

5.1 RESIN TECHNOLOGY - II

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RATIONALE

This subject deals with chemistry, raw materials, synthesis and formulation of various industrial resins used in coating industry.

DETAILED CONTENTS

- 1 Formaldehyde Based Resins/Amino Resins - Phenol-formaldehyde resins (Novolacs and Resols), Resin synthesis, use of phenolic resin in coatings (varnishes, automotive coating, metal coatings, marine paints), Amino Resins, Urea formaldehyde, Melamine formaldehyde resins, chemistry and synthesis of amino resins, Application in coatings (14 hrs)
- 2 Silicon Resins - Synthesis of silicon resins, structure property relationship, as coating binders, coating additives and coating modifiers. Application of silicon resins (10 hrs)
- 3 Epoxy Resins - Chemistry of epoxy resin, Polyaddition (using polyamines and Polyamides) Manufacturing of epoxy resins. Application of epoxy resins (Industrial maintenance coatings, container coatings and heavy duty coatings) (14 hrs)
- 4 Acrylic Resins - Structure- property relationship of acrylics (stability, hardness, flexibility, adhesion, solubility and cross linking), Application of thermoplastic and thermosetting acrylic resins, Modification of acrylic resins (12 hrs)
- 5 Vinyl Resins - Types of vinyl resins, use of vinyl resins (06 hrs)
- 6 Fluoropolymers - Introduction and properties of fluoropolymers, Importance and applications in high temperature and fire resistance coatings (08 hrs)

LIST OF PRACTICALS

1. To synthesize alkyd resins and test acid value and drying value
2. To synthesize urea formaldehyde resin and test the solubility
3. To synthesize phenolic resin and test the solubility and softening point
4. To prepare medium of alkyd resin and test the acid value
5. To prepare oil and resins varnish.

INSTRUCTIONAL STRATEGY

As the subject involves synthesis of various resin used in paint industry. It can be made more interactive 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. Organic Coating Technology, Vol. II by H.F. Payne Published by (John Wiley), 1960.
2. Surface Coating, Science and Technology, by Swarj Paul (John Wiley), Ed. 2, 1997.
3. Outlines of Paint Technology by W.M. Morgans, Publishers Griffin, 1969.
4. Organic Coatings, Wicks W; Jones FN.; Pappas S.P.; & Wicks D.A. (John Wiley 3rd Edn. 2007).

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	25
2	10	20
3	14	30
4	12	15
5	06	05
6	08	05
Total	64	100

5.2 QUALITY CONTROL AND TESTING OF COATINGS

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RATIONALE

This subject converses the student with quality control and performance/testing of end use applications.

DETAILED CONTENTS

1. Objectives of paint testing, quality control procedures, standard specifications and test methods, classification of paint tests and evaluation tests, Test on liquid paints: density, dispersion, viscosity and consistency, wet opacity and dry hiding, spreading capacity and spreading rim, wet and dry rim, thickness, drying time etc (20 hrs)
2. Tests of dried coatings, colour and colour fastness, light fastness, gloss, flexibility, adhesion, impact test, hardness, mar resistance, abrasion resistance, water and moisture resistance, water vapour transmission, PAC and salt spray test, resistance to chemicals, resistance to lubricating oils and solvents, resistance to heat and fire, air permeability etc., evaluation of water based paints, biological effects on paint films (16 hrs)
3. Analysis of paints and varnishes, volatile and nonvolatile matter, pigment content, binder or solid vehicle content, water content, ash content, pigment binder and solvent analysis (14 hrs)
4. Ageing properties of coatings, weatherometry, natural outdoor durability test, accelerated outdoor weathering, artificial weathering test in a weatherometer, defects observed in paint film on exposure, concept of quality and quality standards in paint industry (14 hrs)

LIST OF PRACTICALS

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 gloss, 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, gloss and resistance properties.
10. To prepare emulsion paint and test the gloss and drying time.

INSTRUCTIONAL STRATEGY

Visit to paint R& D laboratories/ industry may be undertaken

RECOMMENDED BOOKS

1. Organic Coating Technology Vol.I and II by H.F. Payne, 1960
2. Surface coatings, by H.F. Payne, John Wiley and Sons, Vol. I and II OCCA, Australia
3. Testing of Organic Coating by Norman I Gaynes, Published by Noyes Data Corporation, 1977

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	20	30
2	16	30
3	14	20
4	14	20
Total	64	100

5.3 CHEMICAL REACTION ENGINEERING

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RATIONALE

It is a core subject of Chemical Engineering and is essential for understanding the kinetics of various reactions, types of reaction vessels and the performance of reactive systems used in industry.

