Estd. 1962
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With CGPA 3.52

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शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

SU/BOS/Science/130 **Date: 12/02/2024**

To,

The Head/Co-ordinator/Director
Department of Chemistry
Shivaji University, Kolhapur.

Subject: Regarding syllabi of as per NEP-2020 under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of degree programme under the Faculty of Science and Technology.

1.	P.G. Diploma in Foundry Technology

This syllabus, nature of question shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk (Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

Syllabus for

"POST-GRADUATE DIPLOMA IN FOUNDRY TECHNOLOGY"

(Add-on Course)

Submitted by

Department of Chemistry

Shivaji University,

Kolhapur 416 004 (MS) India.

In association with

The Indian Institute of Foundrymen, Kolhapur Chapter,

Kolhapur (MS), India.

For

Board of Studies in Chemistry

(To be implemented from the academic year 2023-2024)

Title of the course: Post-Graduate Diploma in Foundry Technology

A. INTRODUCTION

In foundry industry, the metal casting enables the production of the simple to complex parts and that meets the variety of needs viz. heavy automobile parts, building components, agriculture equipment's etc. Hence, the aim of the proposed curriculum is to make the more conceptual, industry friendly and suitable to access for the todays needs of the foundry community. With these goals the proposed curriculum has been formulated for providing the skilled employee needs in the foundry industry in connection with special emphasis on the practical orientations and so that the experiential learning so that investors can get the skilled employability easily. Along with providing the skilled employability it also covers the entrepreneurship in the foundry as well as many industrial sectors. The programme structure, teaching pattern, skilled practical's related to the foundry industry has been finalized suitably through guidance from relative senior faculty, consultants, existing industrialist and suggestions from the core faculty etc. The teaching methodologies related to practical oriented or skill based learning has been highlighted through "National Education Policy-2020" for the designing of the curriculum to prepare the skilled students related to foundry industry to meet global standards.

B. **RATIONALE**

In foundry industry the casting process is the heart of the manufacturing progression in which the metal object obtained by pouring molten metals in to a mould and allowing it to solidify. Basically, casting process is a skill and skilled employee will provide the better quality of solidified metal objects for automobile, agricultural and heavy engineering cast components. Recently, foundry sectors are lacking skilled employees in Pattern making, Molding, Melting and Fettling and hence foundry sector's facing rejection control in the world's market competition and the rejection control has become a key factor in the foundry industry. This rejection control is not possible without skilled employees present in the industry. Hence, to overcome these limitations, the proposed diploma curriculum is to provide the skilled employers in the different sections of the industry for the better-quality outcomes from the foundry industry. This curriculum also focuses on employability and entrepreneurship related to foundry industry for strengthening the skilled foundry outcomes.

C. COURSE OBJECTIVES

To enable the students-

- To develop ability and to acquire the skill and knowledge of terms, facts, concepts, processes, techniques and principles of foundry industries.
- To develop ability to apply the skill and knowledge of contents of principles of foundry technology.
- To promote understanding of basic facts and concepts in foundry process while retaining the excitement of foundry industry.
- To inquire of new skill and knowledge of foundry technology and developments therein.
- To make students capable of studying foundry technology in academic and Industrial courses.
- To expose the students to different processes used in Foundry Industries and their applications.
- To expose the students to various emerging new areas of foundry technology and apprise them with their prevalent in their future studies and their applications in various spheres of manufacturing technology.
- To develop problem solving skills in students.
- To expose and to develop interest in the fields of foundry technology.

D. CORE CONTENT

The students will learn:

- ✓ Principle of Melting furnaces
- ✓ The basics of different moulding operations.
- ✓ The advanced moulding processes.
- ✓ Basics of moulding, pattern making, melting and fettling.
- ✓ Study of Charge calculations
- ✓ Key factors behind accurate pattern construction
- ✓ The principle of fettling.
- ✓ To improve their skills and techniques through practicals and projects.
- ✓ About career options in foundry industry.

E. DETAILS OF THE COURSE

1. **Duration:** The duration of the course will be of one year.

❖ **Scheme** – Post-graduate Diploma in Foundry Technology

The final certificate will be awarded only after completion of one year course. The suggested credits for each of the years are as follows:

Awards	Normal calendar duration	Sem. I credits	Sem. II credits
PG Diploma in Foundry Technology	Two Semesters	20	20
	Total	40	

Credits can be defined as the workload of a student in

1. Lectures
2. Practicals
3. Field work/internship/on-job training/review report
4. Course work in the industry
5. Examination
6. Other assessment activities (seminar/tests/etc).

The following formula should be used for conversion of time into credit hours.

a) One Credit would mean equivalent of one lecture of 60 minutes each for theory,

b) The one practical of 120 mins. equivalent to one credit.

c) For internship/field work, the credit weightage for equivalent hours shall be 100% of that for lectures/workshops;

d) For self-learning, based on e-content or otherwise, the credit weightage for equivalent hours of study should be 50% or less of that for lectures/workshops.

