

Punyashlok Ahilyadevi Holkar Solapur University, Solapur



Name of the Faculty: Science & Technology

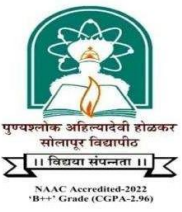
NEP 2020 Syllabus:

Name of the Course: B.Sc. III Paint Technology
(Sem. V & VI)

(Syllabus to be implemented from July 2026)

B.Sc. Part- III Subject: Paint Technology
[According to NEP 2020 W.E.F. June 2026]

Sem.	Paper	Title of Paper	Credits		Marks			
			T	PR	T-CA	PR-CA	T-UA	PR-UA
V	DSC 1-7	Introduction To Paint & Polymer Technology	3	2	30	20	45	30
	DSC 1-8	Resins & Paint Media	3	2	30	20	45	30
	DSC 1-9	Drying Oils, Driers, Solvents & Paint Additives	3	2	30	20	45	30
	DSE 1-1 A	Pigments And Extenders	2	1	20	10	30	15
	DSE 1-1 B	Surface Preparation, Pre-treatment and Corrosion Engineering	2	1	20	10	30	15
	VSC 5	Hands on training related to DSE1-1	---	2	--	20	--	30
	IKS 2	Traditional Indian Knowledge Systems in Paints, Pigments and Surface Coatings	2	---	20	---	30	---
VI	DSC 1-10	Formulation & Manufacturing Of Paints	3	2	30	20	45	30
	DSC 1-11	Coating Properties, Evaluation And Quality Control	3	2	30	20	45	30
	DSC 1-12	Architectural & Industrial Coatings	3	2	30	20	45	30
	DSE 1-2 A	Safety, Health And Environment	2	1	20	10	30	15
	DSE 1-2 B	Advanced Functional Coatings and Emerging Technologies	2	1	20	10	30	15
	VSC 6	Hands on training related to DSE1-2	---	2	--	20	--	30
	FP2/CEP2/OJT1	FP2/CEP2/OJT1	---	2	--	20	--	30

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-V Vertical: DSC1-7 Course Code: G04-DSC1-0540 Course Name: INTRODUCTION TO PAINT & POLYMER TECHNOLOGY
*Teaching Scheme Lectures:03 Hours/week, 03 Credits	*Examination Scheme UA:45 Marks CA: 30 Marks

RATIONALE

In this subject Students will get to know the basic knowledge of Paint as material, and different types of polymers and polymerization techniques to get the film formers.

LEARNING OUTCOMES

After undergoing this Subject, the students will be able to:

- ☐ Understand the Fundamentals of Paints
- ☐ Understand the Fundamentals of Polymers.
- ☐ Understand the Polymerization techniques
- ☐ Understand the Fundamentals of Synthetic Film Formers.

DETAILED CONTENTS

1. BASICS OF PAINT: (13 Periods)

General Introduction of Paint Industry, definition of Paints, Varnishes and Lacquers, their constituents and functions. General classification of surface coatings, mechanism of film formation, sources and composition of oils, non-glyceride, components of oils, classification, extraction and refining of oils.

2. FUNDAMENTAL OF POLYMERS: (12 Periods)

Introduction & historical background of polymers, macro-molecular concept, monomers & polymers nomenclature of polymers, features ,characteristics and applications of a polymer, definition of polymerization, rate of polymerization, average degree of polymerization, functionality and polymerization. oligomers and high polymers, scope of elastomeric, fiber forming and plastic materials.

3. CLASSIFICATION OF POLYMERIZATION: (10 Periods)

Types of polymerization, addition (chain) polymerization, condensation polymerization, Comparison between addition and condensation polymerization. Bulk, suspension, solution & emulsion polymerization.

4. FUNDAMENTAL OF SYNTHETIC FILM FORMERS: (10 Periods)

Fundamental of film formers, chemical structure of monomers, functionality and its determination, polymerization and molecular weight, convertible, non- convertible film formers, linear, branched and cross-linked film formers and co polymers.

RECOMMENDED BOOKS

1 Basics of Paint Technology- Part- 1 By V.C. Maliha, Meenal. A. Sikchi

- 2 Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
- 3 Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
- 4 Outlines of Paint Technology By W.M. Margans Publisher Edward Arnold.
- 5 Introduction To Paint Chemistry By G.P.A. Turner Publisher Champan & Hall
- 6 Polymer Science By V.R. Gowariker Publisher New Age International

 पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 'B++' Grade (CGPA-2.76)	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-V Vertical: DSC1-7P Course Code: G04-DSC1-0540P Course Name: Practical DSC1-7P	
*Teaching Scheme Practical:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks	

LIST OF PRACTICALS

1. Preparation of Acrylic Emulsions.
2. Preparation of Polystyrene by bulk polymerization.
3. Preparation of Polyacrylate by solution/ polymerization
4. To synthesize alkyd resins and test acid value and drying value
5. To synthesize urea formaldehyde resin and test the solubility.
6. To synthesize phenolic resin and test the solubility and softening point .
7. To prepare medium oil alkyd resin and test the acid value
8. To prepare oil and resins varnish.

As the subject involves synthesis of various resin used in paint industry. It can be made more interacting by showing various paint samples (automotive, wall coatings, high duty coatings etc) so that students can appreciate different types of resin and their properties.

