

GOVERNMENT POLYTECHNIC, PUNE
(An Autonomous Institute of Govt. of Maharashtra)

Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Project and Seminar
Course Code : MT561

Teaching Scheme:

	Hours /Week	Total Hours
Theory	--	--
Practical	08	128

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	--	--	--	100	50

Course Objectives:

The project work is included in the syllabus to encourage the students to undertake and tackle an independent problem related to metallurgical field. The project may also comprise of literature survey of a problem assigned. Student should be well acquainted with the skill required for independent thinking and applications to a problem where he can develop in himself 'Self Reliance'. He should be able to make use of library.

The project work will be done by a group of 4 to 6 students. The students will select a topic related to any subject in their syllabi and will design and construct the required equipment, carry out tests and trials and they will submit a report of the work done by them in a suitable form. The project may consist of a market survey or a literature survey of recent developments in the field of metallurgy or it may be a study of a metallurgical processes.

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Course Content:

Selection of topic for project work and relevant experimentation, literature survey, interpretation of results. Group discussion and presentation of the project work in writing.

Seminar:

Each student will select a topic related to technical field and collect detailed information on it. He will deliver a seminar and submit a report.

Laboratory Work:

As per the topic selected by student.

Instructional Strategy:

Literature survey, experiments, trials, group discussion, interpretation of results and discussion with industrial experts.

Reference Books:

As per the selected topic for the project.

Learning Resources: Relevant books and experiments.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
1	Oral	40	30	30	100

Skills to be acquired by Technician:

Various skills are developed depending on the selected topic. These skills are as follows;

Reading skill, tapping resources including library, using knowledge already acquired, thinking and communication skills, working in group, leadership. Interactions with industries, developing contacts, meeting people, making survey, cost consciousness, using resources available in other institutes or industries, skill of handling equipment and instruments safety, observing operations critically, skill of recording results and interpretation of results with group discussion, finding solution for problems and quality awareness, presentation of report in writing, participation in exhibition and developing personality and self confidence.

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(Prof.P.B.Kamble)
Prepared By

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GOVERNMENT POLYTECHNIC, PUNE
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Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Foundry Engineering
Course Code : MT562

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	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	20	80	--	50	25

Course Rationale:

The Metallurgical engineer who is supposed to work as metallurgist or methods Engineer in foundry industries come across specialized foundry processes. He should be able to work as a supervisor for various processes. These processes have been developed depending upon the quantity of castings to be produced, surface quality required, dimensional accuracy achieved, metal cast etc.

Course Objectives:

- The students entering foundry industry will be acquainted with the details of various casting processes, its process variables and controls on the quality of castings.
- To teach the students the basic principles of designing the castings.

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Course Content:

Chapter No.	Name of Topic/Sub topic	Hrs	Weight age
SECTION I			
1	Introduction		
	1.1 Importance of foundry engineering.	02	04
	1.2 Comparison of casting process with other manufacturing processes.		
2	Pattern Making		
	2.1 Pattern materials: Material for patterns and core boxes such as metal, wood, epoxy resin, wax, thermocol etc.	12	14
	2.2 Types of patterns: One piece, split, loose piece, matchplate, gated, skeleton etc. Comparison of various patterns. Pattern plates for hand and machine molding, master pattern.		
	2.3 Pattern design and construction: Pattern allowances, pattern joints, parting line selection, core prints, loose pieces, location of pins on pattern, pattern-lifting devices, color codes for pattern.		
	2.4 Design and construction of various types of core boxes, core venting.		
3	Sand Molding Process		
	3.1 Molding sand: Principal ingredients, sand grains, moisture, binders- inorganic and organic.	18	22
	3.2 Additives in molding sand: Role of additives, commonly used additives such as; Coal dust, Iron oxide, Dextrin, Molasses etc.		
	3.3 Mold washers/coatings, sand preparation and treatment.		
	3.4 Molding sand testing: Need for sand testing, various sand control tests; Moisture content, clay content, grain fineness, permeability, strengths, refractoriness, mold hardness.		

