Syllabus of Final Year

B. Tech (Paint Technology)

Faculty of Science and Technology

University Institute of Chemical Technology
North Maharashtra University, Jalgaon

(Academic Year 2017-2018)

B. Tech. (Paint Technology) Final Year Course Structure w.e.f. 2017-18 (Overall Structure and Revised Syllabus w.e.f. 2017-18)							
Course Code	**Title of Course**	**Teaching Hours**	**Tutorial**	**Credits**	**Practical Hours**	**Credits**	**Total Credits**
Seventh Semester							
PTP-401	**Industrial Training/ Project**	**-**	**-**	**-**	**32**	**16**	**16**
PTP-402	**Technical Seminar & Colloquium**	**-**	**-**	**-**	**08**	**04**	**04**
Total					**40**	**20**	**20**
Eighth Semester							
CHL-405	**Project Engineering & Economics**	**03**	**01**	**04**	**-**	**-**	**04**
CHC-406	**Process Equipment Design**	**02**	**-**	**02**	**03**	**1.5**	**3.5**
PTC-403	**Application Techniques & Paint Defects**	**04**	**-**	**04**	**03**	**1.5**	**5.5**
PTL-404	**Quality Assurance & Analysis of Surface Coatings**	**04**	**-**	**04**	**-**	**-**	**04**
PTP-405	**Processing & Testing of Paints**	**-**	**-**	**-**	**06**	**03**	**03**
Elective	**Elective-III**	**04**	**-**	**04**	**-**	**-**	**04**
Total		**18**		**18**	**12**	**06**	**24**

Nomenclature of the courses

First two letters of the course code denote the branch/ division. Thus PT stands for Paints Technology Course and CH stands for Chemical Engineering Course. Similarly ES stands for Engineering Sciences and HM for Humanities and Management Sciences.

Third letter denotes the type of the course, viz lecture, practical or lecture + practical. If third letter is L, the said course is of lectures. Practical course is shown by P and C represents the course consisting of lecture + practical. First numeral of the course code denotes the level of course, and the other two are for number of course in particular branch/division.

For example course BSL-101 – mathematics-1. Here BS stands for basic science branch, L for lecture; For 101, first 1 for first year and 01 for first course of basic science.

Examination System:

For each theory paper of 04 and 03 credits, Major Examination with paper of 60 marks and duration of 03 Hours will be conducted.

For each theory paper of 02 credits, Major Examination with paper of 30 marks and duration of 02 Hours will be conducted.

For each practical Lab. of 1.5, 02 and 03 credits, the examination will be conducted for 03 hours duration for CH, ES and BS practical. For The practical examination is of 06 hours duration for all PT/PL/FT/OT labs, the Major examination carries 60 marks. For practical lab with 01 credit, the examination will be conducted as viva-voce (major- 30, minor - 20)

List of Electives (Elective III)

Paint Technology
PTL - 406 Special Purpose and Effect Coatings
PTL- 407 Nanotechnology in Paint Industry

Polymer Technology
PLL-405 Polymer Blends and Composites
PLL-406 Plastics for Packaging
PLL-407 Theory of Adhesion and Adhesives
PLL-408 Polymer Nanocomposites: Synthesis and Characterization

Oil Technology
OTL-406 Environmental Aspects of Oil and Allied Industries
OTL-407 Modern Instrumentation Techniques for Analysis of Oils and Oleochemicals
OTL-408 Non Traditional Oils and Non Triglyceride Constituents

Food Technology
FTL-406 Biochemical Engineering
FTL-407 Dairy Technology

Fourth Year Revised Syllabus of B. Tech (Paint Technology) w.e.f 2017-18
Seventh Semester

Department : Department of Paint Technology

Course Code : PTP-401

Course Title : Industrial Training/ Project

Course Type : Project

Total Hrs/Week : 32

Course Credit : 16

Course Objective:

The objective is to create interest of graduates in the field of paint and coatings with subject knowledge they have acquired earlier. The graduates will get exposure of recent industrial practices and technological revolutions. They will also get exposure of technical report writing of their research work and its presentation.

Course Content:

Research Project at Department: The entire semester will be devoted for the detail experimental work on a research problem from the field of Paint Technology selected by the student and specially approved by the faculty member/s designated as research guide/s. The student will present his/her findings in the form of neatly typed and bound thesis and will have to appear before panel of experts for defending his/her Thesis.