2. **Eligibility:**

The eligibility condition for admission to PG diploma shall be

i) Graduate in any faculty.

3. **Medium of Instruction:** The medium of instruction of the course will be English.

4. **Pattern:** Programme structure NEP-2020 Pattern.

5. **Examination:**

5.A. Scheme of examination:

• The semester theory and practical examination with project/OJT/internship will be conducted at the end of each semester.

• Each theory paper, practical paper with research methodology or on-job training will carry 10 marks separately.

• Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus. In each semester, there will be two theory papers, one practical course, and one elective paper with either research methodology or on-job training paper. The detailed structure of this diploma is as follows:

Paper Number	Name of the papers	Credits	Lectures engaged /week (Hrs.)	Marks
Semester I				
Theory Papers (Major - Mandatory)				
PGDFT0101	**Foundry Technology-I**	**4**	**4**	**100**
PGDFT0102	**Physical Metallurgy**	**4**	**4**	**100**
Practical Paper/s (Major - Mandatory)				
PGDFT0103	**Foundry Technology and Physical Metallurgy Practical Course**	**4**	**4**	**100**
Theory Paper (Major - Elective) [Choose only one paper]				
PGDFT0104(A)	**General Science-I**	**4**	**4**	**100**
PGDFT0104(B)	**General Science-II**			
Research Methodology				
PGDFT0105	**Research Methodology**	**4**	**4**	**100**
Total Marks for Semester I (20 Credits)				**500**
Semester II				
Theory Papers (Major - Mandatory)				
PGDFT0201	**Materials Testing and Instrumentation**	**4**	**4**	**100**
PGDFT0202	**Entrepreneurship Development**	**4**	**4**	**100**
Practical Paper/s (Major - Mandatory)				
PGDFT0203	**Testing of Materials and Instrumentation Techniques Practical Course**	**4**	**4**	**100**
Theory Paper (Major - Elective) [Choose only one paper]				
PGDFT0204(A)	**Engineering & Technology-I**	**4**	**4**	**100**
PGDFT0204(B)	**Engineering & Technology-II**			
On-job training/Internship/Apprenticeship				
PGDFT0205	**On-job training OR Internship OR Apprenticeship**	**4**	**4**	**100**
Total Marks for Semester II (20 Credits)				**500**
Total Marks for one-year course (500 marks for sem. I and 500 marks for sem. II)				**1000**

Theory and practical examination with project/OJT evaluation will be conducted after completion of each semester. The 100 marks of each theory paper are distributed as 60 marks for semester theory examination and the remaining 40 marks reserved for internal evaluations. The practical examination will be conducted in two days each of six hours. Each practical paper will be of 100 marks, out of which, 50 marks for major experiment, 30 marks for minor experiment, and the remaining 20 marks for oral and journal. Along with dissertation of project/report, the presentation with personal oral is to be conducted for internship/OJT/apprenticeship evaluation.

5. B. Nature of question paper: For each theory paper, there will be THREE compulsory questions. General nature of the question paper will be:

Question No.	Type		Marks
Q.1	Multiple choice question	No internal options.	12
Q.2 to Q. 3	Short answer questions	Any four out of six	24
Q.4 to Q. 5	Long answer questions	Any two out of four	24

For internal evaluation, tests will be conducted. Each internal test is of 40 marks.

5. C. Standard of Passing:

To pass theory examination, a candidate must obtain at least 40% marks in theory/internal/practical papers. Separate passing will be considered for theory, internal and practical papers in examination.

5. D. External Students:

Not applicable as this is a practical oriented course.

6. University Term: As per academic calendar of the university.

For this PG Diploma in Foundry technology course, the theory lectures will be conducted at the university/college campus and practical components with OJT/internship will be conducted in foundry industries.

7. List of equipment's and instruments:

1. Sand Rammer
2. Sand Sampler
3. Rapid moisture content tester.
4. Compactability Tester
5. Permeability Tester.

6. Universal sand testing machine
7. Mould hardness teller.
8. Core Hardness Tester.
9. Sand Muller
10. Sand Grinder

8. Laboratory Safety Equipment's:

Part I: Personal Precautions:

1. Must wear Lab Aprons / Lab Jacket and safety shoes.
2. Except in emergency, over – hurried activities is forbidden.
3. Eating, Drinking and Smoking in the laboratories is strictly forbidden.

Part II: Use of Safety and Emergency Equipment's:

1. First aid Kits
2. Fire extinguishers (dry chemical and carbon dioxide extinguishers)
3. Management of Local exhaust systems.

9. Workload:

In semester, each theory paper/research methodology paper will have four-hour lectures per week, and practical paper will be four-hour practical per week. For OJT, four hours per week will be reserved.

The total workload for one batch will be:

1. Two theory papers : 2 X 4 = 08 Theory Periods per week
2. Practical work per week : 1 X 4 = 04 Practical periods per week per batch
3. One elective theory paper : 1 X 4 = 04 Theory Periods per week
4. Research Methodology or OJT/Internship **:** 1 X 4 = 04 Theory Periods per week

Total 20 Periods per week.