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	3.5	Types of sand molding processes: Principle, ingredients, pattern and equipments, casting size, alloy range, application, advantages and limitations of; green sand, dry sand, loam sand, CO ₂ sand, shell molding, investment casting processes.		
SECTION II				
4	Molding Process using Metal Moulds			
	4.1	Principle, equipments, casting size, alloy range, application, advantages and limitations of; Die casting –Gravity, low pressure, high pressure.	12	14
	4.2	Centrifugal casting.		
	4.3	Continuous casting.		
5	Miscellaneous Molding Processes			
	5.1	Study of miscellaneous molding processes such as; plaster molding, ceramic molding, slush casting, pit and floor molding, stack molding.	06	08
6	Melting Furnaces			
	6.1	Cupola furnace: Principle, construction, melting procedure, types of cupola furnace.	10	12
	6.2	Electric furnace- Coreless, Induction furnace, Duplexing.		
	6.3	Oil fired furnace.		
7	Selection of Molding Process			
	7.1	Selection of molding process with respect to quantity and weight of metal e.g. lathe bed, manhole cover, piston ring, gear box housing, motor body, turbine housing etc.	04	06
Total			64	80

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Study of various molding tools.	04
2	Study of different types of patterns.	04
3	Study of various sand control tests.	08
4	Study of green sand molding.	08

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5	Study of CO ₂ sand molding.	04
6	Study of shell molding.	04
7	Study of stack molding.	04
8	Casting aluminum in gravity die casting.	04
9	Study of cupola furnace.	04
10	Visit to various foundries to see induction and direct arc furnace.	--
11	Assignment- To select molding process for particular application e.g. lathe bed, manhole cover, piston ring, gear box housing, motor body, turbine housing etc.	04
Total		48

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
SECTION I		
1	Introduction	Lecture
2	Pattern Making	Practical, lecture
3	Sand Molding Process	Practical, lecture and industrial visit
SECTION II		
4	Molding Process using Metal Molds	Practical, lecture and industrial visit
5	Miscellaneous Molding Processes	Lecture, industrial visit
6	Melting Furnaces	Practical, lecture and industrial visit
7	Selection Of Molding Process	Discussion, assignment

Text Books:

Sr. No	Author	Title	Publication
1	T. V. Ramana Rao	Metal Casting Principle and Practice	New Age International (P) Ltd, Publishers.
2	Richard W. Heine, Carl R. Loper, Philip C Rosenthal	Principle of Metal Casting	Tata MacGraw Hill Publishing Comp.

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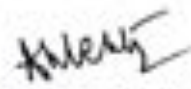
Reference Books:

Sr. No	Author	Title	Publication
1	--	Metal Hand Book no-6	American Soc. Of Metals


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

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
SECTION I					
1	Introduction	04	--	--	04
2	Pattern Making	08	02	04	14
3	Sand Molding Process	12	06	04	22
SECTION II					
4	Molding Process using Metal Molds	08	02	04	14
5	Miscellaneous Molding Processes	04	04	--	08
6	Melting Furnaces	06	02	04	12
7	Selection Of Molding Process	02	00	04	06
Total		44	16	20	80


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Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Powder Metallurgy
Course Code : MT563

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	25

Course Rationale:

Powder metallurgy is one of the important techniques of manufacturing metallic components used in several fields of engineering, automotive, atomic energy, defense, high temperature technology etc. This subject deals with the manufacture and uses of components produced by powder metallurgy techniques.

Course Objectives:

To make the students aware of manufacture, properties and processing of metal powder, compacting and sintering techniques and various applications of sintered products.

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Course Content:

Chapter No.	Name of Topic/Sub topic	Hrs	Weight age
SECTION I			
1	Introduction		
	1.1 Scope of powder metallurgy in industry.	04	06
	1.2 Comparison of powder method with other shaping or forming methods of production.		
	1.3 Principle of the process, its applications, advantages and limitations.		
2	Powder Production		
	2.1 Classification of metal powder production methods.	14	16
	2.2 Various methods of powder production such as Grinding, crushing, Milling, Atomization, Condensation, Carbonyl method, Reduction method, Electrolysis etc.		
	2.3 Specific characteristics of powder manufactured by each method and applications to various metals and alloys.		
3	Characteristics and Testing of Metal Powders		
	3.1 Particle size, shape and distribution, its measurement, Hall flow meter.	16	18
	3.2 Density of metal powders.		
	3.3 Compressibility and its measurement.		
	3.4 Surface area and surface energy.		
SECTION II			
4	Powder Compaction		
	4.1 Classification of compacting methods.	16	18
	4.2 Compacting methods such as pressure less shaping methods, cold compacting methods and compacting with heat.		
	4.3 Brief outline of die and punch. Design, ejection methods.		
	4.4 Lubricants and their use in compacting.		
	4.5 Component shape design, various presses used for compacting, their applications, advantages and disadvantages.		

