

SAURASHTRA UNIVERSITY



ACCREDITED GRADE "A" BY NAAC
(CGPA 3.05)

COURSE DETAILS OF

Master of Science

SEMESTER - III

PAPER: MS-IC-301 -304 (CBCS)

&

SEMESTER - IV

PAPER: MS-IC-401-404 (CBCS)

INDUSTRIAL CHEMISTRY

(In Force from December - 2016)

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Master of Science in Industrial Chemistry

CBCS- Semester - 3 (T & P)

MSIC - 301

SPECTROSCOPY

UNIT- 1 UV-Vis SPECTROSCOPY:

Principle, Theory, Instrumentation, Sampling methods, Applications and structure determination of organic compounds by spectroscopic data.

UNIT- 2 IR SPECTROSCOPY:

Principle, Theory, Instrumentation, Sampling methods, Applications and structure determination of organic compounds by spectroscopic data

UNIT- 3 MASS SPECTROSCOPY:

Boundary layer concept, Calculations for reciprocating and centrifugal pumps, Use of air vessels in pumps, Vapor locking and NPSH. Design of Flow meters, Pressure and Vacuum producing devices

UNIT- 4 NMR SPECTROSCOPY:

Principle, Theory, Instrumentation, Sampling methods, Applications and structure determination of organic compounds by spectroscopic data

REFERENCE BOOKS:

1. Instrumental Methods of analysis, Kalsi.
2. Spectroscopy of organic compounds, Kalsi.
3. Organic Spectroscopy, William Kemp, ILBS
4. Spectroscopy of Organic compounds, Silver Stein,
5. Modern Methods of chemical analysis, Robert. L. Pecsok and Donald Shields.

MSIC – 302

MECHANICAL OPERATIONS

UNIT- 1 : FUNDAMENTALS OF SIZE REDUCTION

Introduction to comminution, Importance of size reduction, specific properties of solids for size reduction, Principles of size reduction, energy required for size reduction, crushing and grinding efficiency, laws of crushing.

UNIT- 2 : SIZE REDUCTION EQUIPMENTS

Classification of size reduction equipment, Principle, Construction & working of crushing and grinding equipment viz., Jaw crushers, gyratory crushers, hammer mill, crushing rolls, ball mills.

UNIT- 3 : SCREENING OPERATION

Screening, classification of screening equipments particle size distribution, particle size measurement, Vibro-Screen, Vibro-blender.

UNIT- 4 : HANDLING OF MATERIALS

Storage of solids in bulk protected and unprotected piles, bins, silos, hoppers. Classification of separation methods for different types of mixtures like solid-solid, Solid-solid sigma mixture, solid-gas, solid-liquid. Electrostatic precipitators, Cyclone, separators, bag filters, scrubbers.

REFERENCE BOOKS:

1. Narayanan C. M. & Bhattacharya B. C. "Mechanical operations for chemical engineers", Khanna Publishers. 3rd Ed.1999.
2. KA Gavhane, Unit Operations-I, Nirali Prakashan.
3. McCabe, Smith and Harriot: Unit Operations of Chemical Engineering, McGraw Hill Education Publication.

MSIC – 303

CHEMICAL TECHNOLOGY-I

Study of following group of Industries with respect to their Classification, Raw materials, manufacturing process of at least four products of each class with special emphasis on chemistry and manufacturing principles:

UNIT- 1 DRUGS AND PHARMACEUTICALS-I

Synthesis of any four drugs from each category: Antibiotics, Analgesics, Antipyretics, Anti inflammatory and AntiT.B.

UNIT- 2 DRUGS AND PHARMACEUTICALS-II

Synthesis of any four drugs from each category: Antimalarial, Antihypertensive, antidiabetic and Anticancer

UNIT- 3 ESSENTIAL OIL AND ISOLATION OF NATURAL PRODUCTS

Essential oils: Source, constituents, isolation and uses.

Isolation of Natural Products of commercial importance: Methods used. Isolation of nicotine from tobacco waste, Citric from lemon grass, Neem extract and eucalyptus oil.

UNIT- 4 DYES AND INTERMEDIATES

Synthesis of Azo, Anthraquinone Vat, Stilbene and Reactive.

