.D.Kodgire	Material Science And Metallurgy	Everest Publishing House

Learning Resources: O. H. P., Charts and Models.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Mechanical properties of metals	08	04	04	16
2	Hardness tests	08	03	03	14
3	Impact tests	05	03	04	12
4	Fatigue test	05	03	04	12
5	Creep test	05	02	03	10
6	Non-destructive testing	05	03	04	12
7	Quality aspects	02	01	01	04
	Total	**38**	**19**	**23**	**80**

(Prof.P.K.Metkar)
Prepared By

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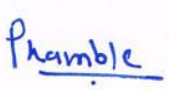
Secretary, PBOS



Prof.P.B.Kamble
Chairman, PBOS

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Metallurgical Analysis
Course Code : MT463

Teaching Scheme:

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

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	**20**	**80**	**50**	--	**25**

Course Rationale:

Material science field is continuously expanding. New alloys and composite materials are coming up rapidly to meet common needs in general and specific needs in particular. Chemical analysis became essential to investigate the composition of these materials to provide data in respect of composition and the properties therefore. The metallurgist is expected to be conversant with various processes of chemical analysis. He should know the principles and laws governing the chemical reactions, which can be applied to decide the extraction path of metals from its specific ores. Metallurgist should have an insight of instruments and their operating principles used for chemical analysis.

Course Objectives:

After studying this course, the student should be able to:

- Know the importance of chemical analysis.
- Know the sampling methods for various materials.
- Know different instruments used for chemical analysis.
- Understand the assay system of analysis.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Introduction**			
	1.1	A brief insight into Analytical Chemistry. Purpose of analysis. Types of analysis, qualitative and quantitative. Methods of quantitative analysis.	**08**	**12**
	1.2	Sample and its importance, methods of sampling of ore; coal and liquid metal and alloys.		
	1.3	Errors in analysis such as systematic; random, absolute, relative and mistakes.		
	1.4	Precision and Accuracy, Deviation, Mean Deviation and Relative Mean Deviation.		
	1.5	Balances and Weights and the calibration of weights.		
	1.6	Equilibrium reaction. Law of mass action: Mass Law Equation: Le Chatelier's Principle.		
	1.7	Electrolytic Dissociation, electrolytes, ions cation. Dissociation of Acid, Base and Salt. Ampholytes. Degree of Dissociation. Effect of concentration, temperature and other ions on, degree of dissociation.		
	1.8	Dissociation of water, Hydrogen ion exponent, P^H: Ionic Product of Water.		
	1.9	Solubility, saturated solution, supersaturated solution. Solubility Product, Salt Effect.		
2	**Gravimetric Analysis**			
	2.1	General process followed i.e. dissolution of sample, precipitation, ignition and weighing of precipitate.	**14**	**25**
	2.2	Precipitation: choice of precipitate, amount of precipitate, the condition of precipitation. Requirements of precipitated and weighed form.		
	2.3	Co-Precipitation, washing of precipitate.		
	2.4	Complex salts, masking of ions.		
	2.5	Simple calculations to determine the % of element in a precipitate or compound; Determination of Carbon and Sulphur in Cast Iron. Determination of Silicon in Cast Iron.		

3	**Volumetric Analysis**			
	3.1	Solution, concentration of solution, methods of expression of solution strength, Equivalent weight, Normality of solution, preparation of standard solution.	**14**	**25**
	3.2	Acid –Base neutralization reaction.		
	3.3	Titration, types and methods of titration. Equivalence point, End point and Neutral point in Acid-Base titrations.		
	3.4	Indicators, role and action of indicators in titration, P^H range of indicator, Selection of indicator for acid base titration.		
	3.5	Titration curve, plotting of different titration curves depending upon different strength of acid and base e.g. weak acid with strong base etc.		
	3.6	Oxidation-Reduction reactions, Oxidizing and Reducing agents, Oxidation-Reduction potential. Redox titration curve, titrations with potassium permanganate solution, Gram-equivalent of oxidizing and reducing agents, Determination of Fe^{++} by redox method.		
	3.7	Comparisons between gravimetric and volumetric analysis.		
	3.8	Simple calculations with respect to strength of the solution.		
4	**Instrumental Analysis**			
	4.1	Scope for instrumental analysis. Advantages of instrumental analysis.	**06**	**08**
	4.2	Introduction to Spectroscopy, Electrolysis, Potentiometric Titration, Polorography and Colourimetry. Beer's Law and Lambert's Law.		
	4.3	Colorimetric methods, Photoelectric colorimeter.		
	4.4	Electrolysis, Potentiometric Titration.		
5	**Fire Assay**			
	5.1	Introduction to and principles of fire assaying, Assay-ton system of weights and sample size in gms taken for assaying.	**06**	**10**