RECOMMENDED BOOKS

- 1 Basics of Paint Technology- Part- 1 By V.C. Maliha, Meenal. A. Sikchi
- 2 Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
- 3 Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
- 4 Outlines of Paint Technology By W.M. Margans Publisher Edward Arnold.
- 5 Introduction To Paint Chemistry By G.P.A. Turner Publisher Champan & Hall
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*Teaching Scheme Lectures:03 Hours/week, 03 Credits	*Examination Scheme UA:45 Marks CA: 30 Marks

RATIONALE

In This subject, Various Types of Resins are discussed which are used as Film former or binder in the Paints & Coating Synthetic Resins for different application area are discussed along with properties and manufacturing of each.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- ☐ Understand about Natural and Synthetic Resins
- ☐ Understand the Manufacturing Process of Resins
- ☐ Understand the Structure-Property Relationship of each Resin.

DETAILED CONTENTS

1.INTRODUCTION TO NATURAL RESINS : (05 Periods)

Classification and properties of natural resins etc, Resins sources, oleoresin and its composition, properties and deficiencies of rosin film, modification of rosin, calcium rosinate and maleopimaric acid from rosin etc, Identification of rosin. Shellac: origin, extraction of lac, different kinds of lac and their properties, composition of lac, chemical modification of shellac for use in coatings, French polish, leather finishes, Oleoresinous varnishes etc, from shellac. Cellulose source, properties, modification of cellulose for use in surface coatings like cellulose esters, ethers. Bitumen, pitches, gums and glues, natural bitumens like gilsonite and petroleum pitches general properties and uses of gums and glues.

2. ALKYD RESIN AND PHENOLIC RESINS: (10 Periods)

Alkyd resin, raw material, chemistry and formulation of various alkyds, manufacturing process classification, properties and application of various types alkyds, water soluble alkyds, polyester Saturated & Unsaturated resins, Phenolic resins, classification, types of phenols used, reaction of phenol and formaldehyde, novolac and resoles, resin production, properties and application of various phenolics, water soluble phenolics.

3. AMINO RESINS AND EPOXY RESINS: (10 Periods)

Amino resin: urea formaldehyde and melamine formaldehyde resins, formulation of methylol products, alkylation and curing reaction, properties and application in surface coatings & water soluble and other amino resins. epoxy resin manufacture, formulation of two pack system like solvent based coatings solvent less, high solids coating, single pack epoxies like epoxy ester, thermoplastic epoxy etc., polyamide resins, poly amines and acids used, dimerised fatty acids, properties and application of various polyamides.

4. POLYURETHANE AND SILICONE RESINS: (10 Periods)

Poly urethanes: various isocyanates used, reaction of the isocyanate group and their hazards, classification of poly urethanes, properties and application of various single and two pack systems; silicone resin; synthesis of silicone resin's, structure and properties relationship, properties and application of silicone resins.

5. VINYL AND ACRYLIC RESINS:

(10 Periods)

A. Vinyl and acrylic : vinyl and acrylic monomers type of vinyl resin used in surface coating . Vinyl co polymer and their properties, thermo plastic and thermo setting acrylics, water soluble acrylics.

B. Other Resins - Hydro carbon resin , coumarone and indene resins, resins from petroleum products, terpene resins, miscellaneous resins : fluoro polymers, ketone resins, poly carbonate etc.

LIST OF RECOMMENDED BOOKS

1. Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi
2. Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
3. Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
4. Outlines of Paint Technology By W.M.Morgans Publisher Edward Arnold.
5. The Chemistry of Organic film formers By D.H.Solomon , R.E.Kriegar
6. A manual for Resin for surface coatings By P.K.Oldring Publisher SITA Technology
7. Polymer Science By V.R.Gowariker Publisher New Age International

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*Teaching Scheme Practical:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks	

LIST OF PRACTICALS

1. Preparation and testing of rosin modification such as ester gum, maleic resins, etc.
2. Preparation and testing of synthetic resins such as alkyds, etc.
3. Preparation & testing of stand oils.
4. Preparation & testing of dehydrated castor oils (DCO).

LIST OF RECOMMENDED BOOKS

1. Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi
2. Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.

3. Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia
Publisher Champas & Hall
4. Outlines of Paint Technology By W.M.Morgans Publisher Edward Arnold.
5. The Chemistry of Organic film formers By D.H.Solomon , R.E.Kriegar
6. A manual for Resin for surface coatings By P.K.Oldring Publisher SITA Technology
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*Teaching Scheme Lectures:03 Hours/week, 03 Credits	*Examination Scheme UA:45 Marks CA: 30 Marks

RATIONALE

This Subject equips the students with the knowledge of the oils used in surface Coating as film formers. It also gives the basic knowledge about driers, solvents and additives.

LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- ☐ Have understanding of the oils used in Paint.
- ☐ Understand about the Solvents used in Paint.
- ☐ Understand about the driers and other additives.

DETAILED CONTENTS

1. INTRODUCTION TO DRYING AND NON DRYING OILS: (10 Periods)

Properties and uses of some commonly used drying, semi drying & non drying oils, yellowing of oils, Chemical reactions of oils, like oxidation, hydrolysis, glycerolysis, saponification etc, Evaluation & characterization of oils, modified oils like heat treated oils, maleinised oils, co polymerized oils, dehydrated castor oils, isomerized oils, reconstituted oils etc.

2. DRIERS: (10 Periods)

Definition of driers, types of driers like primary, secondary and auxiliary. Function of metals as well as, acid part of driers, driers mechanisms, manufacture of driers, their evaluation and recommendation for water based and solvent based coatings, combination and dosage of driers, properties of different metal as well as organic radical of driers.

3. SOLVENTS: (12 Periods)

Types of volatile solvents, general properties of solvents like solvent power, toxicity rate of evaporation, boiling point & aromatic content, etc classification like true solvents, latent solvents and diluents, effect of solvent on film properties, classes of solvents with their sources, properties, evaluation of solvents, solubility parameters.