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	4.6	Special compacting methods such as powder rolling, isostatic compacting, explosive forming, cyclic compacting, powder extrusion etc.		
5	Sintering of Powder			
	5.1	Purpose of sintering.	10	12
	5.2	Mechanism of sintering process.		
	5.3	Liquid phase sintering.		
	5.4	Controls in sintering.		
	5.5	Sintering furnaces and atmosphere.		
6	Applications of Sintered Products			
	6.1	Tools materials, Bearing metals, Permeable materials, friction materials, Magnetic materials and refractory metals etc. Specifications of various sintered products.	06	10
	6.2	Manufacture of P/M parts such as; Cemented carbides, electrical contact materials, sintered metal friction material.		
Total			64	80

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Study of various metal powder manufacturing processes for metal powders of Fe, Cu, Al.	06
2	Flow rate of metal powder.	04
3	Apparent and tap density of powder.	04
4	Compaction of different types of powder in die punch. Effect of load.	06
5	Study of sintering operation given to compacted products.	06
6	Determination of bearing properties of sintered bearing alloys.	06
7	Visit Report on powder metallurgical plant.	--
Total		32

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Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
SECTION I		
1	Introduction	Lecture method
2	Powder Production	Lecture method
3	Characteristics and Testing of Metal Powders	Lecture method
SECTION II		
4	Powder Compaction	Lecture and demonstration method
5	Sintering of Powder	Lecture method
6	Application of Sintered Products	Lecture method

Text Books:

Sr. No	Author	Title	Publication
1	K. Sinha	Powder Metallurgy	Dhanpat Rai And Sons, Delhi
2	Sands & Shakespeare	Powder Metallurgy	George Neunes Ltd., London.

Reference Books:

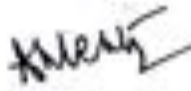
Sr. No	Author	Title	Publication
1	C.G. Goetzel	Treatise On Powder Metallurgy	Interscience Publishers, NewYork

Learning Resources: O.H.P / Transparencies, industrial visit.


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Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
SECTION I					
1	Introduction	06	--	--	06
2	Powder Production	06	05	05	16
3	Characteristics and Testing of Metal Powders	05	05	08	18
SECTION II					
4	Powder Compaction	05	05	08	18
5	Sintering of Powder	04	04	04	12
6	Application of Sintered Products	02	02	06	10
Total		28	21	31	80


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Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Metal Working Processes
Course Code : MT564

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	Two class tests, each of 60 minutes	3Hrs.	--	--	--
Marks	20	80	--	50	--

Course Rationale:

This subject deals with shaping of metal to a suitable form. In this subject, methods of metal working such as rolling, forging, extrusion, wire drawing, tube making and spinning etc. are studied with reference to their uses, applications, equipment and principals etc.

Course Objectives:

After studying this subject, students are expected to know the principles, applications, products, equipments, procedure etc. of various metal working processes.

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Course Content:

Chapter No.	Name of Topic/Sub topic	Hrs	Weight age
SECTION I			
1	Rolling of Metal		
	1.1 Classification of rolling mills; longitudinal, cross and helical rolling.	12	16
	1.2 Elementary metal rolling theory, coefficient of draught, zone of deformation, angle of bite, contact arc, roll bite condition, steady conditions of rolling, determination of coefficient of friction, neutral plane and neutral angle, forward slip, spread, effect of various parameters on spread.		
	1.3 Distribution of draught in the passes, open and close roll pass, neutral line, roll parting line, top pressure and bottom pressure, roll redressing coefficient.		
	1.4 Various types of rolls, construction of rolling mill rolls.		
	1.5 Rolling mills: construction, auxiliary equipment, plant layout, typical roll pass sequence for blooms, billets, rods and flats.		
	1.6 Rolling of tubes.		
	1.7 Defects in rolled products.		
2	Drawing of Wire and Rod		
	2.1 Definition of drawing. Range of starting materials and finished products.	10	12
	2.2 Need for preparation of wires. Preparation of wire; cleaning, rinsing, coating; lime, borax, phosphate coating, baking. Flash baker.		
	2.3 Dies: Construction, shape, materials used, tungsten carbide, diamond dies. Lubrication.		
	2.4 Sink drawing and tube drawing, types of mandrels used, variables in wire drawing, deformation of metal in a drawing die.		