	5.2	Steps involved in fire assaying, such as: Sampling, Mixing of reagents, Firing, Casting, Cupelling and Parting.		
	5.3	Scorification of gold and silver ores and crucible assay.		
		Total	**48**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Preparation of standard solution.	06
2	Observing the effects of common ion and diverse ion on solubility.	06
3	Determination of chemical formula for crystalline compound.	06
4	Determination of Ni, C & S in cast iron.	06
5	To perform acid-base titration.	06
6	Determination of Fe^{++} by redox method.	06
7	Colorimetric determination of concentration of solution [$CuSO_4$ and/or $KMNO_4$].	06
8	Assay of gold/ silver coins or articles.	06
	Total	**64**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Introduction	Lecture method
2	Gravimetric Analysis	Lecture method, Question-Answer method
3	Volumetric Analysis	Lecture method, Question-Answer method
4	Instrumental Analysis	Lecture method
5	Fire assay	Lecture method, Question-Answer method

Text Books:

Sr. No	Author	Title	Publication
1	B.C.Agarwal S.P. Jain	Text Book Of Metallurgical Analysis	Khanna Publisher, N. Delhi
2	Dr. S.B. Salunke Dr. B.B. Deogadkar Dr. C.M. Bhavasar	Physical and Analytical Chemistry	Nirali Prakashan, Pune

Reference Books:

Sr. No	Author	Title	Publication
1	V. Alexeyev	Quantitative Analysis	MIR Publisher, Moscow

Learning Resources: O. H. P., Charts and Models.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Introduction	08	02	02	12
2	Gravimetric Analysis	15	05	05	25
3	Volumetric Analysis	15	05	05	25
4	Instrumental Analysis	05	02	01	08
5	Fire assay	05	03	02	10
	Total	**48**	**17**	**15**	**80**

(Prof.P.K.Metkar)
Prepared By

(Prof.S.B.Kulkarni)
Secretary, PBOS

(Prof.P.B.Kamble)
Chairman, PBOS

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Extraction of Ferrous Metals
Course Code : MT464

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**03**	**48**
Practical	--	--

Evaluation Scheme:

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

Course Rationale:

To expose the students to basic principles and methods involved in extraction of ferrous metals from ores and secondary sources. Metallurgists are required to know, the potential sources of metals, winning of metals from their sources and refining the metals to their highest purity.

Course Objectives:

After studying this course, the student should be able to:

- Understand the general terms used in extraction of metals.
- Correlate the scientific principles and technology used with the different extraction processes.
- Get familiar with major equipments used in extraction of metals.
- Have a brief account of iron and steel industries in India.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Occurrence of Metals**			
	1.1	Introduction to minerals, their types i.e. native metals, oxides, oxy-salts, sulphides, arsenides etc.	**02**	**04**
	1.2	Terminology like ore, gangue, concentrate etc.		
	1.3	General sequence of operations involved in extraction of metals from their ores.		
	1.4	Introduction to Pyrometallurgy, Hydrometallurgy and Electrometallurgy.		
2	**Ore Dressing**			
	2.1	Comminution: Crushing and Grinding with jaw crusher, cone crusher, gyratory crusher and ball mill etc.	**05**	**12**
	2.2	Sorting: Operations based on some physical properties such as density, surface properties, or magnetism such as; classification, jigging, tabling, floatation, magnetic separation, electrostatic separation, agglomeration- palletizing, sintering etc.		
3	**Thermodynamics of Chemical Reactions**			
	3.1	Concept of free energy of formation of compounds, change in free energy, enthalpy.	**03**	**06**
	3.2	Exothermic and endothermic reactions, spontaneous reactions.		
	3.3	Conditions for reduction and oxidation of metals.		
4	**Manufacturing of Pig Iron**			
	4.1	Preparation of charge for blast furnace i.e. coke, flux and ore.	**16**	**24**
	4.2	Blast furnace, its construction and shape, charging arrangement, movement of charge, role of coke and flux.		
	4.3	Chemical reactions occurring in different zones of blast furnace.		
	4.4	Behavior of S, P, Zn and alkali metals, formation of slag and pig iron.		