4. PLASTICIZERS & ADDITIVES: (13 Periods)

Definition, importance, mechanism of plasticization, types of plasticizers with their properties, evaluation of plasticizers. Function of additives, additives for solvent-thinned coating like wetting, and dispersing agents, anti-settling and bodying agents, anti-skinning agents, anti-flooding agents etc, additives for latex paints like surface – active agents, antifoam agents, emulsifier, thickening agents, preservatives & coalescing agents etc.

RECOMMENDED BOOKS

- 1 Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi
- 2 Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
- 3 Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
- 4 Outlines of Paint Technology By W M Margans Publisher Edward Arnold., London
- 5 The Chemistry of Organic film formers By D.H.Solomon , R.E.Kriegar
- 6 Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

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*Teaching Scheme Practical:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

LIST OF PRACTICALS

1. Physical testing of drying oils for Colour, Specific Gravity, Refractive Index, etc.
2. Physical testing of semidrying oils for Colour, Specific Gravity, Refractive Index, etc.
3. Physical testing of non-drying oils for Colour, Specific Gravity, Refractive Index, etc
4. Physical testing of drying oils for colour, sp.gr, R.I, etc.
5. Physical testing of semidrying oils for colour, sp. gr., R.I , etc.
6. Physical testing of non-drying oils for colour, sp. gr., R.I , etc.
7. Determination of acid value of oils.
8. Determination of iodine value of oils.
9. Determination of saponification of oils.
10. Oil/fat splitting to recover fatty acids & glycerol
11. Testing of volatile solvent for Distillation Range.
12. Determination of Flash & Fire Point of volatile solvent.

RECOMMENDED BOOKS

- 1 Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi
- 2 Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
- 3 Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
- 4 Outlines of Paint Technology By W M Margans Publisher Edward Arnold., London
- 5 The Chemistry of Organic film formers By D.H.Solomon , R.E.Kriegar
- 6 Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-V Vertical: DSE 1-1 A Course Code: G04-DSE1-514 Course Name: PIGMENTS AND EXTENDERS
*Teaching Scheme Lectures:02 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

RATIONALE

In this subject, the concept of colours is discussed. Various types of Pigments and Extenders are discussed in this paper which are responsible for colours and other properties in Paints and Coatings.

LEARNING OUTCOMES

After the completion of this course, the students will be able to:

- ☐ Understand the color phenomena.
- ☐ Understand the Difference B/W Pigments & Dyes.
- ☐ Understand the Extenders and Pigments, and their manufacturing Processes.
- ☐ Learn about Inorganic and organic & Special effect Pigments.

DETAILED CONTENTS

1. INTRODUCTION:

(05 Periods)

Concept of color phenomena, classification of pigments, testing of pigments, oil absorption value, bulking value, sp. Gravity, refractive index, mass tone, reducing power, tinting strength, resistance to heat. Definition of pigment Dyes, dyes stuffs, toners and lake pigment etc.

2. INORGANIC PIGMENTS:

(10 Periods)

(A)- White pigment such as titanium di-oxides, zinc oxide, Zinc Sulphate, Lithopone etc.

(B)- Color pigments natural and synthetic iron oxide, lead chromate, silico chromates and molybdates, chrome green, chromium oxide, cadmium pigments, Prussian and ultramarine blue, black, mercuric sulphide, synthetic inorganic complexes etc.

(C)- Metallic pigments such as aluminium, Zinc, copper alloys, stainless steel etc., anti corrosive pigments such as red lead, silicon chromate, zinc and strontium chromate white molybdates, calcium plumbate etc. Functional and miscellaneous pigments such as cuprous and mercuric oxides, barium meta borate, nacreous luminescent, etc.

3. EXTENDERS:

(10 Periods)

Sources, manufacture, properties and uses of extenders pigments such as carbonates, silicates, sulphates, oxides, aluminates etc. Lead carbonate, sulphate, silicate etc, antimony oxides, zirconium oxide and silicate, potassium titanate etc.

4. ORGANIC PIGMENTS:

(10 Periods)

Natural organic pigments, comparison of organic pigments and inorganic pigments. General method of preparation and classification of synthetic organic pigment. Basic and acid dye pigment.

5. MISCELLANEOUS PIGMENTS:

(10 Periods)

Phthalocyanine blue and green, hansa yellows, rubine, toners, para reds, toluidine, metallic, phosphorescent, fluorescent pearl pigments, treated pigments. Testing and identification of organic pigments.

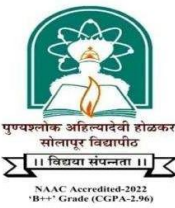
	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-V Vertical: DSE 1-1AP Course Code: G04-DSE1-514P Course Name: Practical DSE1-1AP
*Teaching Scheme PRactical:02 Hours/week, 01 Credits	*Examination Scheme UA:15 Marks CA: 10 Marks

LIST OF PRACTICALS

1. Testing of pigments and extenders such as oil absorption value, bulk-ins value, tinting strength, reducing power, mass tone, etc.
2. To check colors of oils
3. To determine specific gravity of oils (drying, semidrying and non-drying).
4. To check the form and condition of pigment.
5. To determine the moisture content of pigment.
6. To determine the viscosity of paint/primer by FORD cup no 04.
7. To check the flash and fire point of solvent.