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	2.5	Blocks. Wire drawing machines: drawbenches, bull blocks, motor blocks, multiple draft machines, cumulative and non-cumulative continuous machines, drawing frames.		
	2.6	Heat treatments of wires, patenting.		
	2.7	Defects in wires.		
3	Spinning of Metal			
	3.1	Parts produced by spinning, definition of spinning, comparison of spinning with sheet metal working, accuracy of spinning.	10	12
	3.2	Manual spinning: materials used for forms for manual spinning, collapsible mandrel, various types of spinning tools, lubricants used, various spinning operations, optimum speeds for spinning.		
	3.3	Shear spinning (Power spinning): Advantages of power spinning, power spinning in vertical machine, materials for mandrels used, lubrication, shear spinnability.		
	3.4	Defects in spinning.		
SECTION II				
4	Forging of Metal			
	4.1	Definition of forging, selection of steel for forging.	12	16
	4.2	Heating for forging, various fuels used for heating forgings, changes in properties of metals on heating, oxidation and decarburisation of steel, over heating and burning of steel, forging temperature interval, determination of time required for heating stock for forging, heating stock by electric current by contact method and induction heating.		
	4.3	Various hand tools, various hand forging operations like drawing out, fullering or spreading, chiseling, upsetting, bending, punching and piercing, allowances and tolerances on forging. Applications of forging.		

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	4.4	Working principal of various hammers and presses; Spring hammer, Pneumatic hammer, Single and double acting air, steam hammer, Belt and board drop hammer, Hydraulic press, Screw friction press, Mechanical press. High-pressure water supply for forging press, Cooling of forgings.		
	4.5	Forging defects.		
5	Extrusion of Metal			
	5.1	Direct and indirect extrusion.	10	12
	5.2	Extrusion machines, dies, mandrels, container, profile of dies.		
	5.3	Hydraulic operation of presses, extrusion of tapered and stepped sections.		
	5.4	Heating of the container, heating of billets before extrusion, flow in metal during extrusion, lubrication; variables in extrusion like type of extrusion, extrusion ratio, working temp, speed of deformation and frictional conditions.		
	5.5	Impact extrusion and hydraulic extrusion.		
	5.6	Applications of extrusion, extrusion defects.		
6	Sheet Metal Working			
	6.1	Parts made by sheet metal working.	10	12
	6.2	Various cutting operations like shearing, blanking, piercing, trimming, shaving, notching or slitting. Various types of shears like Guillotine shears, shears with inclined blades, circular shears.		
	6.3	Bending operation, spring back, bending with stretching, geometry and dimensions of bending punches and dies, rubber pad bending, lubrication in bending.		
	6.4	Drawing operation, draw reduction ratio, determine need for blank holder or clamp plate, determining dimensions and shape of blanks, determining allowance for edge trimming, Erickson cupping test.		

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	6.5	Applications of sheet metal working. Defects in sheet metal working.		
			Total	64
				80

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs
1	Study of various types of rolling machines.	06
2	Study of draw bench.	06
3	Study of continuous wire drawing machine.	06
4	Study the effect of drawing operation on properties of metals.	06
5	Study of spinning machine.	06
6	Study of various forging hammers.	06
7	Study of various forging presses.	06
8	Study of different types of extrusion processes.	06
		Total
		48

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
SECTION I		
1	Rolling of Metal	Lecture, demonstration and industrial visits.
2	Drawing of Wire and Rod	Lecture, demonstration and industrial visits.
3	Spinning of Metal	Lecture, demonstration and industrial visits.
SECTION II		
4	Forging of Metal	Lecture, demonstration and industrial visits.
5	Extrusion of Metal	Lecture, demonstration and industrial visits.
6	Sheet Metal Working	Lecture, demonstration and industrial visits.