REFERENCE BOOKS:

1. Handbook of Industrial Chemicals, Vol.I & II, K.M. Shah, Multitech pub.House.
2. Handbook of Synthetic Dyes, K.M. Shah, Multitech Pub. Comp.
3. Encyclopedia of chemical technology, Kirk & Othmer.
4. Essential Oils Desk Reference 6th Edition Spiral-bound – 2014
by Life Science Publishing
5. Remington's Pharmaceutical Science, Mach Pub. Comp.
6. M Ash & I Ash: A formulary of cosmetic preparation (Godwin)
7. B. Billot and F.V. Wells- Perfumary Technology (JW)

MSIC – 304

POLYMER CHEMISTRY AND TECHNOLOGY

UNIT- 1 BASICS OF POLYMERS AND ITS CHARACTERIZATION

Introduction and classification of polymers.

Molecular weight determination, tensile strength, viscosity

UNIT- 2 POLYMER PROCESSING

Compounding, compression moulding, transfer moulding, injection moulding, blow moulding, extrusion.

UNIT- 3 BIODEGRADABLE POLYMERS

Manufacturing process, properties and application of following polymers:

Class-I:

PLA (Poly lactic acid), PGA(Poly Glycolic Acid), PHA(Poly Hydroxy Alkanoate), PHBV (Poly Hydroxy Butyrate-co- β -Hydroxy Valerate), PBSA(Poly Butylene Succinate, Adipate)

UNIT- 4 NON-BIODEGRADABLE POLYMERS

Manufacturing process, properties and application of following polymers:

Class-II, Polyethene, Polyvinylchloride, Polyamides, Polyesters, Phenolic and Epoxy resins.

REFERENCE BOOKS:

1. Properties of polymers, D.W. Krenvelen
2. Physical Chemistry of Polymers, A. Tagore
3. Polymer Chemistry, Bill Mayer, Mc. Graw Hill.
4. Polymer Technology, L.C. Miles, J.H. Priston, Chemical Pub. Co.
5. Polymer Science, Gowarikar.

MSICP – 305

LABORATORY COURSE (SEM. - III)

Paper No.	Title	Experiments Based on following*
MSIC – 301	Spectroscopy	• Paper Chromatography
MSIC – 302	Industrial unit operations	• Mechanical Operations
MSIC – 303	Chemical technology-I	• Pharmaceutical estimation
MSIC – 304	Polymer chemistry and technology	• Dyes preparation and Dyeing

* Details to be worked out by the Department.

LIST OF PRACTICAL

PAPER CHROMATOGRAPHY

- 1 To separate the given mixture of amino acid by Ascending chromatography and measure R_f value. (Threonine+ Methionine)
- 2 To separate the given mixture of amino acid by Radial chromatography and measure the R_f value. (Thyrosine+ Methionine)
- 3 To separate the given mixture of amino acid by Ascending chromatography and measure R_f value. (Threonine+ Lysine)
- 4 To separate the given mixture of amino acid by Radial chromatography and measure the R_f value. (Threonine+ Arginine)
- 5 To separate the given mixture of amino acid by Ascending chromatography and measure R_f value. (Histidine+ Lysine)
- 6 To separate the given mixture of amino acid by Radial chromatography and measure the R_f value. (Arginine+ Lysine)
- 7 To separate the given mixture of amino acid by Ascending chromatography and measure R_f value. (Arginine+ Tyrosine)
- 8 To separate the given mixture of amino acid by Radial chromatography and measure the R_f value. (Arginine+ Histidine)
- 9 To separate the given mixture of amino acid by Ascending chromatography and measure R_f value. (Leusine+ Lysine)
- 10 To separate the given mixture of amino acid by Radial chromatography and measure the R_f value. (Arginine+ Leusine)

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Ascending Chromatography chamber
2. Radial Chromatography chamber
3. Hot air dryer.
4. Sprayer

5. Petridis, Beaker.

Mechanical Operation

- 1 To crush the given raw material in a **Jaw Crusher** and to determine average particles size and reduction ratio.
- 2 To crush the given material in a **Roll Crusher** and to determine the average particle size and Reduction ratio
- 3 To analyze a given sample using **Sieve Shaker** and find the average particle size
- 4 To study operation of **Ball Mill** and to calculate the reduction ratio and to find the average particle size
- 5 To study **Psychometric Property** of ambient air using Psychometric chart & to find out: a) Dew Point b) Moisture Content c) Enthalpy d) Relative Humidity.
- 6 To calculate the power requirement of roll crusher with the help of law of crushing and grinding
- 7 To calculate the power requirement of Jaw crusher with the help of law of crushing and grinding.
- 8 To calculate the power requirement of Ball Mill with the help of law of crushing and grinding.