LIST OF RECOMMENDED BOOKS

1. Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
2. Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
3. Outlines of Paint Technology By W M Morgans Publisher Edward Arnold.
4. Pigment Handbook vol-1 By T.C.Patton
5. Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-V Vertical: DSE 1-1B Course Code: G04-DSE2-514 Course Name: Surface Preparation, Pre-treatment and Corrosion Engineering
*Teaching Scheme Lectures:02 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

Course Outcomes

After completion of the course, students will be able to:

- Explain corrosion mechanisms.
- Select suitable surface preparation techniques.
- Recommend appropriate pre-treatment methods.
- Design protective coating systems.
- Apply corrosion control techniques in industries.
- Understand industrial standards for surface treatment.

Unit I

(15 Lectures)

Surface Preparation and Pre-treatment

- Importance of surface preparation, Surface contaminants and cleaning methods, Mechanical cleaning, Chemical cleaning, Degreasing, Pickling, Abrasive blasting, Shot blasting, Sand blasting, Phosphating, Chromating, Passivation, Conversion coatings, Surface roughness, Adhesion mechanisms.

Unit II

(15 Lectures)

Corrosion and Protective Coatings

- Fundamentals of corrosion, Electrochemical theory, Types of corrosion, Atmospheric corrosion, Galvanic corrosion, Pitting corrosion, Crevice corrosion, Corrosion prevention methods, Protective paint systems, Zinc-rich primers, Epoxy coatings, Polyurethane coatings, Marine coatings, Pipeline coatings, Automotive corrosion protection.

Recommended / Reference Books

1. H. Leidheiser – Corrosion Control by Organic Coatings
2. Fontana – Corrosion Engineering
3. V.C. Malshe – Basics of Paint Technology
4. D.A. Bates – Paint and Surface Coatings
5. ASTM Standards for Surface Preparation

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-V Vertical: VSC-5 Course Code: G04-VSC-514 Course Name: VSC-III (Hands-on Training related to DSE 1-1)
*Teaching Scheme Lectures:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

Course Preamble

This course is designed to provide hands-on-training to the students. This course includes practical based on pHmetry and Refractometry. This course also trains in alloy analysis.

Course Objectives

1. To understand the basis of Refractometry
2. To understand the basis of pHmetry
3. To understand the basis of Colorimetry
4. To calibrate the analytical instruments
5. To estimate alloys colorimetrically and gravimetrically

Course Outcomes

After completion of the course students will be able to

1. Calibrate the analytical instruments like refractometer and pHmeter
2. Understand the basic components of refractometer, pHmeter and colorimeter
3. Know the composition of various alloys
4. Understand the gravimetric technique of analysis
5. Handle the analytical instruments

Contents

A) (Any Three)

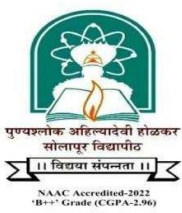
1. To determine the percentage composition of unknown mixture by (i) graphical method and (ii) by composition law (Densities of pure liquids A and B be given) refractometrically.
2. To determine the molar refractivity of methyl acetate, ethyl acetate, n-hexane and carbontetrachloride and calculate the refraction equivalents of C, H and Cl atoms refractometrically.
3. To determine the dissociation constant of monobasic acid (Acetic acid)

pHmetrically.

4. To determine the dissociation constant of dibasic acid (Malonic acid) pHmetrically

B) Alloy Analysis (Any Three)

1. To estimate the amount of tin from solder alloy gravimetrically.
2. To estimate the amount of lead from type metal alloy gravimetrically.
3. To estimate the amount of nickel from cupronickel alloy calorimetrically.
4. To estimate the amount of silver from silver coin gravimetrically.
5. To estimate the amount of copper from brass metal alloy calorimetrically.

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*Teaching Scheme Lectures:02 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

Course Objectives

The course aims to:

1. Introduce students to India's traditional knowledge of pigments, paints, dyes, and protective coatings.
2. Understand the scientific principles behind ancient Indian surface technologies.
3. Appreciate India's contributions to architecture, metallurgy, ceramics, textiles, and natural colouring materials.
4. Promote sustainable and eco-friendly coating technologies based on indigenous knowledge.
5. Encourage innovation by integrating traditional knowledge with modern paint technology.

Course Outcomes (COs)

After completing the course, students will be able to:

CO1: Explain the historical development of traditional Indian paints and coatings.

CO2: Identify natural pigments, dyes, binders, and additives used in ancient India.

CO3: Describe traditional surface protection methods used in architecture, temples, monuments, and handicrafts.

CO4: Compare traditional coating systems with modern industrial coatings.

CO5: Develop environmentally sustainable paint formulations inspired by Indian Knowledge Systems.

Unit I

(8 Hours)

Introduction to Indian Knowledge Systems

- Concept and philosophy of IKS
- Scientific heritage of India
- Traditional chemical sciences
- Ancient Indian materials science
- Contributions of India to chemistry and technology
- Traditional education and artisan knowledge systems

Unit II

(8 Hours)

Traditional Paints, Pigments and Natural Dyes

- History of Indian painting traditions
- Natural mineral pigments, Plant-based pigments, Vegetable dyes, Indigo, Turmeric, Madder, Lac dye, Natural binders, Lime-based paints, Casein paints, Gum Arabic, Natural oils and waxes.

Applications in:

- Ajanta paintings

- Ellora paintings
- Temple murals
- Folk art

Unit III

(8 Hours)

Indigenous Surface Coating Technologies

- Lime plaster technology, Waterproofing techniques in ancient India, Traditional wall finishes, Wooden coatings, Metal protection methods, Corrosion-resistant iron pillar, Stone preservation, Traditional varnishes, Shellac technology, Lac products, Bamboo preservation, Eco-friendly coatings.