	4.5	Blast furnace stoves and their use, cleaning of blast furnace gas.		
	4.6	Average quantity of charge per ton of pig iron. Modern practices in blast furnace such as increased top pressure, preheating of air blast, use of oxygen, steam and hydrocarbons in the air blast.		
	4.7	Irregularities in the operation of blast furnace and their remedies.		
5	**Alternative routes of Iron production**			
	5.1	Reduction of ore in solid state.	**03**	**06**
	5.2	Sponge iron, various processes of sponge iron production. Use of sponge iron.		
6	**Iron making in India**			
	6.1	History of iron making in India.	**03**	**04**
	6.2	Ore deposits in India, their quality and other important aspects.		
	6.3	Major plants in India, their location and other relevant information.		
		Future prospects of iron making in India.		
7	**Production of Steel**			
	7.1	Necessity for conversion of pig iron into steel. Brief historical review of steel making.	**16**	**25**
	7.2	Bessemer Process, Basic Bessemer process.		
	7.3	Oxygen steel making processes such as LD, Kaldo, Rotor etc. & their charge, reactions.		
	7.4	Open hearth processes of steel making. Construction of open hearth furnace, its charge, charging sequence, reactions, ore boils, and lime boil.		
	7.5	Electric processes of steel making. Use of Arc furnace, Resistance furnace and Induction furnace. Their construction and operation. Comparison of different steel making processes.		
	7.6	Duplex process of steel making. A brief introduction to Integrated Steel Plant.		
		Total	**48**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment
1	Layout of Integrated steel plant.
2	Layout of Integrated ore dressing plant.
3	Write up on Iron pillar of Delhi.
4	A report on Industrial visit.

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Occurrence of Metals	Lecture method
2	Ore Dressing	Lecture method, Demonstration
3	Thermodynamics of Chemical Reactions	Lecture method, Demonstration with chart
4	Manufacturing of Pig Iron	Lecture method, Demonstration with chart
5	Alternative routes of Iron production	Lecture method, Demonstration
6	Iron making in India	Lecture method, Demonstration with chart
7	Production of Steel	Lecture method, Demonstration with chart

Text Books:

Sr. No	Author	Title	Publication
1	Boris Kuznetsov	General Metallurgy	Mir Publishers, Moscow
2	Dr. R.H. Tupkari	Modern Iron Making	Khanna Publishers
3	Dr. R.H. Tupkari	Modern Steel Making	Khanna Publishers

Learning Resources: O.H.P / Transparencies, Charts.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Occurrence of Metals	03	01	00	04
2	Ore Dressing	06	04	02	12
3	Thermodynamics of Chemical Reactions	03	01	02	06
4	Manufacturing of Pig Iron	12	08	04	24
5	Alternative routes of Iron production	04	01	01	06
6	Iron making in India	02	02	00	04
7	Production of Steel	12	08	04	24
	Total	**42**	**25**	**13**	**80**

(Prof.P.K.Metkar)
Prepared By

(Prof.S.B.Kulkarni)
Secretary, PBOS

(Prof.P.B.Kamble)
Chairman, PBOS

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Extraction of Non-Ferrous Metals
Course Code : MT465

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**03**	**48**
Practical	--	--

Evaluation Scheme:

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

Course Rationale:

To expose the students to basic principles and methods involved in extraction and refining of few important non-ferrous metals of engineering and commercial applications.

Course Objectives:

After studying this course, the student should be able to:

- Understand the general terms used in extraction of metals.
- Correlate the scientific principles and technology used in extraction of metals.
- Get familiar with major equipments used in extraction of metals.
- Have a brief account of non-ferrous metal industries in India.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Classification of Metals**			
	1.1	Common division of metals i.e. ferrous and non-ferrous. A brief introduction to Periodic Table of elements.	**04**	**06**
	1.2	Classification of metals based on properties, structure, application, such as refractory metals, rare-earth metals, noble metals, alkali-earth metals etc.		
2	**Metallurgy of Copper**			
	2.1	Important copper minerals and ores; oxides, sulphides and native copper.	**08**	**14**
	2.2	Ore dressing processes to obtain concentrate particularly from sulphide ores and flow sheet.		
	2.3	Production of copper from ores and concentrates. Pyrometallurgical methods and Hydrometallurgical methods, their flow sheet.		
	2.4	Refining of copper. OFHC copper and its applications.		
	2.5	Introduction to copper extraction in India.		
3	**Metallurgy of Lead**			
	3.1	Sources of lead. Important lead ores. Ore- Dressing.	**06**	**12**
	3.2	Principles used in smelting of lead ores. Ore Hearth Smelting and Blast Furnace smelting of lead.		
	3.3	Refining of lead: Pyrometallurgical and Electrolytic methods. Flow sheets of various processes.		
4	**Metallurgy of Zinc**			
	4.1	Occurrence of zinc its ores. Ore dressing.	**08**	**10**
	4.2	Roasting of zinc concentrates. Suspension roasting and Fluidized-bed roasting processes.		
	4.3	Extraction of metallic zinc by distillation in horizontal and vertical retort.		
	4.4	Hydrometallurgical processes for zinc extraction. Flow sheets of various processes.		
	4.5	Refining of Zn by liquation and redistillation.		