OR

Research Project/ Training at Industry: The student will undertake research work/ Training at selected reputed Paint Industries for six months on a topic allotted by the concerned Industry Management and approved by the Department. His/her progress will be jointly reviewed by the Department and the concerned Industry Management. The student will present his/her findings in the form of neatly typed and bound thesis, which will carry approval and attendance certificate issued by the concerned Industry Management and will have to appear before panel of experts for defending his/her Thesis.

OR

With due permission, student may opt for additional Theory and Practical Papers equivalent to 16 Credits as an alternative to PTP-401 Industrial Training/ Project.

Course Outcome: On the completion of Industrial Training, the technocrat will develop skills and good practices related to

1. Increased awareness about the paint, coatings, their production, application and allied fields.
2. Identification of raw materials needs/inventory, coating selection and performance criteria, Equipment operation and maintenance, Plant Layout, efficient application method, paint defects, problem resolution and reducing rejection rates.
3. Broad education necessary to understand the impact of technological solutions in a global, economics, environmental, and social context.
4. Individual and Team Work.
5. Career opportunities and Choices.

Department : Department of Paint Technology

Course Code : PTP-402

Course Title : Technical Seminar & Colloquium

Course Type : Seminar

Total Hrs/Week : 08

Course Credit : 04

Course Objective:

The students will develop necessary skills in understanding current technological trends in the field of paints, coatings and related fields. Graduates will get an in-depth exposure of literature survey, preparing technical review report. It will also lead to improvement of technical presentation skills of the graduates.

Course Content:

Student will be required to prepare a critical review of selected topics in Paint Technology and allied subjects and submit the same in the form of a standard typed report under the supervision of designated Guide. The student will also be required to make an oral presentation of the review before panel of experts.

Course Outcome:

1. Knowledge of recent and emerging trends in the field of Surface Coating Technology.
2. Ability to identify, formulate and solve technical problems.
3. Development of skills necessary for preparation and presentation of Technical Reports.
4. Preparation for advanced or independent study of a specific research topic.
5. Recognition of the need for, and an ability to engage in life-long learning

Eighth Semester

Department : Department of Paint Technology

Course Code : CHL 405

Course Title : Project Engineering and Economics

Course Type : Theory

Total Hrs/Week : 04 Hrs (3 Hrs Lectures+1 Hr Tutorial)/week

Course Credit : 04

Course Objective:

The objective of the course is to provide students with a firm grasp of the essential principles of Management, Project identification project feasibility and Project Scheduling Technique with Suitable Examples. This course will help student to understand the concepts and terminology that are used in Management economics and costing. Students know about pipeline design on the basis of fluid dynamics and mechanical properties. students also understand the balance sheet, store ledger account by various methods and solve various engineering problems in process optimization.

Course Content:

Unit -I

1. Project identification, project feasibility
2. Project testing based on vibality risk & Cost estimation.
3. Evaluation of project by different methods on the basis of Vibality
   i) Net Present Value method. ii) Method of Rate of Return on Initial Investment
   iii) Pay out Period iv) Method of Discount Cash Flow v) Capitalized cost method
   vi) Internal rate of return method vii) Break Even Chart
4. Evaluation of project by different methods on the basis of Risk
   i) Profitability Index ii) Demand fore casting iii) Standard Deviation Approach
5. Evaluation of project by different methods on the basis of Cost
   i) Preparation of Cost sheet and statements ii) Preparation of Profit Loss Statement

(10 Hrs)

Unit -II

1. New developments in management, CPM & PERT
   Principle and Objectve of CPM and PERT
   Net work Diagram for calculation Time Duration
2. Linear Programming Problem (Numerical based on each method)
   i) General simplex method ii) Primary & Dual technique method
   iii)Direct simplex method Iv) Graphical Method

(10 Hrs)

Unit -III

1. Cost analysis, fixed capital, working capital, Preparation of store ledger account by pricing issue methods. LIFO, FIFO, Simple average, weighted average
2. Depreciation, significance of inadequacy and obsolescence, and depreciation methods (Numerical Based on It)

(10 Hrs)

Unit -IV

1. Layout and location, objective, principle
2. layout and Location factors.
3. Equipment layout diagram (ELD)
4. Tank firm cum utility block diagram for different processes. (TFCUBD)

(10 Hrs)

Unit -V

1. Design of process flow sheet from process information. Plant utility line diagram for including valve, IPC symbol, unit operations symbols (mass & heat transfer)
2. Utility Block diagram for Boiler House, Refrigeration Plant,Compressor House and Electricity
3. Piping design: Fluid dynamic parameter (Q, Delta, D), piping insulation, Pipe Welding, pipe Fittings, types of valves, selection of valve, P.C. and instrumentation Symbols. Numerical Based On it
4. Design of pipeline on the basis of fitting, valve, Insulation, IPC & utility panel board.