Text Books:

Sr. No	Author	Title	Publication
1	George E. Dieter	Mechanical Metallurgy	McGrawhill International Book Co.
2	V. Masterov, V. Berkovsky	Theory of Plastic deformation & Metalworking	MIR Publication

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Reference Books:

Sr. No	Author	Title	Publication
1	Claud, Pearson & Parkins	The Extrusion of metals	Chapman and Hall, London
2	K. Burtsev	Rolling Practice	MIR Publication
3	G. Kamenshchikov, S. Koltan, V. Naumov, B. Chernobrovkin.	Forging Practice	MIR Publication
4	P. Polukhin, N.Fedosov, A. Korolyov, Y. Matveyer	Rolling Mill Practice	MIR Publication
5	Raymond A. Higgins	Engineering Metallurgy	English University Press
6	S. E. Rusinoff	Forging & Forming Metals	D. B. Taraporewala & Sons
7	ASS Book	Making Shaping & Treating of Steel	American Society for Steel

Learning Resources: Books, Models and CDs.

Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
SECTION I					
1	Rolling of Metal	08	04	04	16
2	Drawing of Wire and Rod	06	03	03	12
3	Spinning of Metal	06	03	03	12
SECTION II					
4	Forging of Metal	08	04	04	16
5	Extrusion of Metal	06	03	03	12
6	Sheet Metal Working	06	03	03	12
Total		40	20	20	80

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GOVERNMENT POLYTECHNIC, PUNE
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Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Heat Treatment of Metals and Alloys
Course Code : MT565

Teaching Scheme:

	Hours /Week	Total Hours
Theory	04	64
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:

The subject includes study of transformation systems, TTT diagram, hardenability of steel. The mechanical properties of metals and alloys are important from design point of view. After selection of material and alloys the mechanical properties such as tensile strength, ductility, fatigue, hardness can still be further improved by various types of heat-treatment given to ferrous and non-ferrous alloys. Hence, the course has its own value in metallurgical field.

Course Objectives:

After studying this course, the student will be able to

- Understand various transformations in steel.
- Know heat treatments of steels and cast-iron.
- Study heat treatment of non-ferrous alloys.
- Study the relation between microstructure and heat treatment.
- To make aware of safety in heat treatment shops.

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Course Content:

Chapter No.	Name of Topic/Sub topic	Hrs	Weight age
SECTION I			
1	Transformations in Steels		
	1.1 Transformation of Pearlite into Austenite on slow heating. Effect of grain size, Determination of Austenitic grain size, Measurement of grain size.	12	10
	1.2 Transformation of Austenite into Pearlite on slow cooling. Nucleation and growth of Cementite and ferrite. Effect of time & grain size.		
	1.3 Martensite Transformation: MS – MF temperature, Characteristics of Martensite transformation, effect of carbon and alloying elements, retained Austenite, CCR, effect of Austenitic grain size, Volumetric changes during martensite transformation.		
	1.4 Bainite Transformation: Characteristics comparison with Martensite & Pearlite transformation.		
2	Hardening Heat Treatment		
	2.1 Heat treatment furnaces, Vacuum Heat treatment furnaces.	12	10
	2.2 Factors governing heating rate.		
	2.3 Furnace atmospheres – oxidation, decarburization.		
	2.4 Quenching mediums, properties, selection of quenching medium. Polymer quenching. Selection of H. T. cycle for given steel.		
	2.5 Finishing operations after H. T.		
	2.6 Finishing operation on HT Treated component, Shot blasting and Shot pinning.		
	2.7 Defects in heat treatment.		
3	Tempering of Steel		
	3.1 Objects of tempering, stages in tempering, effect of temperature and time of tempering on structure and properties.	04	10
	3.2 Precipitation of carbides, Temper embrittlement.		
	3.3 Secondary hardness.		