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Jaw Crusher with Panel.
2. Roll Crusher with Panel.
3. Sieve Shaker with Panel.
4. Ball mill with Panel.
5. Cyclone Separator with Panel.
6. Thermometer – porcelain dish- cotton wick system.

Pharmaceutical Estimation

- 1 To determine the Content of Li_2CO_3 in Lithium Carbonate Tablet.
- 2 To determine % of Lactic Acid in given Sample.
- 3 To determine the amount of Ibuprofen tablets.
- 4 To determine the amount of FeSO_4 in given Tablet.
- 5 To determine the Bromohexine HCl in given solid sample.
- 6 To determine % of Isaniazide in the given sample.
- 7 To determine the Bromohexine HCl in given syrup sample.
- 8 To determine % and amount of Ascorbic acid in given sample.

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Burette, pipette, beaker, conical flask etc.

Dyes Preparation & Dyeing

- 1 Preparation of Methyl Orange Dye
- 2 Preparation of Fast Green O dye. (Dinitroso resorcinol)
- 3 Preparation of Nitroso dimethyl aniline hydrochloride dye.
- 4 Preparation of Orange-I dye.
- 5 Preparation of Orange-II dye.
- 6 Dyeing of cotton with direct dye CONGO RED.
- 7 Dyeing of cotton with direct dye FAST RED A.
- 8 Dyeing of cotton with direct dye METHYLENE BLUE.
- 9 Dyeing of cotton with direct dye ANILINE BLACK.
- 10 Dyeing of cotton with direct dye CRYSTAL VIOLET.

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Burette, pipette, beaker, conical flask etc.

Master of Science in Industrial Chemistry

CBCS- SEMESTER - 4 (T & P)

MSIC – 401

MATERIAL SCIENCE

UNIT- 1 BASICS OF MATERIAL SCIENCE

Property Spectrum of materials, Bravice Lattices, Atomic Packing factor, Planes and Directions in Crystals, Solid solutions.

UNIT- 2 PHASE DIAGRAMS & MECHANICAL PROPERTIES OF METALS

Cooling curves and phase rules and various phase diagrams, Study of Mechanical Properties – resilience, toughness, creep, fatigue, hardness, effect of microstructure on properties.

UNIT- 3 COMPOSITES AND IRON CARBON ALLOYS MATERIALS

Properties and applications of Iron carbon alloys and high temperature alloys, failure of materials at high temperatures, properties and applications of composites with special emphasis on its use as material of construction in chemical industries, structures and packaging material.

UNIT- 4 HEAT TREATMENTS AND NDT-XRD METHODS OF MATERIALS

Heat treatment of materials, Non-destructive testing of materials, XRD and scanning electron microscope for analysis of selected metallic, ceramic and composite materials.

REFERENCE BOOKS:

1. Introduction of Engineering Materials, B.K. Agarwal
2. Material Science and Engineering, V. Raghavan
3. Material Science and Metallurgy, O.P. Khanna.
4. Material Science, G.K. Narulla, K.S.Narulla, V.K. Gupta

MSIC – 402

PROCESS DYNAMICS & CONTROL

UNIT- 1 Fundamentals of Process Control

Introduction to system, manual system & automatic system, terminologies, transfer function, Open loop and closed loop systems, Transportation lag.

UNIT- 2 Modes of Control Action

Development of block diagrams, stability of control systems, Modes of control action: ON-OFF Control, Proportional Control, Integral Control, Derivative Control.

UNIT- 3 Laplace Transform

Introduction to Laplace Transform, Laplace transform derivation for step function, impulse function, exponential function, Laplace transform of derivatives and its application

UNIT- 4 Application of Process Control

Control Valves-Sizing, Sensitivity, linear and Non-linear valve, Advanced control strategies: Cascade, forward feed.

REFERENCES:

1. Process Dynamics & Control, Sudheer Bhagade & Govind Das Nageshwar, PHI Learning Pvt Ltd.
2. Process Dynamics & Control, Prabir Kumar Sarkar, PHI Learning Pvt Ltd.
3. Process Systems, Analysis and Control, Donald Coughanowr, Second Edi., Mc.Graw Hill International Edition
4. Chemical Process Control, George Stephenopoulis, Prentice hall.
5. Principles of process Control, D. Patransbia, Mc. Graw Hill book Co.