(10 Hrs)

Course Outcome:

1. To enhance knowledge of students about pipeline design on the basis of fluid dynamics and mechanical.
2. To understand the various methods of profitability evaluation and their application.
3. To enhance knowledge of students to understand the balance sheet and store ledger account by various methods.
4. To enhance knowledge of students about various scale up methods and to understand the new development in management and optimization techniques.
5. To enhance the ability of students to identify and solve various engineering problems in process optimization.

Reference Book:

1. Dawande, S. D. "Process Design of Equipments." Central Techno Publication, Nagpur (2000).
2. Pathak B.V. & Mahajan M.S. “Industrial Organization & Management”,Nirali Prakashan 1986
3. Peters, Max Stone , Timmerhaus K.D.. “Plant Design and Economics for Chemical Engineers”. Vol. 4. New York: McGraw-Hill, 1968.
4. Austin, George T. "Shreve's Chemical Process Industries." (1984): 136-138.
5. G.V.Kumbhojkar , “Applied Mathematics Optimization –IV” , 2002
6. Dhone D.B., “Plant Utilities” Nirali Prakashan, 2008.
7. T,S,Grewal and S.C.Gupta, “Introduction to Accountancy” S.Chand Publication 2008
8. Christopher J,S. and L.M.Weather, “Managerial and Cost Accounting”Ventus PublisherAPS, 2011

Department	**: Department of Paint Technology**
Course Code	**: CHC 406**
Course Title	**: Process Equipment Design (Th)**
Course Type	**: Theory**
Total Hrs/ Week	**: 02**
Course Credit	**: 02**

Course Objective:

To study the design procedure for chemical equipments.To study the behavior of material under stress. The student should be able to understand the designing of pressure vessels, high pressure vessels, supports, calendriaevaporator,shell and tube heat exchanger, sieve tray and bubble cap tray for distillation column, agitators.

Course Content:

Unit –I

General design procedure for designing chemical equipment, protective coating, corrosion causes and prevention. Theory of failure, factor of safety. The material behavior under stresses.Unfired pressure vessel subjected to internal and external pressure. Design of shell, nozzle, different types of head. **(10hrs)**

Unit –II

Vessels for high pressure operation, constructional features, multi shell construction, determination of thickness of shell applying various theories of failures.Agitators, selection, types application, power required for agitation. **(10hrs)**

Unit-III

Types of support for vertical and horizontal vessels, Process design for short tube calendria type of evaporator,Types of heat exchangers, shell and tube heat exchanger construction and design in details. Design for sieve tray and bubble cap tray for distillation column, Heating and cooling arrangements for reaction vessel.

(10hrs)

Course Outcome:

1. At the end of the course the student exhibits how to design and draw in a competitive manner various process equipment with proper scale and each components with detail dimensions.
2. Learn how to design Pressure vessels, Reaction vessels, Shell and Tube Heat Exchanger, Short Tube Calendria Evaporator.
3. Understands the constructional features of high Pressure vessels, Detail arrangement of Sieve tray and bubble cap trays.
4. Understand how to read drawings to know details about process equipment, which can be utilized for fabrication, maintenance, assembling and dismantling.

Reference Book:

1. Bhattacharya, B. C. "Introduction of Chemical Equipment Design." Mechanical Aspects (2003): 201-203.
2. Sinnott, R. K. Coulson & Richardson's "Chemical Enginering: Volume 6/Chemical Engineering Design", Elsevier Butterworth Heinemann, 1999.
3. Joshi, Mansukhlal Vrajlal, and V. V. Mahajani. Process Equipment Design. Macmillan India, 1996.
4. Dawande, S. D. "Process design of equipments." Central Tecno Publication, Nagpur (2000).