Case Studies

- Ajanta Cave Paintings, Ellora Caves, Brihadeeswara Temple
- Rajasthan Frescoes

Unit IV

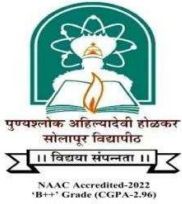
(6 Hours)

Sustainable Paint Technology Based on IKS

- Green chemistry concepts, Bio-based coatings, Renewable raw materials, Low VOC coatings, Traditional preservatives, Herbal antimicrobial coatings, Nano materials in Ayurveda and Rasashastra, Modern applications of traditional knowledge, Intellectual Property Rights and Traditional Knowledge Digital Library (TKDL).

Reference Books

1. *Indian Knowledge Systems* – Ministry of Education, Govt. of India.
2. S. Krishnamurthy – *Traditional Indian Technologies*.
3. Kapila Vatsyayan – *The Indian Arts*.
4. Debiprasad Chattopadhyaya – *History of Science and Technology in Ancient India*.
5. A. Ghosh – *Conservation of Wall Paintings*.
6. V. C. Malshe – *Basics of Paint Technology*.
7. H. F. Payne – *Organic Coating Technology*.
8. T. C. Patton – *Paint Flow and Pigment Dispersion*.
9. Selected research papers on natural pigments, eco-friendly coatings, and heritage conservation.

 पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ SAAC Accredited-2022 'B++' Grade (CGPA-2.96)	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSC1-10 Course Code: G04-DSC1-0640 Course Name: FORMULATION & MANUFACTURING OF PAINTS
*Teaching Scheme Lectures:03 Hours/week, 03 Credits	*Examination Scheme UA:45 Marks CA: 30 Marks

RATIONALE

In this Subject there is discussion of Formulation of the Coating for different applications. Various parameters, and steps during formulation is discussed, there is also discussion on the machinery for manufacturing of Coating and safety principles during the same.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- ☐ Formulate a Coating for the Given Requirement.
- ☐ Choose the correct machinery for manufacturing.
- ☐ Make the safe environment during manufacturing.

DETAILED CONTENTS

1. INTRODUCTION: (15 Periods)

Principles of paint formulation, formulation elements, mathematics & steps involved in paint : Pigment Volume Concentration (PVC), Pigment to Binder (P/B) ratio, etc, Formulation of primers, under coats, base coats and finish coats for steel surfaces.

2. STEPS IN PAINT MANUFACTURING: (15 Periods)

Rheology and rheological considerations (Pseudoplasticity, dilatancy and thixotropy). Steps in paint manufacture- mixing, grinding, letdown, thinning, tinting (shade matching), straining, phenomenon of wetting, grinding and dispersion, important considerations in pigment dispersion

3. MACHINERY USED IN PAINT MANUFACTURING: (15 Periods)

Heavy duty mixers; double blade mixers W& P blending, sigma kneaders pug mills, change, edge runner roller mills , different variants, material balance, power inputs and mill base composition for three roll mill, Ball, pebble and bead mills, cascading & factors affecting effectiveness of milling, such as size & shape of grinding medium, mill base , attritors and vibration mill, sand mill : type of grinding media, sand grinding process efficiency of mill, horizontal sand mills like dyno mill , pearl mills etc, miscellaneous mills, high speed and impingement mill, etc.

RECOMMENDED BOOKS

- ☐ Basics of Paint Technology- Part- 2 By V.C.Maliha, Meenal. A.Sikchi
- ☐ Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
- ☐ Surface Coatings : Raw materials & their usage Volume-2 By OCCA-Australia

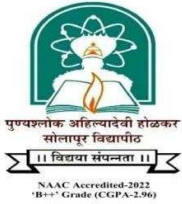
Publisher Champas & Hall

□ Outlines of Paint Technology By W.M.Margans Publisher Edward Arnold.

□ Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

□ Organic Coatings: Science & Technology By Z.W.WICKS, F.N.JONES, S.P.PAPPAS Publisher Wiley & Sons

□ Paint Formulation : Principles and Practice By J Boxall & J.A.Fraunhofer

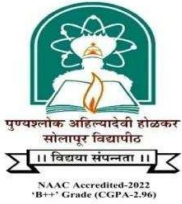
	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSC1-10P Course Code: G04-DSC1-0640P Course Name: Practical DSC1-10P
*Teaching Scheme PRactical:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

LIST OF PRACTICALS

1. To check refractive index of oils (Drying, semidrying and non-drying)
2. To determine specific gravity of oils (Drying, semidrying and non-drying)
3. To check colour of oils (Drying, semidrying and non drying)
4. To determine acid value of oils
5. To determine acid value of resins
6. To test the flash point of solvents
7. To test the aromatic content in the material
8. Preparation of oleo-resinous varnishes
9. Preparation of primers (solvent based and water based).
10. Preparation of glossy paints

RECOMMENDED BOOKS

- ☐ Basics of Paint Technology- Part- 2 By V.C.Maliha, Meenal. A.Sikchi
- ☐ Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
- ☐ Surface Coatings : Raw materials & their usage Volume-2 By OCCA-Australia Publisher Champas & Hall
- ☐ Outlines of Paint Technology By W.M.Margans Publisher Edward Arnold.
- ☐ Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.
- ☐ Organic Coatings: Science & Technology By Z.W.WICKS, F.N.JONES, S.P.PAPPAS Publisher Wiley & Sons
- ☐ Paint Formulation : Principles and Practice By J Boxall & J.A.Fraunhofer

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*Teaching Scheme Lectures:03 Hours/week, 03 Credits	*Examination Scheme UA:45 Marks CA: 30 Marks

RATIONALE

This subject equips the students with basic paint testing. In the subject students learn the fundamental concepts on which paint properties to be evaluated and practically done in quality control lab.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- ☐ Have understanding scope of material properties.
- ☐ Practical Test of Paint Properties.
- ☐ Understanding the Performance of Paint Film
- ☐ Determination of individual raw material properties.
- ☐ Understanding of comparative properties of Architectural paints vs Industrial Paints.
- ☐ Learning of Paint effectiveness against Corrosion.
- ☐ Quality control of paints according specification.