Working hours will be 20 hours (60 minutes each) per week per batch.

Course Structure of PG Dipolma in Foundry Technology

The overall structure of this course is as follows as per NEP2020:

Yrs	Level	Sem	Major			RM	OJT/FP	RP	Cum Cr.
			Mandatory		Electives				
			Theory	Practical					
Ist	6.0	I	**PGDFT0101** *(4 Cr–100 M)* **PGDFT0102** *(4 Cr–100 M)*	**PGDFT0103** *(4 Cr–100M)*	**PGDFT0104(A)** *(4 Cr–100 M)* **PGDFT0104 (B)** *(4 Cr–100 M)*	**PGDFT0105** *(4 Cr–100 M)*	---	---	
			(8 Cr – 200 M)	***(4 Cr – 100M)***	***(4 Cr – 100 M)***	***(4 Cr–100M)***	----	---	**(20Cr–500M)**
		II	**PGDFT0201** *(4 Cr–100 M)* **PGDFT0202** *(4 Cr–100 M)*	**PGDFT0203** *(4 Cr–100M)*	**PGDFT0204 (A)** *(4 Cr–100 M)* **PGDFT0204 (B)** *(4 Cr–100 M)*	----	**PGDFT0205** *(4 Cr–100 M)*	---	
			(8 Cr – 200 M)	***(4 Cr – 100M)***	***(4 Cr – 100 M)***	-----	***(4 Cr–100M)***	---	**(20Cr–500M)**
Cum. Cr. For PG Diploma			**(16Cr – 400 M)**	**(8Cr – 200 M)**	**(8Cr – 200 M)**	**(4 Cr–100M)**	**(4 Cr–100M)**	---	**(40Cr-1000M)**
			(24Cr – 600 M)		**(8Cr – 200 M)**	**(4 Cr–100M)**	**(4 Cr–100M)**	---	**(40Cr-1000M)**

As per the aforementioned structure, the name of the papers with credits, lectures engaged and their marks are highlighted in the following table:

Paper Number	Name of the papers	Credits	Lectures engaged /week (Hrs.)	Marks
Semester I				
Theory Papers (Major - Mandatory)				
PGDFT0101	**Foundry Technology-I**	**4**	**4**	**100**
PGDFT0102	**Physical Metallurgy**	**4**	**4**	**100**
Practical Paper/s (Major - Mandatory)				
PGDFT0103	**Foundry Technology and Physical Metallurgy Practical Course**	**4**	**4**	**100**
Theory Paper (Major - Elective) [Choose only one paper]				
PGDFT0104(A)	**General Science-I**	**4**	**4**	**100**
PGDFT0104(B)	**General Science-II**			
Research Methodology				
PGDFT0105	**Research Methodology**	**4**	**4**	**100**
Total Marks for Semester I (20 Credits)				**500**
Semester II				
Theory Papers (Major - Mandatory)				
PGDFT0201	**Materials Testing and Instrumentation**	**4**	**4**	**100**
PGDFT0202	**Entrepreneurship**	**4**	**4**	**100**

	Development			
Practical Paper/s (Major - Mandatory)				
PGDFT0203	**Testing of Materials and Instrumentation Techniques Practical Course**	**4**	**4**	**100**
Theory Paper (Major - Elective) [Choose only one paper]				
PGDFT0204(A)	**Engineering & Technology-I**	**4**	**4**	**100**
PGDFT0204(B)	**Engineering & Technology-II**			
On-job training/Internship/Apprenticeship				
PGDFT0205	**On-job training OR Internship OR Apprenticeship**	**4**	**4**	**100**
Total Marks for Semester II (20 Credits)				**500**
Total Marks for one-year course (500 marks for sem. I and 500 marks for sem. II)				**1000**

Theory and practical examination with project/OJT evaluation will be conducted after completion of each semester. The 100 marks of each theory paper are distributed as 60 marks for semester theory examination and the remaining 40 marks reserved for internal evaluations. The practical examination will be conducted in two days each of six hours. Each practical paper will be of 100 marks, out of which, 50 marks for major experiment, 30 marks for minor experiment, and the remaining 20 marks for oral and journal. Along with dissertation of project/report, the presentation with personal oral is to be conducted for internship/OJT/apprenticeship evaluation.

10. SYLLABUS

(i) Figures shown in bracket indicate the total lectures required for the respective units.

(ii) The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective to units.

(iii) All units should be dealt with S.I. units.

(iv) Industrial training / tour / visit per semester is compulsory.

(v) Use of recent editions of reference books is essential.

(vi) Use of Scientific calculator is allowed.

SEMESTER – I

Paper Name: Foundry Technology - I

Paper Code: PGDFT0101

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Mark for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit 1: Fundamentals of Metal Casting 15 h

1.1: Casting Definition, Importance of casting as manufacturing process- Position of India in casting manufacturing, advantages, disadvantages and limitations of casting processes. Castable alloys - Ferrous and Non Ferrous, Castability.