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4	Annealing and Normalizing				
	4.1	Various purposes of annealing.	04	10	
	4.2	Subcritical and full annealing, recrystallization, homogenizing annealing, Stress relieving annealing.			
	4.3	Normalizing; purposes, changes in properties.			
SECTION II					
5	Types of Heat Treatments Based on T.T.T. Diagram				
	5.1	Martempering.	02	06	
	5.2	Austempering.			
	5.3	Ausforming.			
	5.4	Patenting.			
	5.5	Isothermal annealing.			
6	Case Hardening Of Steel				
	6.1	Carburising- pack, gas and liquid carburizing. H. T. after carburizing.	12	12	
	6.2	Nitriding - Tufftriding.			
	6.3	Cyaniding - carbonitriding.			
	6.4	Diffusion metallizing, Plasma Nitriding.			
7	Surface Hardening Of Steels And C.I.				
	7.1	Induction hardening.	10	08	
	7.2	Flame hardening.			
	7.3	Electrolytic bath hardening.			
	7.4	Laser hardening.			
8	Heat Treatment Of Cast Irons				
	8.1	H. T. of grey C. I., White C. I., Malleable C.I., H. T. of S. G. Irons.	02	06	
9	Heat Treatment of Non-ferrous Metals And Alloys				
	9.1	Effect of annealing on cold working metals. H. T. of Al, Copper and Mg alloys.	04	06	
	9.2	Precipitation hardening of Al-Cu system.			
10	Safety Measurements In H. T. Shop				
	10.1	Environmental control in H. T. shop.	02	02	
			Total	64	80

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List of Practicals/Experiments/Assignments:

Sr. No.	Name of Pracical/Experiment/Assignment	Hrs
1	Study of heat treatment furnaces.	04
2	Hardening – effect of quenching medium.	08
3	Hardening – effect of hardening temperature.	08
4	Hardening – effect of composition.	08
5	Tempering – effect of tempering temperature.	06
6	Tempering – effect of tempering time.	06
7	Hardening and tempering – effect on toughness of steel.	06
8	Heat treatment of cast irons.	06
9	Precipitation hardening of aluminum copper alloys.	06
10	Hardening of aluminum bronze	06
Total		64

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Transformations In Steels	Class room teaching, practical work, Group discussion and industrial visits.
2	Hardening Heat Treatment	Class room teaching
3	Tempering Of Steel	Class room teaching
4	Annealing And Normalizing	Class room teaching, industrial visits
5	Types Of Heat Treatments Based On T.T.T. Diagram	Class room teaching, group discussion and industrial visits.
6	Case Hardening Of Steel	Class room teaching, expert lectures
7	Surface Hardening Of Steels & C. I.	Class room teaching, expert lectures group discussion and industrial visits.
8	Heat Treatment Of Cast Irons	Class room teaching
9	Heat Treatment Of Non-Ferrous Metals And Alloys	Class room teaching, expert lectures
10	Safety Measurements In H. T. Shop	Class room teaching

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Text Books:

Sr. No	Author	Title	Publication
1	Clark & 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	Higgins	Physical metallurgy	English University Press, London

Reference Books:

Sr. No	Author	Title	Publication
1	--	ASM Handbook	American Society of Metals
2	Prabhudeva,	Heat treatment handbook	Tata McGraw Hill Co. Ltd.

Learning Resources:

Models, charts, structures, slides and photographs.

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Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
SECTION I					
1	Transformations In Steels	06	02	02	10
2	Hardening Heat Treatment	05	03	02	10
3	Tempering Of Steel	06	02	02	10
4	Annealing And Normalizing	06	02	02	10
SECTION II					
5	Types Of Heat Treatments Based On T.T.T. Diagram	04	01	01	06
6	Case Hardening Of Steel	08	02	02	12
7	Surface Hardening Of Steels & C.I	06	01	01	08
8	Heat Treatment Of Cast Irons	04	01	01	06
9	Heat Treatment Of Non-Ferrous Metals And Alloys	04	01	01	06
10	Safety Measurements In H.T. Shop	01	00	01	02
Total		50	15	15	80

N.S.Kadam
(Prof.N.S.Kadam)
Prepared By

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Programme : Diploma in MT
Programme Code : 05/19
Name of Course : Furnace Technology
Course Code : MT566

Teaching Scheme:

	Hours /Week	Total Hours
Theory	03	48
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:

The subject deals with different types of fuels, refractories, pyrometers and furnaces.

Course Objectives:

After studying this course, the student will be able to

- Understand various fuels.
- Understand various refractories.
- Understand various pyrometers.
- Study various furnaces.