DETAILED CONTENTS

1. COATING PROPERTIES: (07 Periods)

General properties of oil paints, enamels varnishes and lacquers, their comparative merits, classification of paints, and adhesive and cohesion properties, factors affecting adhesion, wetting power, optical properties, color, L, a, b, and E values, gloss, hiding etc, physical, chemical and mechanical properties of paint films factors affecting coating properties, rheological properties, Newtonian and non Newtonian liquids, thixo/tropy, factors affecting viscosity influence of the rheological behaviour.

2. TESTING OF LIQUID FILMS: (10 Periods)

Objective of paint testing, quality control procedures, standard specifications and test methods, classifications of paint test and evaluation tests, test on liquid paints; density, dispersion, viscosity and consistency, wet opacity and dry hiding, spreading capacity and spreading rate, wet & dry film thickness, drying time etc.

3. TESTING OF DRY PAINT FILMS: (10 Periods)

Test of dried coatings, color and color fastness, light fastness, gloss, flexibility, adhesion impact test, hardness, mar resistance, abrasion, resistance, water and moisture resistance, Protection against corrosion (PAC), and salt spray test, resistance to chemical, Vaseline

resistance (petrol resistance) to lubricating oils and solvents, resistance to heat and fire, air permeability etc, evaluation of water based paints, biological effects on paint films.

4. ANALYSIS OF PAINTS & VARNISHES: (10 Periods)

Analysis of paints and varnishes, volatile and non volatile matter, pigment content, binder or solid vehicle content, water content, ash content, pigment, binder and solvent analysis.

5. DURABILITY TESTS: (10 Periods)

Ageing properties of coatings, weatherometry, natural and outdoor durability test, accelerated outdoor weathering, artificial weathering test in a weatherometer, defects observed in paint film on exposure, concept of quality circles, introduction to ISO.

 पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्या संपन्नता ॥ NAAC Accredited-2022 (B++ Grade (CGPA-2.96))	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSC1-11P Course Code: G04-DSC1-0641P Course Name: Practical DSC1-11P
*Teaching Scheme PRactical:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

LIST OF PRACTICALS

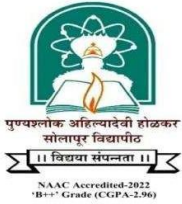
TESTING & QUALITY CONTROL LAB

LIST OF EXPERIMENT

1. To check the gloss and drying of paints
2. To prepare copal varnish and check the gloss
3. To check the drying time and gloss varnish
4. To prepare bitumen varnish and check the hardness
5. To check the glass, drying time, hardness and flexibility of paints
6. To prepare dry distemper and check the adhesion
7. To prepare cement paint and check the adhesion
8. To prepare cement colour and check the stability
9. To prepare ready mixed paints and test the drying time, glass and resistance properties
10. To prepare emulsion paint and test the gloss and drying time.

RECOMMENDED BOOKS

1. Organic Coating Technology Vol-1 By- Henry Fleming Payne Publisher John Willey & sons
2. Surface Coatings : Raw materials & their usage Vol-2 By-OCCA-Australia Publisher Champan & Hall
3. Outlines of Paint Technology By -W.M.Morgans Publisher Edward Arnold
4. Paint and Coating Testing Manual By- Joshep V. Koleske Publishur ASTM International

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSC1-12 Course Code: G04-DSC1-0642 Course Name: ARCHITECTURAL & INDUSTRIAL COATINGS
*Teaching Scheme Lectures:03 Hours/week, 03 Credits	*Examination Scheme UA:45 Marks CA: 30 Marks

RATIONALE

In this Subject those Coatings are discussed which are used in surroundings like buildings, industries, industrial appliances and other miscellaneous Coating.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- ☐ Understand the exterior & interior Coatings for architectural Application
- ☐ Understand the Industrial Coatings
- ☐ Understand Marine and High-Performance Coatings
- ☐ Understand Coatings for Substrates other than wood, Concrete and Steel

DETAILED CONTENTS

1. Unit -1 (10 Periods)

Exterior coatings, Solvent and water based coatings, Formulation considerations: compositions, sealers ,primers, stoppers, undercoats, finish coats/ Coatings for wood, masonry, metal etc, Substrates criteria in selecting, Coating systems, etc.; interior coatings; factors determining selection of coatings, Coatings formulation, manufacture & testing of Coating.

2. Unit -II (15 Periods)

Selection of decorative paints, factors in selection, choice of solvent and water as thinner/ tinters, universal tinters, effects of tinter machines; Water soluble and water reducible binders such as oils, alkyds acrylics, etc.; Emulsion paints; phase of emulsion, emulsifying agents preparation of phases, stability of emulsions, oil in water and water in oil emulsion. Drying mechanism, Application of Architectural paint.

3. Unit -III (20 Periods)

Industrial coatings ; substrates , application and cure, air drying forced drying and stoving, clear finishes for metal and wood , furniture finishes, lacquers automotive coatings; materials of construction, primers, fillers, surface base coats, top coats, clear coats refinishing, etc.;

4. Unit-IV (10 Periods)

Marine coatings; dock and harbor installations, offshore structures , ships paints ,

fouling, organisms leaching rate, types of antifouling paints, recent developments ; industrial structures and industrial buildings (chemical plants) substrate types and their preparation, primers, undercoats, finish coats non-convertible and convertible, red oxide-zinc chromate, zinc rich primers /etch primers, conversion coatings, etc..