1.2: Steps in the process of Casting, Flow Chart, Foundry Layouts.

1.3: Tooling in casting: Patterns and Core boxes: Introduction and types of patterns, core boxes. Materials used and selection criteria for pattern, Pattern layout, pattern allowances and color codes used in patterns.

Unit 2: Sand & Die Casting 15 h

2.1: Sand Casting: Types of sands used in moulding and core making, their properties. Advantages and limitations of sand casting. Sand systems used for moulding and Core making- advantages, limitations and applications of each- Green sand Moulding, Shell Moulding, CO_2 Moulding, Cold box process, No bake sand, Furan sand. Investment casting. Full mould process.

2.2: Equipment's and tools used for moulding and core making: Hand Moulding, Machine moulding- Jolt and Squeeze moulding machines, HPL, Core shooters.

2.3: Components of gating system, functions and importance of runners and risers, Gating and riser design Calculations, solidification control devices: chills, ceramics. Casting Simulation.

2.4: Introduction to permanent mould casting processes such as Continuous casting, Gravity die casting, pressure die-casting, Centrifugal casting, Vacuum die casting, Squeeze casting.

Unit 3: Melting, Pouring and Post Processing **15 h**

3.1: Types of melting furnaces-Cupola furnace, oil/gas fired furnaces, crucible furnaces, Electrical furnaces, Rotary furnaces, etc. Furnace selection criteria their applications and melting practices in different furnaces (Ferrous and Non Ferrous.

3.2: Charge Calculation, Alloy addition, Inoculation, Nodularization, Grain refinement, Modification treatments, Metal Control- Temperature measuring devices, Composition measuring devises.

3.2: Metal pouring equipments: Ladles- types, Automation in metal pouring

3.3: Knock out, De-coring, Fettling and cleaning (Shot blasting), Grinding, Painting of castings.

Unit 4: Casting defects, Heat Treatment and trends **15 h**

4.1: Casting defects, their causes and remedies.

4.2: Sand reclamation: Significance, types and method

4.3: Heat Treatment of Ferrous and Non Ferrous castings

4.4: Automation, Mechanization and Robotics in foundries

Reference Books:

1. Metal Casting Principle and Practice - T. V. Ramana Rao, New Age International (P) Ltd. Publishers.
2. Metal hand book no-6, American Soc. of Metals

Paper Name: Physical Metallurgy-I

Paper Code: PGDFT0102

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Mark for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit 1: Crystallography 15 h

Bravais lattice, Average no. atoms per unit cell, co-ordination number, atomic packing factor (APF) of S.C., B.C.C., F.C.C. and C.P.H. crystal structures, Miller indices for planes and directions, Imperfections in crystals-Point, line, surface defects Polymorphism.

Unit 2: Solidification of Metals 15 h

(1)Transformation of liquid metals in to solid metals, cooling curves, nucleation dendrite formation, nucleation & growth mechanism.

(2)Grains and grain boundaries, cooling curves for pure metals and alloys

(3)Phase Equilibrium, Gibb's phase rule and applications, Solid solution, Hume Rothery rules with examples.

(4)Types of solid solution substitutional, intermetallic compounds

Unit 3: Equilibrium Diagram 15 h

Cooling curves and construction of a binary equilibrium diagram, reactions in binary system. Monoeutectic, eutectic partial solubility. Eutectoid and peritectoid reactions. Lever rule and its applications. Identification of microstructural changes with respect to equilibrium diagram.

Unit 4: Iron-Carbon Diagram 15 h

Allotropic transformation of pure iron phases, Cooling of steels, Peritectic reaction, Eutectic reaction, Eutectoid reaction, Relationship between microstructure and properties of steel, Effect of carbon on properties, microstructure

References:

1. Text Book Of Metallurgical Analysis - B.C.Agarwal & S.P. Jain, Khanna Publisher, N. Delhi
2. Text Book Of Quantitative Analysis - Willgrd H. H., East West Press, N.Delhi

Paper Name: Foundry Technology and Physical Metallurgy Practical Course

Paper Code: PGDFT0103

Total Workload: 04 hours per batch per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 hours (60 mins. each) per batch per week

Marks for practical: (50 for major + 30 for minor + 20 for oral and journal) 100 marks

A) Following Laboratory experiences and related skills will be developed under Foundry Technology:

Sr. no	Laboratory experience	Skills developed
01	Study of various types of gates.	1) Use the functions of the Ingates in the filing of the mould. 2) Use the nature of the flow in designing of the Ingates. 3) Use types of the gating systems to suit the requirement
02	Study of various types of risers.	1) Use shrinkage behavior of the metal. 2) Use types of the risers to suit the requirements of the feeding. 3) Determine size & shape of the risers effective feeding.
03	Case study of design of gating system and riser	1) Follow the steps involved in the design of the sprue, runner & risers. 2) Calculate the elements of the gating system. 3) location & joining of the gating system to the casting.
04	Study of various methods of the S.G.Iron production.	4) Use various types of methods of S.G. Iron production. 5) Compare various methods of S.G. Iron production 6) Produce the desired microstructure in terms of nodule type, size, nodularity
05	Crucible Melting of Al	1) related with the melting of Al & care to be taken to avoid these problems.
06	Study of the modification of the Al-Si. Alloys.	1) Undertake modification of Al –Si alloys
07	Chemical methods for material Analysis	i) Determine Acid Demand Value, active/dead clay, loss of ignition, volatile matter, Oolitic test, Swelling capacity test, humidity of Sand (Green, waste, resin sand)
08	Physical analysis	i) Determine Compatibility test, permeability test, green-compressive strength

B) Following Laboratory experiences and related skills will be developed under Physical metallurgy:

Sr. no	Laboratory experience	Skills developed
1	Preparation of specimen Mounting of specimen Etching techniques	1) Prepare Metallurgical specimen for microscopic analysis.
2	Metallurgical microscope Macroscopic examination Quantitative Metallography.	1) Use metallurgical microscope for analysis of microstructure
3	Microstructures of plain carbon steels: 0%C,0.2%C,0.4%C,0.6%C,0.8%C, 1.0%C	7) Identify and estimate various phases such as ferrite, pearlite, cementite in the structure. 8) Correlate the microstructure & chemical composition of the steels.
4	Microstructures of cast irons	1) Identify the various microstructures of the cast irons. 2) Identify shape, size and distribution of the graphite flakes in grey cast iron. 3) Use ASTM charts for various measurements in the microstructure 4) Identify nodule shape, size, count and nodularity in S. G. iron of the S.G. Iron. 5) Identify various types of nodules in the structure of S. G. Iron
6	Microstructures of copper, aluminum alloys and bearing metals.	1) Identify the various phase present in the nonferrous alloys such as Cu and Al alloys.

At least 8 - 10 practical experiments from above two sections should be completed in each semester.

Paper Name: General Science-I

Paper Code: PGDFT0104 (A)

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Mark for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit I: Titrimetric and Precipitation Analysis 15 hr

Volumetric methods: Classification of reactions in volumetry. Theories of indicators: Acid-base, redox, adsorption, metallochromic, fluorescent and chemiluminescent indicators. Complexation titrations: Titrations using EDTA, NTA and Titriplex. Precipitation titrations. Redox titrations. Gravimetric methods: Mechanism of precipitate formation. Aging of precipitates. Precipitation from homogeneous solutions. Coprecipitation and post-precipitation. Contamination of precipitates. Washing, drying and ignition of precipitates. Organic reagents used in gravimetry: Oxine, dimethylglyoxime and cupferron.

Unit II: Nanomaterials and their Applications 15hr

Introduction, Historical background of Nanotechnology, Bottom up and top-down approaches, Synthesis of nanomaterials using chemical methods such as chemical reduction, sol-gel, solvothermal, and physical methods, Instrumental techniques include Electron Microscopy (SEM, TEM), Optical Microscopy and Chemical Spectroscopy for properties studies. Properties of Nanomaterials: Electronic, Optical, Chemical, Mechanical, Thermal and Magnetic properties. Applications of Nanomaterials

Unit III: Solid State Chemistry 15 hr

Introduction of Materials: Classification metals, alloys, ceramics, polymers and composites (GRP, glass cermets and cermets), types, properties and applications. Theoretical concept of crystalline materials – types of packing, voids and packing factors, need of alloy design using lattice positions and interstitial voids. Planes and directions and imperfections in solids. Polymorphism and allotropy.

Unit IV: Metallurgy Analysis **15 hr**

Introduction to metals and their alloys (Duralumin, Al-Li, Mg-Li alloys, Titanium alloys, etc.). Their physical metallurgy, properties, and industrial applications. Extraction of metals: Overview of Extractive Metallurgy processes; Thermodynamic Principles of metal extraction.Biocampatble alloys ,

Reference Books:

1. Gilchrist J.D., Extraction Metallurgy, Pergamon.
2. Principles of Extractive Metallurgy: A. Ghosh & H.S. Ray, IIN Publications, Kolkata 1984
3. Introduction To Physical Metallurgy, -Avner, TMH
4. Materials Science and Metallurgy, -Dr. Kodgire (Everest, Pune)

Paper Name: General Science-II

Paper Code: PGDFT0104 (B)

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Marks for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit I: Environmental Degradation and Corrosion 15hr

Electrochemistry of corrosion: Corrosion: Introduction-Definitions and Types (Uniform, Galvanic, Pitting, Crevice), Electrochemical Cells-Definitions and Principles, Potential Measurements-Galvanic Cells, Concentration Cells. EMF and Galvanic Series-Bimetallic Couples, thermodynamic aspects of Corrosion, relation between free energy and equilibrium constant, Derive Nernst equation, standard reduction potential series of Pure Metal, Limitation of Reduction Potential, Concentration cell and Spontaneity of Corrosion Process.