5	**Metallurgy of Aluminum**			
	5.1	Sources of aluminum. Preparation of alumina by processes such as acid, alkaline and elecrothermic, with emphasis to Bayer and Le Chetelier-Morin processes.	**12**	**16**
	5.2	Preparation of Cryolite. Manufacturing of carbon electrodes and anode materials.		
	5.3	Production of metallic aluminum by electrolysis, Construction and working of aluminum reduction cell. Composition of bath and its properties. The anode effect, cathode effect and minor effects in the electrolyte. Modern practices in design of electrolytic cell.		
	5.4	Refining of aluminum by chlorination and electrolytic processes.		
6	**Metallurgy of Gold and Silver**			
	6.1	Sources of gold. Methods of gold recovery.	**06**	**12**
	6.2	Gravity concentration, Amalgamation, Cyanidation and gold precipitation from cyanide solutions. Typical flow sheets.		
	6.3	A brief introduction to production of silver.		
	6.4	Refining of gold and silver bullion.		
7	**Metallurgy of Tungsten**			
	7.1	Sources of tungsten. Concentration of ores.	**04**	**10**
	7.2	Treatments to wolframite and scheelite concentrates.		
	7.3	Production of tungsten powder and ductile tungsten.		
		Total	**48**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment
1	Preparation of report on historical development of metals.
2	Flow sheet for Flotation process (for mixed sulphite ore).
3	A report on Industrial visit.

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Classification of Metals	Lecture method
2	Metallurgy of Copper	Lecture method
3	Metallurgy of Lead	Lecture method
4	Metallurgy of Zinc	Lecture method
5	Metallurgy of Aluminum	Lecture method
6	Metallurgy of Gold and Silver	Lecture method
7	Metallurgy of Tungsten	Lecture method

Text Books:

Sr. No	Author	Title	Publication
1	Boris Kuznetsov	General Metallurgy	Mir Publishers, Moscow
2	Dr. R.H. Tupkari	Modern Iron Making	Khanna Publishers
3	Dr. R.H. Tupkari	Modern Steel Making	Khanna Publishers
4	J.D. Gilchrist	Extraction Metallurgy	Pergamon Press, London

Learning Resources: O.H.P / Transparencies, Charts.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Classification of Metals	04	01	01	06
2	Metallurgy of Copper	10	02	02	14
3	Metallurgy of Lead	08	02	02	12
4	Metallurgy of Zinc	05	03	02	10
5	Metallurgy of Aluminum	10	04	02	16
6	Metallurgy of Gold and Silver	06	03	03	12
7	Metallurgy of Tungsten	05	03	02	10
	Total	**48**	**18**	**14**	**80**

(Prof.P.K.Metkar)
Prepared By

(Prof.S.B.Kulkarni)
Secretary, PBOS

(Prof.P.B.Kamble)
Chairman, PBOS

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Non Conventional Machining Processes
Course Code : MT466

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**02**	**32**
Practical	**01**	**16**

Evaluation Scheme:

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

Course Rationale:

Now days non conventional machining processes are gaining importance due their accuracy and versatility. These processes include improved technologies to which the students are not exposed sufficiently. In this subject student will be introduced to modern machining processes.

Course Objectives:

After studying this course, the student will be able to

- Learn the principles of various non conventional machining processes.
- Acquaint him with the different machineries and equipments used in these processes.
- Adapt these processes to potential applications to improve the quality of the product.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Introduction**			
	1.1	Non traditional machining.	**02**	**06**
	1.2	Definitions of various processes. Classification of non conventional processes.		
	1.3	Historical background of new technological processes.		
2	**Mechanical Processes**			
	2.1	Process, principles, equipments and applications of; Abrasive jet machining	**03**	**10**
	2.2	Ultrasonic machining		
	2.3	Abrasive flow machining		
	2.4	Water jet machining		
	2.5	Magnetic abrasive machining		
3	**Electrochemical Machining (ECM)**			
	3.1	Background of ECM process.	**03**	**10**
	3.2	Classification of ECM process.		
	3.3	Fundamental principle of ECM, equipments required in ECM.		
	3.4	Applications.		
4	**Electrochemical Grinding**			
	4.1	Principles.	**03**	**07**
	4.2	Process parameters.		
	4.3	Applications.		
5	**Electrical Discharge Machining (EDM)**			
	5.1	Principles.	**03**	**07**
	5.2	Equipment.		
	5.3	Process parameters.		
	5.4	Applications.		
6	**Chemical Machining**			
	6.1	Introduction.	**06**	**12**
	6.2	Fundamental Principles.		
	6.3	Process parameters.		
	6.4	Classification of etchant resistant materials.		