MSIC – 403

CHEMICAL TECHNOLOGY – II

UNIT- 1 Ceramic and Refractories

Ceramics: Introduction, Classification based on reduction in porosity, Raw Materials, Manufacturing process, Glazing, Decoration, Methods of Applying colours.

Refractories: Introduction, Classification, properties and manufacturing processes, Introduction, manufacturing process, properties and uses of Fire clay bricks.

UNIT- 2 Soaps and Detergents

Soaps: Introduction, Raw Materials, Manufacturing process, Classification, Cleaning action, Recovery of glycerin from spent lye.

Detergents: Introduction, Classification, Biodegradability of surfactants, Difference between soaps and detergents, Enzyme containing detergents, Eco friendly detergents (Zeolites).

UNIT- 3 Paints

Paints: Introduction, Classification based on application, raw materials for paint, manufacturing processes, setting process of paints, requirements of good paint, paint failure, PVC, Methods of application, Paint removers, Special applications of paints.

UNIT- 4 Pigments

Pigments: Introduction, Classification, Manufacturing processes and Uses of Various types of pigments

- White Pigment : White lead, TiO_2 ,
- Blue Pigment : Ultramarine blue, Cobalt Blue, Iron Blue.
- Red Pigment : Red lead, Synthetic iron oxide
- Green Pigment : Chrome green, Guignet green.

REFERENCE BOOKS:

1. Handbook of Industrial Chemicals, Vol. I & II, K.M. Shah, Multitech pub.House.
2. Handbook of Synthetic Dyes, K.M. Shah, Multitech Pub. Comp.
3. Perfumes, Cosmetics & Soaps, Vol 1, 2 & 3, W.A. Poucher, Chapman & Hall.
4. Surface Coatings, Vol, I & II, Oil & Color Chemists Association, Australian Chapman and Hall, London / New York.
5. **Modern trends in formulating soaps and detergents, P.C. Deb. CBS Pub.**

ADVANCED ORGANIC CHEMISTRY

UNIT-1 STEREOISOMERISM

Classification, racemic modification, molecules with one & two chiral centres; Configuration nomenclature, D L, R S and E Z nomenclature. Axial and planer chirality and helicity (P & M); Stereochemistry and configurations of allenes, spiranes, and biphenyls compounds.

Cyclosteroisomerism: Configurations, conformations and stability of cyclohexanes (mono-, di-, and trisubstituted), cyclohexenes and cyclohexanones. Asymmetric induction: Cram's, Prelog's and Horeau's rules.

UNIT- 2 GREEN CHEMISTRY:

Pressure Principles of Green Chemistry and its applications, Environmentally benign reaction like strecker synthesis, Reformatsky reaction, Grignard reaction, Diekmann condensation.

Principles of microwave assisted organic synthesis (Knoevenagel Condensation, Beginelli Reaction, Ugi Coupling, Miyaura Coupling, Stille Coupling) Reactions in ionic liquids (Diels Alder Reactions, Knoevenagel Condensation, Friedel Crafts Alkylation)

UNIT- 3 METHODS IN ORGANIC SYNTHESIS:

GMP: Applications of Pd(0) and Pd(II) complexes in organic synthesis- Stille, Suzuki and Sonogashira coupling, Heck reaction and Negishi Coupling. Preparation & applications of lithium organocuparates.

UNIT- 4 OXIDIZING & REDUCING REAGENTS:

Stereochemistry, stereo selection and mechanism of the following reagents:

Sodium borohydride, sodium cyanoborohydride and DIBAL

Oxidations: Scope of the following oxidizing reagents with relevant applications and mechanisms: SeO₂, Tl(NO₃)₃, Sharpless epoxidation.

REFERENCE BOOKS:

1. New Organic Synthesis based on Name reaction and unnamed reaction, A.Hassner & C. Stummer, Pergamon press.
2. Organic Chemistry Vol. 1 & Vol. 2, I.L. Finar, Long man Scientific.
3. Advanced organic Chemistry – Reaction mechanism & structure, J. March, John Wiley & Sons.
4. Carruthers, W. Modern Methods of Organic Synthesis Cambridge University Press (1971).
5. Organic Spectroscopy 3rd Ed., W. H. Freeman & Co. (1991).