Unit II: X-ray and Electron Microscopy 15hr

Electron optical methods-I: Scanning electron microscopy and X-ray microanalysis including electron probe microanalysis, electron optics, electron beam specimen interaction, image formation in the SEM. X- ray spectral measurements: WDS and EDS, quantitative Xray analysis.

Electron optical methods-II: Analytical transmission electron microscopy: Electron diffraction, reciprocal lattice, analysis of SAD patterns; different electron diffraction techniques, atomic resolution microscopy, analytical devices with TEM, field ion microscopy, and scanning tunnelling microscopy, advanced techniques.

Unit III: Thermal Methods of Analysis 15 hr

Thermal methods of analysis: Principles and instrumentation of TG and DTA. Complementary nature of TG and DTA. Differential scanning calorimeter (DSC). Applications of thermal methods in analytical chemistry and in the study of minerals and polymers.

Unit IV: Heat Treatment **15hr**

Classification of heat treatment processes for various types of steels, Bainite & Martensite formation, Introduction & applications of various case hardening & surface hardening treatments, Precipitation Hardening, Heat treatment defects.

Reference Books:

1. U. K. Chatterjee, S. K. Bose and S. K. Roy: Environmental Degradation of Metals, Marcel Dekker, 2001.
2. Narain S. and Saran R., An Introduction to Electrometallurgy, Standard Publishers.
3. Materials Characterization, Metals Handbook, Vol. 10, ASM
4. Basics of X-Ray Diffraction and its Applications by K. Ramakanth Hebbar
5. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties and Applications, Imperial College Press, 2nd Edition, 2004
6. T. Pradeep, Nano- The Essentials, Tata McGraw-Hill, 1st Edition, 2008

Paper Name: Research Methodology

Paper Code: PGDFT0105

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Marks for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

1. Research Design and Methodology 15 Hrs.

Objectives of research, Types of research, Research approaches, Research process, Research problem, Selection of research problem, Defining research problem, Literature review, Meta-analysis, Effect sizes, Integrating research findings, Identification of research gaps, Errors in research.

Features of good design, Dependent, independent, and extraneous variables, Experimental and control groups, Treatments, Experiment, Research designs in exploratory studies, Research designs in descriptive studies, Experimental research designs (informal and formal), Replication, Randomization, Blocking

2. Sampling and Measurement Techniques 15 Hrs.

Need for sampling, Population, Sample, Normal distribution, Steps in sampling, External validity and threats, Sampling error, Probability sampling, Random sampling, Systematic sampling, Stratified sampling, Cluster sampling, Student's distribution, Standard error, Determination of sample size

Measurement scales, Errors in measurement, Content validity, Criterion-related validity, Construct validity (convergent and discriminant), Reliability, Rating scales, Paired comparison, Differential scales, Summated scales, Cumulative scales, Factor scales

3. Data Collection and Analysis 15 Hrs.

Primary data collection through observations and interviews, Questionnaire surveys, Secondary data collection, Data processing, Measures of central tendency and dispersion, mean, median, mode, range, variance, standard deviation, inter-quartile range, histogram, box-plot, normal probability plot, Measures of association (simple regression analysis, association of attributes) (Use Minitab software)

4. Report Writing 15 Hrs.

Interpretation of results, Techniques and precaution in interpretation, Steps in report writing, Layout of research report, Types of research report, Mechanics and precautions in writing

research report, Structure of research paper, Referencing and bibliographic styles, Citations, Impact factor, Peer review, Plagiarism

Reference Books

1. Montgomery, Douglas C. (2007) – Design & Analysis of Experiments, 5/e. (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.) ISBN: 978-81-265-1048-1

2. Montgomery, Douglas C. & Runger, George C. (2007) – Applied Statistics & Probability for Engineers, 3/e, . (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.), ISBN: 978-81- 265-1424-3 3. Ranjit Kumar, (2006), Research Methodology- A Step-By-Step Guide for Beginners, (Pearson Education, Delhi) ISBN: 81-317-0496-3

4. Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi), ISBN: 81-7722-372-0

5. Kothari, C.K., (2004), 2/e, Research Methodology- Methods and Techniques, (New Age International, New Delhi)

6. Krishnaswamy, K. N., Sivakumar, Appa Iyer and Mathirajan, M. (2006), Management Research Methodology: Integration of Principles, Methods and Techniques (Pearson Education, New Delhi) 7. Panneerselvam – Research Methodology, (PHI), ISBN: 81-203-2452-8

SEMESTER – II

Paper Name: Testing of Materials and Instrumentation Techniques

Paper Code: PGDFT0201

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Marks for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit 1: Structural, Microscopic and Compositional Analysis 15 h

Principle, instrumentation and applications of Compound Optical Microscope, Scanning electron microscopy (SEM), Transmission electron microscopy (SEM), XRD, EDAX, XRF, TGA, DTA.

Unit 2: 15 h

(a) Tensile Testing:

Tensile test: Scope and applicability, specification for testing specimens, conduct and observations of test, effect of important variables, yield stress and proof stress determinations.

a. Universal testing machine.
b. Compression test of steel and cast Iron.