7	**Laser Beam Machining (LBM)**			
	7.1	Introduction.	**06**	**12**
	7.2	Application of Laser in machining, drilling, cutting, marking, welding, heat treating, cladding.		
8	**Plasma Arc Cutting (PAC)**			
	8.1	Principles.	**03**	**08**
	8.2	Applications.		
9	**Thermal Energy Method (TEM)**			
	9.1	Introduction.	**03**	**08**
	9.2	Process principles.		
		Total	**32**	**80**

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/ Experiment/Assignment	Hrs
1	Study of mechanical processes.	02
2	Study of Electrochemical Machining.	02
3	Study of Electrochemical Grinding.	02
4	Study of Electrical Discharge Machining.	02
5	Study of Chemical Machining.	02
6	Study of Laser Beam Machining.	02
7	Study of Plasma Arc Cutting.	02
8	Study of Thermal Energy Method	02
	Total	**16**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Introduction	Lecture method
2	Mechanical Processes	Lecture method
3	Electrochemical Machining (ECM)	Lecture method
4	Electrochemical Grinding	Lecture method
5	Electrical Discharge Machining (EDM)	Lecture method
6	Chemical Machining	Lecture method
7	Laser Beam Machining (LBM)	Lecture method
8	Plasma Arc Cutting (PAC)	Lecture method
9	Thermal Energy Method (TEM)	Lecture method

Text Books:

Sr. No	Author	Title	Publication
1	Amitabha Gosh Asok Kumar Mallik	Manufacturing Science	Ellis Horwood,1986
2	P.K.Mishra	Nonconventional Machining Methods	Galgotia

Reference Books:

Sr. No	Author	Title	Publication
1	P.C.Pandey H.C.Shah	Nontraditional Manufacturing Methods	Tata McGraw Hill

Learning Resources: O. H. P., Charts.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Introduction	04	02	02	06
2	Mechanical Processes	06	02	02	10
3	Electrochemical Machining (ECM)	06	02	02	10
4	Electrochemical Grinding	04	02	02	07
5	Electrical Discharge Machining (EDM)	04	02	02	07
6	Chemical Machining	06	02	02	12
7	Laser Beam Machining (LBM)	06	02	02	12
8	Plasma Arc Cutting (PAC)	04	02	02	08
9	Thermal Energy Method (TEM)	04	02	02	08
	Total	**44**	**18**	**18**	**80**

(Prof.N.S.Kadam)	(Prof.S.B.Kulkarni)	(Prof.P.B.Kamble)
Prepared By	**Secretary, PBOS**	**Chairman, PBOS**

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Elements of Physical Metallurgy
Course Code : MT467

Teaching Scheme:

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

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests, each of 60 minutes	3 Hrs.	--	--	--
Marks	**20**	**80**	**50**	--	**25**

Course Rationale:

This subject deals with the solidification of metals and alloys, and various types of equilibrium diagrams and their applications. It covers metallographic examination of metals and alloys such as macroscopic examination and quantitative metallography. The subject includes study of iron-iron carbon equilibrium diagrams, transformation systems on different cooling rates, TTT diagram hardenability of steels.

Course Objectives:

After studying this course, the student will be able to

- Understand the use of binary equilibrium diagrams.
- Determine composition and quantity of different phases in equilibrium.
- Perform metallographic examination.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weightage
1	**Solidification of Metals**			
	1.1	Transformation of liquid metal to solid metal, nucleation, dendrite formation, grains & grain boundaries.	**06**	**09**
	1.2	Cooling curves for pure metals & alloys.		
	1.3	Phase equilibrium, Gibb's phase rule & its application.		
	1.4	Solid solution & its types, intermetallic compounds, Hume Rothery rules.		
2	**Equilibrium Diagram**			
	2.1	Types of cooling curves for binary alloy.	**06**	**09**
	2.2	Construction of binary equilibrium diagram, reactions in binary system; Monoeutectic, Eutectic, Eutectoid and peritectoid reactions, partial solubility.		
	2.3	Lever rule, its derivation & application.		
	2.4	Identification of microstructural changes with respect to equilibrium diagram.		
3	**Microscopic Examination**			
	3.1	Sample preparation techniques, methods of polishing; mechanical & electrolytic polishing.	**04**	**06**
	3.2	Etching techniques, etching reagents.		
	3.3	Principle of working of metallurgical microscope.		
	3.4	Microphotography; negatives, exposing, developing & printing.		
	3.5	Macroscopic examination; principle, interpretation of results, Sulphur printing, Phosphorous printing.		
4	**Quantitative Metallography**			
	4.1	ASTM grain size numbers, measurement of plating thickness, case depth.	**01**	**04**