Department	**: Department of Paint Technology**
Course Code	**: CHC 406**
Course Title	**: Process Equipment Design (Pr)**
Course Type	**: Practical**
Total Hrs/ Week	**: 03**
Course Credit	**: 1.5**

Course Objective:

To study the design procedure for designing chemical equipment and selection of proper material of construction by considering different mechanical and physical properties. To study the behavior of material under stresses. The student should be able to understand the designing of pressure vessels, high pressure vessels, supports, calendria evaporator,shell and tube heat exchanger,sieve tray and bubble cap tray for distillation column, agitators.

Course Content:

Students will be required to do process design and submit drawings of at least six equipments such as pressure vessels, heat exchangers, agitators, short tube calendria type evaporator etc. Types of agitators, supports. Design of bubble cap tray, sieve tray, different types of packing

Course Outcome:

1. At the end of the course the student exhibits how to design and draw in a competitive manner various process equipments with proper scale and each component with detail dimension.
2. Learn how to draw from the design problem solved in theory the exact Drawings of Pressure vessel, Reaction vessel, Shell and Tube Heat Exchanger, Short Tube Calendria Evaporator.
3. Understands the constructional features with the help of drawings of high Pressure vessels, Detail arrangement of Sieve tray and bubble cap trays.
4. Understand how to read drawings to know details about process equipment, which can be utilized for fabrication, maintenance, assembling and dismantling.

Department : Department of Paint Technology

Course Code : PTC-403

Course Title : Application Techniques & Paint Defects (Th)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

1. To understand the importance of surface preparation in system recommendation over various substrates.
2. To acquire knowledge of various surface preparation standards.
3. To learn coat effective and easiest available methods for paint application and curing
4. Identification, analysis and reduction of various paint defects during application

Course Content:

Unit -I Preparation of Substrate Surfaces

Nature and sources of contaminations/ Soils - mill-scale / rust, lubricants/grease/ washing oils, particulate soils/ welding pearls/ dirt/dust, old coatings, classification of rust

Chemical paint removal methods for metals, alkaline, solvent type and other paint removers,

Mechanical Cleaning-Hand tool cleaning, Blasting, Blast Media, compressed air blasting, water jet blasting, standards for blast cleaned surfaces-testing,

Chemical Surface preparation: Solvent wiping and degreasing, alkali/detergent cleaning, emulsifiable solvent cleaning, steam cleaning, flame cleaning, acid cleaning/ pickling, (H_3PO_4, HNO_3, H_2SO_4, HF acid), electrolytic pickling, Ultrasonic Cleaning etc. **(10 hrs)**

Unit -II Pretreatment Techniques / Conversion Coatings for Substrates

Ferrous and nonferrous metals -Iron Phosphate, Coating Weight, Iron Phosphate Controls-Temperature, Chemical Concentration, Acid Consumed.

Zinc Phosphate-Electrochemical Mechanism, Role of accelerators, temperature, catalysts, and total acid to free acid ratio, Eco-friendly tricationic phosphate conversion coatings based on Zn, Mn, and Ni, Plant Layout,

Pretreatment of Al, Mg. Activation, Passivation, Chromatisation, Chemical etching, Anodisation and other treatments, Environmental Legislations on pretreatments

Surface Treatment of Plastics, Flame Surface Treatment, Plasma Surface Treatment,Pre-treatment of Wood and glass surfaces **(10 hrs)**

Unit - III Techniques for Applications of Solvent Thinnable / Waterborne paints

Spray Techniques-Methods of Atomization, Compressed air-Manual and automatic, airless, Air-Assisted Airless, Fluid Needles and Tips for air and airless spray, hot and two nozzle spray Electrostatic spray-automatic Air-Spray Guns and Rotary (disc and bell) Atomizers, supercritical fluid spray, Transfer Efficiency, Spray Booths

Dipping, roller, and coil coating, curtain coating, flow coating, knife coating, vacuum impregnation, silk screen coatings etc. Coating of Plastics and Wood **(10 hrs)**

Unit –IV Application Setup for Powder and UV Cure coatings and Design of Ovens

Design and operation of Carona & Tribo charging guns, Fluidized bed process, Flame Spray, Newer developments in application techniques, Recovery & recycling of powder waste.

Design of UV Lamp, Application Plant Setup for UV and Electron Beam Cure, Dual Cure, Health and Safety Aspects.