5. Unit-V (15 Periods)

Miscellaneous coatings; finishes for appliances, swimming pool, can coatings, coil coatings, coatings for metal containers, paper, plastic, leather, textile, etc., heavy duty coatings; Surface preparation, and application /weather conditions.

LIST OF RECOMMENDED BOOKS

1. Organic Coating Technology, Vol I & II by H.F Payne.
2. Surface Coatings , Vol, I & II by , OCCA, Australia
3. Outlines of Paint Technology by W M Morgan
4. Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
5. Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

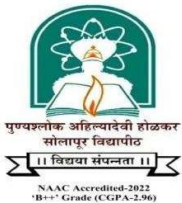
	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSC1-12P Course Code: G04-DSC1-0642P Course Name: Practical DSC1-12P	
*Teaching Scheme PRactical:04 Hours/week, 02 Credits		*Examination Scheme UA:30 Marks CA: 20 Marks

LIST OF PRACTICALS

1. Preparation of dry and oil bound distempers
2. Preparation of acrylic emulsion paints (exterior and interior)
3. Preparation of cement paints

LIST OF RECOMMENDED BOOKS

1. Organic Coating Technology, Vol I & II by H.F Payne.
2. Surface Coatings , Vol, I & II by , OCCA, Australia
3. Outlines of Paint Technology by W M Morgan
4. Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
5. Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

 पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ NAAC Accredited-2022 B++ Grade (CGPA-2.96)	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSE 1-2A Course Code: G04-DSE3-614 Course Name: SAFETY, HEALTH AND ENVIRONMENT
*Teaching Scheme Lectures:02 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

Rationale

This course introduces students to safety practices, occupational health, and environmental protection in paint manufacturing and application. It emphasizes safe handling of chemicals, fire prevention, use of personal protective equipment (PPE), hazard communication, and compliance with industrial safety standards.

Learning Outcomes

After successful completion of the course, students will be able to:

1. Identify hazards associated with paint raw materials and processes.
2. Follow safe handling, storage, and transportation practices for chemicals.
3. Use appropriate PPE and implement workplace safety measures.
4. Interpret MSDS/SDS, hazard labels, and safety symbols.
5. Apply basic first aid, fire safety, and environmental protection practices.

Unit I

15

Safety at manufacturing and application of paint. Materials used in paint shops. Toxicity of materials. Behaviour of solvents, Flash point, odour etc. Handling, storage, transportation and usage of materials. flammability of solvents.

Unit II

15

Explosive limits- Inhalation of solvent vapors. Safety at shop floor. Occupational and Threshold limits

Safety and wellbeing of employees, Health and welfare provisions, change rooms, safety requirement for the processes eg. Abrasive blasting, Electrostatic application, Airless spraying and electrodeposition

Unit III A

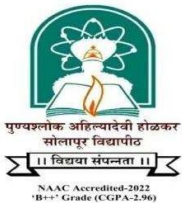
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First Aid firefighting. Noise levels – protection from noise, ventilation, wash room

Unit IIIB

7

Packaging – packaging material composition, labelling, warning for toxins and poisons. MSDS, symbols, personal protective equipments Working at height

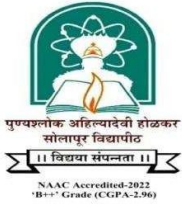
 पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ SAAAC Accredited-2022 'B++' Grade (CGPA-2.96)	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSE 1-2AP Course Code: G04-DSE3-614P Course Name: Practical DSE1-2AP
*Teaching Scheme Lectures:02 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

List of Practicals (Any 8–10)

1. Study of PPE used in paint industries.
2. Interpretation of MSDS/SDS.
3. Identification of GHS hazard symbols and labels.
4. Demonstration of flash point determination.
5. Fire extinguisher demonstration and fire safety practices.
6. First aid for chemical exposure and burns.
7. Safety audit of a paint laboratory.
8. Study of safe storage and handling of solvents.
9. Demonstration of workplace ventilation and noise control.
10. Industrial visit to observe safety practices.

Recommended / Reference Books

1. V. C. Malshe, **Basics of Paint Technology**, Parts I & II.
2. H. F. Payne, **Organic Coating Technology**, Volume I & II.
3. D. A. Bates, **Paint and Surface Coatings – Theory and Practice**.
4. T. C. Patton, **Paint Flow and Pigment Dispersion**.
5. Frank R. Spellman, **Handbook of Environmental Health and Safety**.
6. N. V. S. S. Murthy, **Industrial Safety**.
7. National Safety Council, **Accident Prevention Manual for Industrial Operations**.
8. Frank P. Lees, **Lees' Loss Prevention in the Process Industries**.
9. Government of India, **The Factories Act, 1948** (with amendments) and applicable Occupational Safety, Health and Working Conditions Code.
10. BIS Standards related to Paints, Hazardous Chemicals, Packaging, and Labelling.
11. OSHA Guidelines for Chemical Safety and Hazard Communication.
12. NFPA (National Fire Protection Association) Handbook – Fire Protection and Prevention.

 पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ॥ विद्यया संपन्नता ॥ SAAC Accredited-2022 'B++' Grade (CGPA-2.96)	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: DSE 1-2B Course Code: G04-DSE4-614 Course Name: Advanced Functional Coatings and Emerging Technologies
*Teaching Scheme Lectures:02 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

Course Outcomes

After successful completion, students will be able to:

- Explain modern coating technologies.
- Understand smart and nano coatings.
- Compare conventional and advanced coatings.
- Appreciate sustainable manufacturing practices.
- Understand AI and digital technologies in the paint industry.
- Identify future opportunities in coating science.

Unit I

(15 Lectures)

Functional and Specialty Coatings

- Functional coatings, Nano coatings, Smart coatings, Self-healing coatings, Self-cleaning coatings, Hydrophobic coatings, Anti-graffiti coatings, Antimicrobial coatings, Fire-retardant coatings, Conductive coatings, Optical coatings, UV-curable coatings, Powder coatings, Water-borne coatings, High-solid coatings.

Unit II

(15 Lectures)

Emerging Trends in Paint Technology

- Green coatings, Bio-based binders, Sustainable raw materials, Low VOC coatings, Circular economy in paint industry, Digital colour matching, Colour measurement, Computerized paint formulation, Artificial Intelligence in coating formulation, Robotics in paint manufacturing, Industrial automation, Quality by Design (QbD), Industry 4.0 in paint industries, Recycling of paint waste, Future trends in coating technology.

Recommended / Reference Books

1. Organic Coatings Technology – H.F. Payne
2. Paint Flow and Pigment Dispersion – T.C. Patton
3. Surface Coatings – Oil and Colour Chemists' Association
4. Smart Coatings – A.T. Hubbard
5. Journal of Coatings Technology and Research
6. Progress in Organic Coatings

	Punyashlok Ahilyadevi Holkar Solapur University, Solapur Third Year B.Sc. (Paint Technology) Semester-VI Vertical: VSC-6 Course Code: G04-VSC-614 Course Name: VSC-6 (Hands-on Training related to DSE1-2)
*Teaching Scheme Lectures:04 Hours/week, 02 Credits	*Examination Scheme UA:30 Marks CA: 20 Marks

Course Preamble

This course provides hands-on-training to the students. This course comprises organic estimation, organic preparation and the spectral analysis problems. Students will be provided the IR, NMR and Mass spectra and on the basis of these information, student has to confirm the structure of the given organic compound.

Course Objectives

1. To estimate the organic compounds
2. To prepare various derivatives of organic compounds
3. To read IR, NMR and Mass spectra
4. To predict the important function groups, kinds of protons present in the given organic compounds
5. To predict the probable structure of the organic compound.

Course Outcomes

After completion of the course students will be able to

1. Estimate acetone, ibuprofen and ethyl benzoate
2. Prepare organic compounds and recrystallize them
3. Understand important organic reactions like aldol condensation, radical coupling reactions
4. Calculate the percentage practical yield of prepared compounds
5. Analyse the spectral data and confirm the structure of given organic compound

Contents
A) Organic Estimations (Any two) 1) Estimation of acetone 2) Estimation of ibuprofen from given ibuprofen tablet 3) Estimation of ethyl benzoate B) Organic Preparations (Any two) N.B.: a) Calculation of percentage practical yield. b) Recrystallisation of crude product and its melting point. 1) Base catalyzed Aldol condensation: Preparation of Dibenzal propanone from benzaldehyde and acetone. 2) Radical coupling reaction: Preparation of 1,1,2 bis-2naphthol from β-naphthol 3) Multicomponent reaction: Preparation of Dihydropyrimidone from benzaldehyde, ethyl acetoacetate and urea. C) Spectral Analysis (Any Six) Identification of unknown organic molecules by analysis of their spectra. Photocopies of IR, NMR and Mass spectra of standard compounds are to be interpreted to determine the structure of the compound. Ethanol, Benzyl alcohol, Acetophenone, Ethyl bromide, Ethyl acetate, Ethyl benzoate, Propanoic acid, Acetaldehyde, Butyraldehyde, n-Propyl cyanide, Isopropyl benzene, 2-Chloro butane. At the time of practical examination, candidates are expected to submit the Journal.

Reference Books:

1. Organic Spectroscopy by P. S. Kalsi.
2. Organic Spectroscopy by William Kemp
3. Spectrometric Identification of Organic Compounds by Robert Silverstein, Francis Webster, David Kiemle.
4. Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan
5. Practical Organic Chemistry by A. I. Vogel.
6. Hand book of Organic qualitative analysis by H. T. Clarke.
7. A laboratory Hand Book of Organic qualitative analysis and separation by V. S. Kulkarni. Dastane Ramchandra & Co.
8. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis by V.K. Ahluwalia, Renu Agarwal. University Press. Distributor-Orient Longmann Ltd.
9. Practical Chemistry-Physical-Inorganic-Organic and Viva-voce by Balwant Rai Satija. Allied Publishers Private Limited.

Practical / Field Activities

Students shall perform any five activities:

1. Preparation of natural pigments.
2. Extraction of natural dyes from plant materials.
3. Preparation of lime wash.
4. Preparation of natural wall paint.
5. Preparation of shellac polish.
6. Identification of traditional pigments.
7. Industrial/heritage site visit.
8. Documentation of local traditional coating practices.
9. Seminar on ancient Indian materials technology.
10. Mini-project on sustainable paint formulation.

Suggested Teaching Methods

- Interactive lectures, Demonstrations, Laboratory activities, Field visits, Heritage site studies, Documentary presentations, Expert lectures, Student seminars, Case studies, Project-based learning.

Suggested Field Visits

- Heritage monuments with traditional murals, Local artisan clusters, Paint manufacturing industries, Lac processing units, Natural dye industries, Museums and conservation laboratories.