5	**Iron Carbon Equilibrium Diagram**			
	5.1	Allotropic transformation of pure iron.	**07**	**12**
	5.2	Fe-C equilibrium diagram, various phases, critical temperatures. Reactions in Fe-C diagram; peritectic, eutectic and eutectoid.		
	5.3	Cooling of various steels from liquid to room temperature, relationship between microstructure & properties of steel.		
	5.4	Specification of steels; AISI, SAE, EN, IS etc.		
6	**Cast Iron**			
	6.1	Graphitization in cast iron, morphology of graphite, carbon equivalent, Maurer's diagram.	**08**	**12**
	6.2	Forms of graphite; A, B, C, D & E, flake size of graphite, ASTM size. Relationship between microstructure & mechanical properties, phosphide eutectic.		
	6.3	Properties of cast iron; tensile strength, machinability, damping capacity, ductility, impact, hardness etc.		
	6.4	Types of cast iron; Composition, microstructure, properties and applications of- Gray CI, White CI, Chilled CI, Malleable CI, SG iron, high duty CI- Meehanite, Alloy CI.		
7	**T.T.T Diagram**			
	7.1	Construction & use of T.T.T. diagram, cooling rates & microstructure, CCR, CCT diagram.	**04**	**06**
8	**Hardenability Of Steel**			
	8.1	Actual cooling curve after quenching, stages in cooling curve, severity of quench, quenching mediums, Hardness penetration curve.	**04**	**06**
	8.2	Hardenability of steel, determination of hardenability, Grossman & Jominy end quench test, determination of ideal critical diameter from Jominy end quench test.		
	8.3	Factors affecting hardenability, use of hardenability data in industries.		
	8.4	Hardenability of different steels.		

9	**Effect Of Alloying Elements**			
	9.1	Effect of alloying elements on Iron-Carbon diagram & T.T.T. curve.	**01**	**04**
10	**Metallurgy Of Nonferrous Alloys**			
	10.1	Brasses: Cu- Zn equilibrium diagram, order-disorder transformation, hot working of brasses, orange peel defect, season cracking, dezincfication, Zn equivalent, coring & twining in microstructure. Composition, properties & applications of commonly used brasses.	**07**	**12**
	10.2	Bronzes: Cu- Sn equilibrium diagram. Composition, properties & applications of commonly used bronzes; Gun metal, Phosphor Bronzes.		
	10.3	Aluminum Alloy: Al-Si equilibrium diagram, modification of Al-Si alloy. Composition, properties & applications of Al-Si alloys. LM series, Al-Cu alloy system, Duralumin.		
	10.4	Bearing metals: Classification of bearing metals, requirement of good bearing metals. Sn-Sb, Pb-Sb equilibrium diagram. Composition, microstructure, mechanical properties & applications of lead base & tin base bearing metals, effect of Cu addition.		
		Total	**48**	**80**

List of Practical/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Preparation of specimen.	08
2	Mounting of specimen.	04
3	Etching techniques.	02
4	Metallurgical microscope.	02
5	Macroscopic examination.	04
6	Quantitative metallography.	04
7	Microstructures of plain carbon steels.	08
8	Microstructures of cast irons.	08
9	Measurement of hardenability of steel.	02
10	Microstructures of copper, aluminum alloys and bearing metals.	06
	Total	**48**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Solidification of Metals	Lecture method
2	Equilibrium Diagram	Lecture method, Demonstration with chart
3	Microscopic Examination	Lecture method, Demonstration with chart
4	Quantitative Metallography	Lecture method, Demonstration with chart
5	Iron Carbon Equilibrium Diagram	Lecture method, Demonstration with chart
6	Cast Iron	Lecture method, Demonstration with chart
7	T.T.T. Diagram	Lecture method
8	Hardenability of Steel	Lecture method
9	Effect of Alloying Elements	Lecture method
10	Metallurgy of Nonferrous Alloys	Lecture method

Text Books:

Sr. No	Author	Title	Publication
1	Clark and Verney	Physical Metallurgy for Engineers	CBS Publishers and Distributors
2	Avner	Introduction to Physical Metallurgy	Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
3	Dr.V.D.Kodgire	Material Science And Metallurgy	Everest Publishing House

Reference Books:

Sr. No	Author	Title	Publication
1	George L. Khel	Metallurgical Laboratory Practice	Eurasia Publishing House (Pvt) Ltd, New Delhi
2	Robert E. Reed - Hill	Physical Metallurgy Principles	Affiliated East-West Press Pvt. Ltd, New Delhi.