Design of different types of Ovens for curing-convection air (Duct Design, Oven Fuels, Heat Recovery), IR, radiofrequency

Paint shop services: Paint shakers or tumblers, paint distribution systems, waste treatment, paint shop troubles, Inspection and service complaints **(10 hrs)**

Unit – V Paint Defects

Identification, assessment,causes & remedial measures. Crawling, cratering & related defects; Flooding, Floating, and Mottling, wrinkling, Silking, Solvent Popping, Bubbling and Pinholing, Overspray and Dry Spray, Blushing, foaming, blistering, checking and cracking, blooming, chalking, cissing, cobwebbing, crocodiling, embrittlement, gassing, lifting, opacity defects, orange peel, yellowing etc. Problems associated with drying **(10 hrs)**

Course Outcome: On completion of this course, the Technocrat will demonstrate the

1. Awareness of preparation various surfaces for painting as per internationally recognized standards.
2. Understanding of various methods of Pretreatment Techniques / Conversion Coatings for substrate surface.
3. In-depth Knowledge of specification and selection of spray guns, compressors, gun washers, pressure hoses, regulators, spray booths, and design of paint shop/ Ovens.
4. Identifying the reasons for paint failure and coating defects, failure analysis, equipment technology, pretreatment methods and troubleshooting, and coatings service life prediction.
5. Identifying their academic and career interests for career mapping.

Reference Book:

1. Kearne, J. D., Ed., “Steel Structures Painting Manual, Vol. I, Good Painting Practices”, Third Edition , Steel Structures Painting Council, 1993
2. Bernard R. Appleman, Janet Rex, Terry Sowers, “Steel Structures Painting Manual, Vol. II, Systems and Specifications”, Seventh Edition, Steel Structures Painting Council, Pittsburgh, PA, 1995.
3. Hare, C. H., “Protective Coatings, Fundamental of Chemistry and Composition” Steel Structures Painting Council, Pittsburgh, PA, 1995.
4. Treseder, R. S. "NACE corrosion engineer's reference book." (1980).
5. Zeno W. Wicks, Jr., Frank N. Jones, S. Peter Pappas; Douglas A. Wicks,“Organic coatings : Science and Technology”**,** Edited by Third Edition, John Wiley & Sons, Inc., Hoboken, New Jersey. 2007.

Department : Department of Paint Technology

Course Code : PTC-403

Course Title : Application Techniques & Paint Defects (Pr)

Course Type : Practical

Total Hrs/Week : 03

Course Credit : 1.5

Course Objective:

1. To provide knowledge to the students on various practical aspects of surface preparation, pretreatments and application of paints on various substrates.
2. To understand various application techniques, parameters and aspects responsible for a quality finish**.**
3. To learn about various application defects, their probable causes and remedies

Course Content:

Minimum of **twelve** experiments based on five units of **PTC-- 403 (Theory)** with due coverage of following:Preparation of MS, Tin, Al, glass, plastics and wooden surfaces, Phosphating of ferrous and nonferrous surfaces, Spray application, Electrostatic spray application of powder coatings, UV cure set up, analysis of flow, levelling and sagging aspects, Coating calculations in reference to covering and cost per square foot, Identification and analysis of various paint defects.

Course Outcome: On completion of this course, the technocrat will develop laboratory skills and good practice related to

1. Preparation and pretreatment of surfaces.
2. Understanding of paint system inspections, requirement of standards and coating calculations in refer to covering and cost per square foot.
3. Techniques for application of solvent/ waterborne paint, UV cure and powder coatings.
4. Identification and analysis of various paint defects.

Department : Department of Paint Technology

Course Code : PTL-404

Course Title : Quality Assurance & Analysis of Surface Coatings (Th)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

1. To provide knowledge to the students on various standard paint testing procedures.
2. To analyze the influence of various paint formulating ingredients in the formulation**.**
3. To provide a knowledge to students in recommendation of various paint formulations according to service requirements

Course Content:

Unit –I General Analysis of Paints and Awareness of Standard Specifications
Objectives of paint testing for decorative & industrial finishes, IS, BS, ISO, ASTM, SSPC standards, classification of paint tests, methods of sampling; determination of wt per lit, % NVM, P/B ratio, PVC; preparation of metal/ glass/ wood/ cement panels, laboratory application techniques, measurement of wet & dry film thickness, determination of touch/surface/ tack free/ hard/ thorough dry & curing schedule; chemical separation of paints & printing inks into constituents. Analysis of separated binders/ pigments and extenders/ solvents/ additives **(10 hrs)**