(b) Hardness Tests:

Scope and applicability, Constructional principals of common hardness machines.

Brinell Test: Procedure, effect of variable. Rockwell Test: Procedure, Rockwell superficial hardness tester. Vickers Hardness Test, Microhardness Tester, Shore Sclerescope, Knoop hardness test, scratches and wear hardness tests. Equotip hardness tests its application for measuring hardness of thin layer and hollow surfaces. Relation between various systems of hardness numbers. Relation of hardness to tensile strength. Testing of non-metallic materials.

Unit 3: **15 h**

(a) Fatigue test

Repeated loading, Nature of fatigue in metal. Scope and applicability of fatigue test, machines for fatigue test on metals, General Procedures-N curve, Effect of important variables, correlation with other properties, Improvement of fatigue strength

(b) Creep Test:

Nature of creep, Scope and applicability of creep test, Creep curve and its interpretation. Creep apparatus, Rupture test. Factors influencing creep.

Unit IV: Non-Destructive Testing: 15 h

1) Need of non-destructive tests. Types of non-destructive tests.
2) Methods of examination of defects: Visual examination, penetrant test, hammers tests, Zyglo.
3) Methods of magnetic analysis:
   Magnetic particle method, Magnaflux, magnaglo.
4) Methods of electrical analysis:
   Sperry detector for flaws, Eddy current test
5) Radiographic Examination:
   X-ray and Gama ray generation and their practical application in radiography.
6) Ultrasonic test-Pulse echo method, through transmission method.

Reference Books:

1. Mechanical Metallurgy - George E. Dieter, Mc Graw – Hill Book Company.
2. Testing and Inspection of Engineering Materials- Davis, Troxell And Wiskonell, Mc Graw – Hill Book Company

Paper Name: Entrepreneurship Development

Paper Code: PGDFT0202

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Marks for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit. I: Innovation and Entrepreneurship Development 15 hrs.

Innovation and types of innovation, Startups and Government policies for promoting startups, Entrepreneurship as a career, Traits of successful intrapreneu / entrepreneur: Consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, Entrepreneurship: Scope in local and global market. Intrapreneur and entrepreneur. Types of enterprises and their features: Manufacturing, Service and trading. Steps in Setting up of a business

UNIT.II: Entrepreneurial Opportunities and Selection Process 15 hrs.

2.1 Product / Service selection: Process, core competence, product / service life cycle, new product / service development process, mortality curve, Creativity and innovation in product / Service modification / development.

2.2 Process selection: Technology life cycle, forms and cost of transformation, Factors affecting process selection, Location for an industry, Material handling.

2.3 Market study procedures: Questionnaire design, sampling, Market survey, Data analysis

2.4 Getting information from concerned stake holders such as Maharashtra Centre for Entrepreneurship Development (MCED), National Institute for Micro, Small and Medium Enterprises (NI-MSME, Prime Minister Employment Generation Program (PMEGP),

Directorate of Industries (DI), Khadi Village Industries, Commission (KVIC).

UNIT.III: Support Systems **15 hrs.**

3.1 Categorization of MSME, Ancillary Industries. .

3.2 Support system-Government Agencies: MCED, NI- MSME, PMEGP, DI, KVIC.

3.3 Support agencies for entrepreneurship guidance, training, registration, technical consolation, technology transfer and quality control, marketing and finance

3.4 Breakeven point, return of investment and return on sales.

UNIT IV : Lean Manufacturing and Auditing **15 hrs.**

Introduction to lean manufacturing

Overview of VE/VA

Definition of audit

Types of auditing

Introduction to Internal auditing technique of QMS

Reference Books:

1. Montgomery, Douglas C. (2007) – Design & Analysis of Experiments, 5/e. (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.) ISBN: 978-81-265-1048-1.

2. Montgomery, Douglas C. & Runger, George C. (2007) – Applied Statistics & Probability for Engineers, 3/e, . (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.), ISBN: 978-81- 265-1424-3.

3. Ranjit Kumar, (2006), Research Methodology- A Step-By-Step Guide for Beginners, (Pearson Education, Delhi) ISBN: 81-317-0496-3

4. Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi), ISBN: 81-7722-372-0

5. Kothari, C.K., (2004), 2/e, Research Methodology- Methods and Techniques, (New Age International, New Delhi) 6. Krishnaswamy, K. N., Sivakumar, Appa Iyer and Mathirajan, M. (2006), Management Research Methodology: Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

7. Panneerselvam – Research Methodology, (PHI), ISBN: 81-203-2452-8

Paper Name: Testing of Materials and Instrumentation Techniques Practical Course

Paper Code: PGDFT0203

Total Workload: 04 hours per batch per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 hours (60 mins. each) per batch per week

Marks for practical: (50 for major + 30 for minor + 20 for oral and journal) 100 marks