Learning Resources: O. H. P., Charts, CDs.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Solidification of Metals	05	02	02	09
2	Equilibrium Diagram	05	02	02	09
3	Microscopic Examination	04	01	01	06
4	Quantitative Metallography	03	--	01	04
5	Iron Carbon Equilibrium Diagram	08	02	02	12
6	Cast Iron	08	02	02	12
7	T.T.T. Diagram	04	01	01	06
8	Hardenability of Steel	04	01	01	06
9	Effect of Alloying Elements	02	01	01	04
10	Metallurgy of Nonferrous Alloys	08	02	02	12
	Total	**51**	**14**	**15**	**80**

(Prof.A.V.Mehtre)	(Prof.S.B.Kulkarni)	(Prof.P.B.Kamble)
Prepared By	**Secretary, PBOS**	**Chairman, PBOS**

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Advanced Physics
Course Code : SC463

Teaching Scheme:

	Hours /Week	Total Hours
Theory	**03**	**48**
Practical	**02**	**32**

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	**20**	**80**	--	--	**25**

Course Rationale:

This subject deals with preliminary ideas about the concepts of plasma, laser, microscopy and superconductivity to give industrial applications of these concepts. It will also make the students to think logically and solving problem analytically. Further these concepts can be applied for various applications.

Course Objectives:

After studying this course, the student will be able to

- Understand the role of Advanced Physics in engineering field.
- Think in scientific manner and apply the knowledge gained in different situations.

Course Content:

Chapter No.	Name of Topic/Sub topic		Hrs	Weigh tage
1	**Metallurgical Microscope (Optics)**			
	1.1	Revision: types of lenses & image formation by lenses.	**06**	**16**
	1.2	Magnification & power of lens - Definition, formula. Aperture of lens, Numerical Aperture.		
	1.3	Lens aberrations– Spherical, chromatic, coma, astigmatism (no derivations). Minimization of aberration. Achromatic, apochromatic, semi apochromatic lenses.		
	1.4	Revision of simple & compound microscope. Metallurgical microscope– construction & ray diagram.		
	1.5	Eyepieces- Huygens & Ramsden.		
	1.6	Objective- oil immersion objective, properties, N.A., R.P.		
2	**Electronic Microscopy**			
	2.1	Terminology- De Broglie's hypothesis.	**02**	**05**
	2.2	Electron microscope; principle, construction, working & applications, comparison with optical microscope.		
	2.3	Types of electron microscopes- Working & application of scanning (SEM), transmission (TEM).		
3	**LASER**			
	3.1	Terminology- Atomic excitation, critical potential, excitation potential, optical pumping, population inversion, spontaneous & stimulated emission (revision).	**04**	**06**
	3.2	Working & application- Emission of laser using energy level diagram.		
	3.3	Production of Gas & Ruby LASER.		
	3.4	LASER coating & industrial applications.		
4	**X-Rays**			
	4.1	Origin of X-rays, diffraction of x-ray's, Bragge's law and crystal structure, crystal systems with examples.	**04**	**06**
	4.2	Methods for the determination of crystal structure- single crystal and powder method.		

5	**Spectroscopy**			
	5.1	Revision on different types of spectrum.	**04**	**05**
	5.2	Terminology- spectral analysis, types of spectra- lines, band & continuous & its origin.		
	5.3	Application - spectra, types of spectrometers.		
6	**Temperature Measuring Devices**			
	6.1	Laws-Introduction of radiation, Stefan's Boltzman's law, Newton's law, Kirchhof's law, Wein's law.	**09**	**12**
	6.2	Differentiate between the thermometry & pyrometry, Change of properties.		
	6.3	Classification of pyrometer: (1) Distance type (2) Contact type. Contact type pyrometer: A) Thermocouple- Seeback effect, Thomson effect, Peltier effect, base metal & nobel metal thermocouple. Thermoelectric series Calibration of important thermocouple. B) Resistance pyrometer- construction, working, accuracy & application. Distant type pyrometer: A) Disappearing filament optical pyrometer- principle, construction, working, accuracy. B) Total radiation pyrometer- principle, construction, working, accuracy.		
	6.4	Bimetalic thermometer: principle, construction, working & application.		
7	**Plasma Physics**			
	7.1	Concept, properties, formation, occurrence & production of plasma, application of plasma in various area- 1) Welding – plasma arc welding, key hole welding. 2) Coating- use of plasma in coating application. 3) Nitriding- Plasma nitriding.	**03**	**05**
8	**Magnetism and Superconductivity**			
	8.1	Revision on type of magnets & definitions, susceptibility, permeability, hysterisis, retentively, coercivity, area under hysterisis loop & work done. Loss of energy by hysterisis.	**07**	**12**