Unit -II Specifications, Methods, Instruments for Evaluation of Appearance of Coatings
I) Gloss: specular gloss, sheen, contrast ratio, DOI gloss, metallic luster, diffuse reflectance; II) Opacity: covering power, wet opacity & dry hiding; chequer board/ contrast ratio/ spectral methods; relation to practical painting. III) Colour matching & control in paint manufacture
Experimental methods for measuring paint rheology for application and flow-out after application, Measurement of Flow & rheological Characteristics; leveling & sagging, Paint rheology during manufacture and storage **(10 hrs)**

Unit -III Mechanical Properties of Coatings
Viscoelastic properties of polymers, Ultimate mechanical properties of polymers (Tensile strength and elongation at break, Loss Tangent; brittle-ductile transition, Dynamic mechanical analysis), definition, scope & determination of adhesion, mandrel and cupping flexibility and extensibility, impact test, indentation, pencil and scratch hardness, mar resistance, Taber abrasion test, crockmeter, wet-scrub abrasion, stone-chip Resistance, nanoscratch test, field exposure & laboratory simulation tests. **(10 hrs)**

Unit -IV Durability Testing
Mechanism of photo initiated oxidative& hydrolytic degradation; aging properties of coatings, effect of pigmentation,antioxidants, peroxide decomposers, UV absorbers, excited state quenchers, HALS, natural weathering, artificial weathering, construction and working of various artificial weatherometers, light fastness, Various characterization techniques to monitor changes in free radical concentration changes in coatings, Evaluation of bio-deterioration resistance; **(10 hrs)**

Unit -V Miscellaneous Testing
Corrosion Resistance: mechanism of corrosion, water & humidity resistance, water vapour transmission, salt spray corrosion test, Miscellaneous testing: resistance to solvents, lubricating oils, fuels, chemicals, alkalis, acids, & salts, stain resistance, heat & fire

resistance, efflorescence, cold- check, freeze-thaw stability, electrical resistance, freedom from lead, determination of VOC etc.
The Use of X-ray Fluorescence for Coat Weight Determinations, Thermal Analysis (DSC-TGA-DTA) for Coatings Characterizations, Infrared Spectroscopy of Coatings, Cure Monitoring **(10 hrs)**

Course Outcome: On completion of this course, the technocrat will exhibit the

1. Statistical process and quality.
2. Benchmark analysis for all stages of coating Technology.
3. Advances in characterization and instrumental analysis.
4. Awareness of recent developments, eco-friendly trends, good manufacturing practices and future challenge in relation to quality assurance and analysis of surface coatings.
5. Identifying their academic and career interests for career mapping.

Reference Book:

1. Koleske, J. V. "Paint and Coating Testing Manual": Gardner-Sward Handbook Fifteenth Edition, ASTM International 2012
2. Tracton, Arthur A.,"Coatings Technology: Fundamentals, Testing, and Processing Techniques",CRC Press, 2006.
3. Weldon, Dwight G. "Failure analysis of paints and coatings", John Wiley & Sons, 2009.
4. Martin, J. W, "Methodologies for Predicting Service Lives of Coating Systems", Federation of Societies for Coatings Technology, Blue Bell, PA, 1996.

Department : Department of Paint Technology

Course Code : PTP-405

Course Title : Processing & Testing of Paints (Pr)

Course Type : Practical

Total Hrs/Week : 06

Course Credit : 03

Course Objective:

1. To provide the students a brief information about various available products in the market from standard paint manufacturing companies.
2. Performance evaluation of standard commercial products according to standard procedures
3. Formulating techniques, raw materials selection for coatings according to service requirement.

Course Content:

Minimum of twelve experiments with due coverage of following:
Characterization & application of coatings covered under Paper **PTL-404**. Sampling, application and Evaluation of standard commercially available coating products from market

Formulation and processing of Eco-friendly and Special Purpose/ Effect Coatingscovered under Papers- **PTL-311** and **PTL-405,** Application and Evaluation of these products based on techniques covered under Paper **PTL-404.**

Course Outcome: On completion of this course, the technocrat will develop laboratory skills and good practice related to

1. Sampling, application and evaluation of standard coating products from commercial market.
2. Drying and curing of paints and coatings.
3. Formulation and processing of Eco-friendly and Special Purpose / Effect Coatings.