DETAILED CONTENTS

1. Introduction to Chemical Kinetics (12 hrs)

Homogenous Reaction, Heterogeneous Reaction, Catalytic and Non-catalytic reaction, Elementary and Non – elementary, Simple and Multiple reaction, Reversible and Irreversible reaction, Endothermic and Exothermic reaction – definition and example. Chemical Equilibria, Le-chatlier principle and factors affecting chemical Equilibria like temperature, concentration, pressure, catalyst.

2. Kinetics of Homogenous Reaction (14 hrs)

Concept of rate of reaction, rate equation, rate constant, order of reaction, molecularity of reaction, factors affecting rate of reaction. Theories of reaction rate constant; Arrhenius Law and problems based on it from thermodynamics, from collision theory, from transmission state theory. Activation energy – concept.

3. Interpretation of Batch Reactor Data (20 hrs)

Constant Volume Batch Reactor, Relation of concentration and conversion for constant volume batch reactor, analysis of total pressure data obtained in constant volume batch reactor. Methods used to analyse the kinetic data/rate data or to determine order of reaction: Integral method of analysis of rate data – procedure. Integral method of analysis for irreversible unimolecular, first order reaction, bimolecular second order reaction, n^{th} order reaction, zero order reaction and simple problems. Half life concept for the overall order of irreversible reaction. Differential method of analysis of rate data or order of reaction – only procedure. Variable Volume Batch Reactor – concept only.

4. Reactors (12 hrs)

Basic type of reactors - batch reactor, CSTR, plug flow reactor, semi-batch reactor. Fixed bed reactor Vs Fluidised bed reactor. Performance equation for ideal batch reactor, MFR, PFR for constant volume – no derivation only final expression and their graphical representation of first order irreversible reaction. Concept of space time, space velocity, and holding time.

5. Catalysis (06 hrs)

Definition, types and classification, preparation of catalyst, ingredients (promoters, inhibitors, accelerators). Catalyst poisoning, regenerator.

INSTRUCTIONAL STRATEGY

Emphasis should be laid on problem-solving using some simple numericals.

RECOMMENDED BOOKS

1. Chemical Reaction Engineering by Levenspeil, John Wiley Publication
2. Chemical Engineering Kinetics by Smith, McGraw Hill Publication
3. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India
4. Reaction Kinetics for Chemical Engineering by Wales, McGraw Hill Publication
5. Chemical Reaction Theory – An Introduction by Denbigh and Turner, Cambridge University Press Publication
6. Chemical Reaction Engineering by K.A. Gavhane, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted Hrs
1	12	15
2	14	25
3	20	30
4	12	20
5	06	10
Total	64	100

5.4 ADEHESIVES AND SURFACE COATINGS - I

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RATIONALE

This course is designed to impart knowledge relating to adhesive and coatings. Study of this course will enable the students to learn about the types and testing of adhesives and coatings.

DETAILED CONTENTS

1. Fundamentals of Adhesives (10 hrs)
Adhesives – Fundamentals – types of substrates – immiscible planar, immiscible with complex surface, miscible etc – setting, adhesive strength, thermodynamics of adhesives- concepts of surface energy, contact angle etc – types of joints, joint selection.
2. Non Reactive Adhesives (12 hrs)
Natural adhesives like animals glue, casein, starch – rubber based adhesives – NR, SBR, NBR, CR, IR adhesives – Latex based and solution based – Formulations – Pressure sensitive and hot melt adhesives based on SBS, EVA, polyvinyl acetate and polyvinyl alcohol.
3. Reactive Adhesives (12 hrs)
Phenolics, epoxies, acrylics, cyanoacrylates – uses of adhesives in civil engineering, automobile, aerospace, electrical and electronic industries.
4. Testing of Adhesives (04 hrs)
Mechanical testing, water resistance, water and chemical resistance, oil resistance, fire resistance etc.
5. Introduction to Coatings (06 hrs)
Definition, components of coatings (solvent, resin, pigments, stabilizers, additives, filters), types of coatings: water borne (latex), oil borne coatings, varnishes with and without solvent (elastomeric coatings).
6. Surface Coatings (10 hrs)
Components of Paints – Preparations, formulations, pigment, dispersion, drying and film formation mechanisms, types of paints – based on emulsion, oil, alkyds, epoxies, Analysis of Phenol Formaldehyde, Urea Formaldehyde etc., Urethanes, Silicons – Primers like chlorinated rubber – applications, powder coatings.
7. Surface Preparation (10 hrs)
Surface Preparation for adhesions and painting, powder coatings, factors affecting coating properties, barrier properties – rheology and its importance, paint and adhesion performance testing.