MSICP – 405

LABORATORY COURSE (SEM. - IV)

Paper No.	Title	Experiments Based on following*
MSIC – 401	Material Science	• Petroleum and oil Analysis
MSIC – 402	Process Dynamics & Control	• Process Dynamics & Control
MSIC – 403	Chemical Technology-II	• Multistage synthesis including Green Chemistry approach
MSIC – 404	Advance Organic Chemistry	

* Details to be worked out by the Department.

LIST OF PRACTICALS:

PETROLEUM AND OIL ANALYSIS

1. To determine the penetration number of given Bituminous sample.
2. To determine the softening point of Bituminous material (Grease or Wax)
3. To determine the smoke point of light petroleum products.
4. To determine the kinematic viscosity of an oil sample using Redwood viscometer.
5. To determine the kinematic viscosity of an oil sample using Saybolt viscometer.
6. To determine flash and fire point of the given sample by using Cleaveland open cup apparatus.
7. To determine the % moisture present in a given sample of liquid petroleum by Dean and Stark's method.
8. Determination of Cloud and Pour point of heavy petroleum product.
9. Determination of Aniline point of a given sample.
10. To determine the Saponification Value of given Oil Sample.
11. To determine the content of Free fatty acids in given Oil Sample.
12. To determine flash point of the given sample by using Pensky Marten closed cup apparatus.

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. Redwood viscometer
2. Saybolt viscometer
3. Cleveland open cup apparatus
4. Dean and Stark's apparatus
5. Smoke point apparatus
6. Cloud and Pour point apparatus
7. Pensky Martens Flash point apparatus
8. Softening point apparatus
9. ABELS flash point apparatus
10. Carbon residue measurement apparatus
11. Aniline Point Apparatus.
12. Penetration index apparatus.

PROCESS DYNAMICS & CONTROL

1. To study the dynamics of given thermometer and compare the theoretical value of the time constant with experimental value.
2. To study the dynamics of liquid level in a tank and compare the experimental value of time constant with the experimental value. (for step input)
3. To study the dynamics of liquid level in a tank and compare the experimental value of time constant with the experimental value. (for Impulse)
4. To study the response of two first order system (tank) in series of the non – interacting system (For step input)
5. To study the response of two first order system (tank) in series of the non – interacting system (For Impulse)
6. To study the response of first order system in series of the interacting system (For step input)
7. To Study the response of first order system in series of the two interacting system. (for Impulse disturbance)
8. To develop approximation for nonlinear model to be linear & study the dynamics of liquid tank.
9. To develop approximation for nonlinear model to be linear & study the dynamics of liquid tank.(For Impulse distribution)
10. To determine the time constant of the given thermo well from its response to the change in the surrounding temperature.
11. To find out the response of first order mixing index

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

1. First order interacting apparatus.
2. First order non-interacting apparatus.
3. Second order interacting apparatus.
4. Second order non-interacting apparatus.
5. Thermometer-water bath-ice bath system.

MULTISTAGE SYNTHESIS INCLUDING GREEN CHEMISTRY APPROACH

1. To prepare Dihydropyridine derivative (Hantzsch pyridine synthesis).
2. To prepare Benzanilide from Benzophenone (Beckmann rearrangement- Two step)
3. To prepare Acridone from Phthalic acid. (Six step)

4. To prepare 2,3-diphenyl thiazolidine from benzalidine aniline (Schiff base). (Two setp)
5. To prepare p-amino benzene sulfonamide (sulfanilamide) from acetanilide. (Three step)
6. To prepare 7-Hydroxy-4-methyl Coumarin from resorcinol. (Pechmann condensation)
7. To prepare 2-phenyl indole from acetophenone. (Fisher indole synthesis- Two step)
8. To prepare benzilic acid from benzoin. (Two step)
9. To prepare Benzocaine from p-nitro toluene.(Three step)
10. To prepare 2,5-dihydroxy acetophenone from Hydroquinone. (Two step)

LIST OF EQUIPMENTS/INSTRUMENTS/ GLASSWARES:

- | | |
|--------------------|---------------------|
| 1. Microwave | 7. Weighing Balance |
| 2. Oil bath | 8. Hot air Oven |
| 3. Rbf | 9. UV Chamber |
| 4. Hot water bath. | 10. Thermometer |
| 5. Condenser | |
| 6. Mortar -Pastel, | |

MSICP – 406

DISSERTATION

Paper No.	Title	Experiments Based on following*
MSIC – 406	Dissertation & Viva Voce	Dissertation Project report based on literature survey an laboratory work conducted on topics related to chemical engineering and / or chemistry is to be submitted and presented as a seminar by each student