Department : Department of Paint Technology

Course Code : Elective III PTL-406

Course Title : Special Purpose and Effect Coatings (Th)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

1. To provide knowledge to the students on various paint systems for specialized applications
2. To know about performance requirement, raw material selection and formulating techniques in various paints for specialized applications**.**
3. To learn about standard coating practices in various industries in paint application and recommendation of paint types and systems in industry applied and site applied coatings according to service environment.

Course Content:

Unit –I OEM and Refinish Coatings

Automotive coatings- Methods of car body construction, formulations of surfacer, antichip coatings, solid Colour Monocoats, Basecoat-clear coat for topcoats, High solid top coats, waterborne/ powder surfacers and topcoats, Wet-On-Wet-On-Wet Application (3 Coat 1 Bake) of Primer-Surfacer–Base Coat–Clear Coat, Painting of plastic body components, Repair and Refinish automotive paints,Coatings for Domestic Appliances, Coatings for Packaging (Can/ Container coatings) **(10 hrs)**

Unit- II Insulation, Furniture and Coil Coatings

Fundamentals of Electrical Insulation, Binders used in electrical insulation, Formulation of Insulating varnishes, Wire enamels, Impregnating Compounds, Casting & Potting Compounds etc., Application & Testing methods, Other insulations: Thermal, aquatic & vibrational. Recent DevelopmentsFurniture Coatings, Coil Coatings. **(10 hrs)**

Unit - III Marine Paints and Heavy Duty Paints

Coatings for ships topcoats for boot topping, topside, and Superstructure, Tanks Ballast Coatings for Ship Bottom, Antifouling Agents/biocides, Self-polishing paints, Mechanism of antifouling based on prevention of adhesion of fouling organisms. Formulation and performance. Coatings for dockyard (dock and harbour installations), Paint systems for off-shore structures, underwater coatingsHeavy-Duty Coatings, maintenance paints, Painting specifications-new/old work, at site/works.**(10 hrs)**

Unit -IV Special Effect Paints

Aluminium/Bronze paints, general and special floor paints, Roadmarking paints, Multicolor Coatings, flamboyant finishes, polychromatic finish, wrinkle/ hammer finish, fungistatic paints, Elastomeric Coatings, Anticarbonation coatings, Anti-condensation paints, flame retardant and heat resisting paints, Anti-condensation paints **(10 hrs)**

Unit -V Special Purpose Coatings

Paints Used for Commercial Transport Vehicles**-**Railroad Rolling Stock, Freight Containers, Road Transport Vehicles, Aircraft Coatings, Paintings Conservation Varnish, Peelable Medical Coatings, Conductive Coatings, Leather Coatings, Coated Fabrics for Protective Clothing and Apparel Use**,** Computers and modelling in paint and resin formulating **(10 hrs)**

Course Outcome: On completion of this course, the Technocrat will exhibit the knowledge of

1. Formulation of industrial, heavy duty, OEM and refinish coatings.
2. Special effect coatings such as Multicolor Coatings, Flamboyant finishes, polychromatic finish, wrinkle/ Hammer finish, fungistatic paints, Elastomeric Coatings etc.
3. Special purpose coatings such as Conservation Varnish, Peelable Medical Coatings, Conductive Coatings, Leather Coatings etc.
4. Awareness of recent developments, Eco-friendly trends, good manufacturing practices and future challenges in relation to Special Purpose and Effect Coatings.
5. Identifying their academic and career interests for career mapping.

Reference Book:

1. Zeno W. Wicks, Jr., Frank N. Jones, S. Peter Pappas; Douglas A. Wicks,"Organic coatings : Science and Technology"**,** Edited by Third Edition, John Wiley & Sons, Inc., Hoboken, New Jersey. 2007.
2. Hans-Joachim Streitberger, Karl-Friedrich Dossel,, "Automotive Paints and Coatings" Second Edition, John Wiley & Sons 2008.
3. McBane, B. N., "Automotive Coatings", Federation of Societies for Coatings Technology, Blue Bell, PA, 1987.
4. Horst Sulzbach, "Polymers for Electrical Insulations", Elantas GmbH, 2008.
5. Hare, C. H., "Protective Coatings, Fundamental of Chemistry and Composition" Steel Structures Painting Council, Pittsburgh, PA, 1995.
6. Hellio, Claire, and Diego Yebra, "Advances in Marine Antifouling Coatings and Technologies", Elsevier, 2009.