LIST OF PRACTICALS

1. To determine the scratch resistance of a coating
2. To study if different adhesives work best on wood, and if sanding the wood surface before gluing would help the adhesive stick better.
3. To study how differences in surfaces affect the adhesion of several brands of tape.
4. To determine curing times for different types of coatings
5. To determine the molecular weight of a polymer by viscosity method
6. Preparation of coating using the electrolysis technique or by dipping technique/Spray technique
7. Preparation of Non Fogging mirror. In this laboratory exercise undergraduate students can prepare and test a nonfogging mirror. The mirror can be prepared by coating a glass microscope cover slip with silver in a Tollens' reaction and to be rendered nonfogging by coating it with a hydrophilic polyacrylate polymer and testing using the Breath Fog Test - No fog formation after direct breathing on the coated surface.
8. Preparation of phenol formaldehyde resin for coating and its use in coating
9. To test the compatibility of an adhesive for different surfaces

INSTRUCTIONAL STRATEGY

Actual application should be shown by visits to sites.

RECOMMENDED BOOKS

1. Organic Coating Technology, Vol. II by H.F. Payne Published by (John Wiley), 1960.
2. Surface Coating, Science and Technology published by Swarj Paul (John Wiley), Ed. 2, 1997.
3. Outlines of Paint Technology by W.M. Morgans, Publishers Griffin, 1969.
4. Organic Coatings, Wicks W; Jones FN.; Pappas S.P.; & Wicks D.A. (John Wiley 3rd Edn. 2007).

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	12	20
3	12	20
4	04	05
5	06	10
6	10	15
7	10	15
Total	64	100

5.5 EMPLOYABILITY SKILLS – I

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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS

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| 1. | Writing skills | (08 hrs) |
| | i) Official and business correspondence | |
| | ii) Job application - covering letter and resume | |
| | iii) Report writing - key features and kinds | |
| 2. | Oral Communication Skills | (20 hrs) |
| | i) Giving advice | |
| | ii) Making comparisons | |
| | iii) Agreeing and disagreeing | |
| | iv) Taking turns in conversation | |
| | v) Fixing and cancelling appointments | |
| 3. | Generic Skills | (04 hrs) |
| | i) Stress management | |
| | ii) Time management | |
| | iii) Negotiations and conflict resolution | |
| | iv) Team work and leadership qualities | |

5.6 ENVIRONMENTAL EDUCATION

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RATIONALE

Education about environment protection is a must for all the citizens. In addition, a diploma holder must have knowledge of different types of pollution caused by industries and construction activities so that he may help in balancing the eco system and controlling pollution by adopting pollution control measures. He should also be aware of environmental laws related to the control of pollution.

DETAILED CONTENTS

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|----|---|----------|
| 1. | Definition, Scope and Importance of Environmental Education | (02 hrs) |
| 2. | Basics of ecology, biodiversity, eco system and sustainable development | (03 hrs) |
| 3. | Sources of pollution - natural and manmade, causes, effects and control measures of pollution (air, water, noise, soil, radioactive and nuclear) and their units of measurement | (12 hrs) |
| 4. | Solid waste management – Causes, effects and control measures of urban and industrial waste | (06 hrs) |
| 5. | Mining and deforestation – Causes, effects and control measures | (04 hrs) |
| 6. | Environmental Legislation - Water (prevention and control of pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board, Environmental Impact Assessment (EIA) | (10 hrs) |
| 7. | Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio Energy, Hydro Energy) | (04 hrs) |
| 8. | Current Issues in Environmental Pollution – Global Warming, Green House Effect, Depletion of Ozone Layer, Recycling of Material, Environmental Ethics, Rain Water Harvesting, Maintenance of Groundwater, Acid Rain, Carbon Credits | (07 hrs) |

INSTRUCTIONAL STRATEGY

The contents will be covered through lecture cum discussion sessions. In addition, in order to have more appreciation of need for protection of environment, it is suggested that different activities pertaining to Environmental Education like video films, seminars, environmental awareness camps and expert lectures may also be organized.

RECOMMENDED BOOKS

1. Environmental Engineering and Management by Suresh K Dhameja; SK Kataria and Sons, New Delhi.
2. Environmental Science by Dr. Suresh K Dhameja; SK Kataria and Sons, New Delhi.
3. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
4. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
5. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
7. Environmental Studies by Erach Bharucha; UGC University Press.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted for Lectures (Periods)	Marks Allotted (%)
1	02	04
2	03	06
3	12	24
4	06	12
5	04	10
6	10	20
7	04	10
8	07	14
Total	48	100