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Course Content:

Chapter No.	Name of Topic/Sub topic	Hrs	Weight age
SECTION I			
1	Refractories		
	1.1 Definition, classification, important properties, materials and factors affecting selection of proper refractories.	07	12
	1.2 Types & Properties of refractories, Special refractories.		
	1.3 Testing of refractories; Interaction between refractories and metals.		
	1.4 Applications of refractories.		
2	Fuels		
	2.1 Introduction to conventional fuels.	05	08
	2.2 Properties of solid, liquid & gaseous fuels.		
	2.3 Classification & characteristics of various fuels.		
3	Heat Transfer In Industrial Furnaces		
	3.1 Basic principles	05	08
	3.2 Regenerators and recuperators.		
4	Introduction To Furnaces		
	4.1 Classification, construction, working & application, lining of various fuel fired furnaces.	07	12
	4.2 Materials for Industrial furnace construction, accessories such as burners, blowers, vacuum pumps, exhaust system.		
	4.3 Operations and control of industrial furnaces.		
	4.4 Industrial furnace atmosphere.		
SECTION II			
5	Electric Resistance Heating		
	5.1 Direct & Indirect resistance heating.	10	16
	5.2 Melting of glasses & Electric salt bath furnace.		
	5.3 Types of heating elements.		
	5.4 Construction of furnace, coil dimensions.		
	5.5 Design & construction of muffle furnace.		

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6	Arc Furnaces (Steel melting)				
	6.1	Direct & Indirect arc furnaces, construction, working & application, refractory lining, electrodes, operational parameters.	10	16	
	6.2	Induction Furnaces (cast iron & steel melting). Principle, core & coreless type, skin effect, calculation of minimum frequency, power generation, depth of penetration, crucible preparation. Vacuum induction furnace.			
7	Melting of Nonferrous Materials				
	7.1	Crucible furnace- Lift out type, Tilting type.	04	08	
	7.2	Reverberatory furnace - Sklener furnace.			
	7.3	Barrel type furnace.			
	7.4	Degassing procedure, charge calculation and other individual problem.			
			Total	48	80

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment	Hrs	
1	Study of properties and applications of different furnace refractories.	02	
2	Study of characteristics and classification of fuels.	04	
3	Study of construction of fuel fired furnace.	04	
4	Study of various heating elements for electric heating.	02	
5	Study of electric arc furnace.	02	
6	Study of types of induction furnace.	02	
		Total	16

Instructional Strategy:

Sr. No.	Topic	Instructional Strategy
1	Refractories	Class room teaching, practical work, group discussion and industrial visits.
2	Fuels	Class room teaching

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3	Heat Transfer In Industrial Furnaces	Class room teaching
4	Furnaces	Class room teaching, industrial visits
5	Electric Resistance Heating	Class room teaching, group discussion and industrial visits.
6	Arc Furnaces	Class room teaching, expert lectures
7	Melting of Nonferrous Materials	Class room teaching, expert lectures group discussion and industrial visits.

Text Books:

Sr. No	Author	Title	Publication
1	O.P.Gupta	Element of Fuels, Furnace & Refractories	Khanna Publishers
2	W. Trinks & M.H.Nawhiney	Industrial Furnaces, VI Edition, 2004	Wiley Publisher Newyork
3	Barbers	Electroheat	Granada Publication, London

Reference Books:

Sr. No	Author	Title	Publication
1	D.N.Nandi	Handbook On Refractories	Tata McGraw Hill Co. Ltd.
2	S. Sarkar	Fuels & Combustion	Orient Longmann Mumbai 1990
3	Trinks, Mawhinney, Shannon, Reed & Garvey	Industrial Furnace Vol. I & II	
4	Heine, Loper & Rosenthal	Principal of Metal Casting	

Learning Resources: Models, charts, structures, slides and photographs.

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Specification Table:

Sr. No.	Topic	Cognitive Levels			Total
		Knowledge	Comprehension	Application	
SECTION I					
1	Refractories	08	02	02	12
2	Fuels	06	01	01	08
3	Heat Transfer In Industrial Furnaces	05	01	02	08
4	Furnaces	08	02	02	12
SECTION II					
5	Electric Resistance Heating	10	03	03	16
6	Arc Furnaces	10	03	03	16
7	Melting of Nonferrous Materials	06	01	01	08
Total		53	13	14	80

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