Department : Department of Paint Technology

Course Code : Elective III PTL-407

Course Title : Nanotechnology in Paint Industry (Th)

Course Type : Theory

Total Hrs/Week : 04

Course Credit : 04

Course Objective:

1. To provide in depth knowledge of nanotechnology and its applications in developing various high performance and special formulations.
2. To understand various nanotechnology advantages in paint and coating formulation development**.**
3. To learn about synthesis methodology and incorporation of various nanoparticles in performance enhancement of various surface coatings.

Course Content:

Unit -I Introduction to Nanotechnology

Different approaches in Nanotechnology- The top-down approach, The bottom-up approach, Classification of Nanomaterials, unique properties at nanoscale- chemical, optical, magnetic, physical, thermal, mechanical-detail discussion with examples; Nanopigments- properties, changes in characteristics of nanocomposite coating through nanosized additions, exfoliation of the inorganic material, Polymer-melt intercalation, Coating nanoparticles with layers of polymers and machines for dispersion **(10 hrs)**

Unit -II Synthesis of Nanomaterials

Synthesis using oriented monolayers, direct/Reverse Micelles, O/W or W/O microemulsions, Solvothermal synthesis, Hydrothermal synthesis, Sonochemical routes, Photochemical synthesis, Electrochemical synthesis, Nanocrystals of semiconductors and other materials by arrested precipitation, Sol-gel method and Hybrid Coatings, Role of Dendrimers in size reductions **(10 hrs)**

Unit -III Retrofitting in Existing Paint Products through use of Nanotechnology

Enhancement of hiding powernano-spacing extenders such as $CaCO_3$ and silica for improvement of TiO_2 spacing, Bacteria Proof Material, Paint against UV Degradation (Nanoparticles as UV absorber for Wood Coatings), Scratch and Abrasion Resistant automotive clear top coats, Fire Retardant Coatings, Hybrid Coatings with Improved corrosion resistance, Coatings with Improved Barrier properties (e.g. oxygen and water permeability, for packaging and metal protection) **(10 hrs)**

Unit-IV Smart and Functional Coatings

Self Cleaning / Hygienic Coatings- Self-cleaning paint employing photocatalyticactivity of TiO_2 and antimicrobial activity of nanosilver, The natural lotus leaf self cleaning effect, Paint for Purifying the gas detrimental to the environment.Functional Coatings through Special-Effect Pigments**,** Smart Windows,Self Healing/ Repair Coatings- Microencapsulation,

Bleeding Composites, Colloidal aggregation Sensor Coatings- Thermochromic Paints, Pressure sensing / Barochromic Paints, Corrosion sensing Paints, Antireflective Coatings, Hydrophilic Surface Coatings as Anti-Fogging Coatings, Anti-Graffiti Coatings**(10 hrs)**

Unit -V Analysis of Nanocomposite Coatings and Safety Aspects

Construction, Working Principle, Operation of following Instruments-Scanning Electron Microscope, Tranmission Electron Microscope, Atomic Force Microscopy, XRD, Particle size by light scattering method, Zeta potential; analysis of nanosystems using these instruments.Risk of nanotechnology - Negative consequences for health and the environmental measures **(10 hrs)**

Course Outcome: On completion of this course, the Technocrat will exhibit the knowledge of

a) Synthesis methodologies of various nanoparticles.
b) Performance enhancement and formulation development using various nanoparticles
c) Awareness of recent developments and future challenges in relation to specialized formulation using nanoparticles.
d) Negative impact of nanoparticles on health and environment and safety measures to prevent them.

Reference Book:

1. Makhlouf, Abdel Salam Hamdy, “Handbook of Smart Coatings for Materials Protection” Elsevier, 2014.
2. Ghosh, Swapan Kumar, “Functional Coatings: by Polymer Microencapsulation” John Wiley & Sons, 2006.
3. Baghdachi, Jamil, Heidi Perez, and Amit Shah. "Design and Development of Self-healing Polymers and Coatings." Smart Coatings III. American Chemical Society, 2010.
4. Saji, Viswanathan S., and R. M. Cook, “Corrosion Protection and Control using Nanomaterials” Elsevier, 2012.