	8.2	Hard & soft magnetic materials & its relation using hysterisis loop, properties & uses of magnets. Memory cores, permanent magnets, magnetic insulators.		
	8.3	Superconductivity Phenomena, critical temperature, Messner's effect, superconducting materials, type1 & type 2, destruction of superconductivity.		
9	**Interference**			
	9.1	Corpuscular theory, Huygens theory, types of wavefronts, super imposition of waves.	**05**	**09**
	9.2	Phenomena of interference, Constructive & destructive types, conditions for stationary interference pattern, flatness testing, wedge shape film, measurement of diameter of microscopic objects, Newton's rings, measurement of radius, refractive index, wavelength.		
10	**Thin Film**			
	10.1	Thin film, thin film deposition methods, Vacuum deposition, sputtering.	**04**	**04**
	10.2	Chemical vapor deposition (CVD), Chemical bath deposition (CBT) - principle & comparison, thickness measurement.		
		Total	**48**	**80**

List of Practicals/Experiments/Assignments: (Any Ten)

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Ray diagrams of different types of microscopes.	02
2	Measurement of unknown temperature using thermocouple.	02
3	Determination of refractive index & dispersive power using spectrometer.	02
4	Measurement of wavelength using spectrometer.	02
5	To determine the surface tension using traveling microscope.	02
6	To determine radius of curvature of convex surface using Newton's ring method.	02

7	To determine the temperature coefficient of resistance using platinum resistance thermometer.	02
8	Measurement of pole strength of magnet.	02
9	Non destructive testing – LPT/MPT.	02
10	Plotting Hysterisis loop & to determine coercivity & retentivity.	02
11	Study of crystals using models.	02
12	Ultrasonic testing.	02
13	Visit.	02
	Total	**32**

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Metallurgical Microscope	Lecture method
2	Electron Microscopy	Lecture method
3	Laser	Lecture method
4	X-rays	Lecture method
5	Spectroscopy	Lecture method
6	Temperature Measuring Devices	Lecture method
7	Plasma Physics	Lecture method
8	Magnetism & Superconductivity	Lecture method
9	Interference	Lecture method
10	Thin film	Lecture method

Reference Books:

Sr. No	Author	Title	Publication
1	R.K. Gaur & S. L. Gupta	Engineering Physics	Dhanpal Rai & Sons Publications, Delhi
2	Kehl	Principles of Metallographic Laboratory Practice	
3	M.S. Kotgire	Physics for Engineering Material Science	New Age International Publisher
4	A. S. Vasudeva	Engineering Physics	S. K. Karia & Sons, Delhi
5	M.R. Shrinivasan	Perspective of Modern Physics	Mc Graw Hills Book Co.
6	Garfield Shrager	Introductory Material Science	Mc Graw Hills Book Co.
7	Guy	Elements of Physical Metallurgy	
8	A. Beiser	Concepts of Modern Physics	Dhanpal Rai & Sons Publications, Delhi.
9	M. Aditan & A. B. Gupta	Manufacturing Technology	Newage International
10	Subramanim & Brigelal	Text Book of Optics	S. Chand & Co.

Learning Resources: Charts, Black Board, Television, Internet, Educational CD's, Models, Experimentation, Diagram Demonstration, Visit.

Specification Table:

Note: Figures in the bracket indicate the marks for which question will be set to account for internal options.

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Metallurgical Microscope	8(12)	4(6)	4(6)	16(24)
2	Electron Microscopy	3(5)	0	2(2)	5(7)
3	Laser	3(5)	0	3(4)	6(9)
4	X-rays	3(4)	2(3)	1(2)	6(9)
5	Spectroscopy	2(4)	2(2)	1(2)	5(8)
6	Temperature Measuring Devices	6(9)	4(6)	2(3)	12(18)
7	Plasma Physics	3(5)	0	2(2)	5(7)
8	Magnetism & Superconductivity	5(8)	3(5)	4(5)	12(18)
9	Interference	4(7)	3(3)	2(3)	9(13)
10	Thin film	2(3)	1(2)	1(1)	4(6)
	Total	**39**	**19**	**22**	**80**

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