Sr. No	Laboratory Experience	Skills developed
	Tension Test:	
1	Study of single testing machine Determination of U.T.S., yield strength, Ductility(%elongation),%reduction of area	Conduct tensile test to measure UTS, Y.S., Young's modulus and other related properties
2.	Hardness test Brinell hardness test on steel,	Measure the hardness (BHN) of suitable material and identify its limitations.
3.	Vickers hardness test load selection, calculation of hardness	Measure the hardness (VPN) of suitable material and identify its limitations.
4.	1. Rockwell hardness type of indenters, loads, used. 2. Shores Sclerescope 3. Poldi hardness test.	Measure the Rockwell hardness with various scales such as A,B,C of suitable material and identify its limitations
5.	Charpy and Izod Impact test	Measure the impact values of material by Charpy and Izod tests
6.	Fatigue test	Idetify fatigue limit and
7.	Non-destructive testing Magnetic particle test Dye penetrant test. Ultrasonic testing	Identify the applications of NDT tests.

Few practicals of SEM/TEM Analysis, XRD analysis, TGA/DTA will be conducted

Paper Name: Engineering & Technology-I

Paper Code: PGDFT0204 (A)

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Mark for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit I: Mechanical properties of materials 15 Hrs.

Theory of plasticity: The flow curve, yielding criteria for ductile metals, Plastic deformation of single crystal and polycrystalline materials, Deformation by slips, Deformation by twinning, strain hardening of single crystals.

Dislocation theory: Dislocations in FCC, HCP and BCC lattice, forces on dislocations, forces between dislocations, dislocation climb, intersection of dislocations, Jogs, multiplication of dislocations, dislocation pile-ups.

Unit II: 15 Hrs.

Strengthening mechanisms: Strengthening of grain boundaries, yield point phenomenon, strain aging, solid solution strengthening, strengthening from fine particles, fiber strengthening, martensitic strengthening.

Fracture mechanics and fracture toughness evaluation: Strain energy release rate, stress intensity factor, fracture toughness and design, KICPlain-strain toughness testing, crack opening displacement, probabilistic aspects of fracture mechanics, and toughness of materials.

Unit III: 15 Hrs.

Projections of solids Projection of simple solids like prisms, pyramids, cylinders, cone and truncated solids when the axis is inclined to one of the principal planes.

Development of surfaces Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. (Solids in simple position only)

Unit IV: **15 Hrs.**

Orthographic Projections Different types of lines, Selection of views, spacing of views, dimensioning and sections, Conversion of pictorial view into orthographic view including sectional orthographic view.

Isometric projections Principles of Isometric Projection, Isometric scale, Isometric projections and Isometric views/drawings. Circles in isometric view. Isometric views of simple solids and objects.

Paper Name: Engineering & Technology-II

Paper Code: PGDFT0204 (B)

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Marks for Theory: (40 for Internal + 60 for semester examination) 100 Marks.

Unit I: 15 Hrs.

Study of B.I.S. (Bureau of Indian Standards) Conventions: Significance and importance of various BIS Conventions as per BIS- SP 46, Conventional representation of engineering materials, BIS conventions for sectioning, conventional representation of screw threads and threaded parts, Internal and external threads, conventional representation of springs, conventional representation of gears and gearings, conventional representation of common machine elements (splined shaft, serrated shaft, Knurling, bearings) Symbolic representation of Welds as per BIS conventions.

Unit II: 15 Hrs.

Sketching of Machine Component: Importance of sketching and entering proportionate dimensions on sketches. Sketches of nuts (square and Hexagonal), Flanged nuts, Lock nuts, Dome nuts, Capstan nuts, Wing nuts, Castle nuts, Split pins, etc. Sketches of bolts (square and hexagonal), Cup headed or round-headed bolts, Threaded bolts, countersunk-headed bolts, Hook bolts, Headless tapered bolts, Types of foundation bolts, Studs, Washer, Set screws, Cap screws. Muff coupling, Protected and unprotected Flanged coupling, Universal coupling

Unit III: 15 Hrs.

Limits, Fits and Tolerances: Significance of limit systems, terminology, Dimensional Tolerances, types of fits, Recommendations and selections, Geometric Tolerances, form and position, Representation of geometric tolerances on drawing

Unit IV: 15 Hrs.

Details and Assembly Drawing: Assembly drawing from given detail drawing and vice versa with tolerances and fits. The number of parts is limited to ten to twelve. Preparation of detail and assembly drawing from the following details such as: Tool post, Tailstock, Machine vice, Chucks, Stuffing box, Crosshead assembly, Piston and connecting rod, Valve assembly, Screw jack, Jigs and fixtures, Pipe vice, etc.

Paper Name: On-job training/Internship/Apprenticeship

Paper Code: PGDFT0205

Total Workload: 04 lectures per week (each for 60 mins.)

Distribution of Workload:

Theory: 04 lectures (60 mins. each) per week

Marks distribution: (50 for report/dissertation+ 50 for interview/oral) 100 Marks.

The internship/on-job training/apprenticeship will be carried out at foundry industry and its report will be submitted in the form of dissertation