

Sant Gadge Baba Amravati University Amravati
Syllabus Prescribed for Three Years UG Program
Program B.Sc. with Industrial Chemistry
Semester 5
5S Industrial Chemistry (Regular/Vocational)
Chemical Process Economics, Heavy and Fine
Chemicals

Total Lectures: 84

Marks :80

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
INC (5S) T	Industrial Chemistry 5S	84

COs

By the end of the course, the student will be able to:

1. Differentiate between Batch wise and Continuous Industrial Processes.
2. Identify various industrial processes.
3. Compare Various Industrial Processes.
4. Understand the operational mechanism of various industrial equipment's.
5. Calculate depreciation.
6. Identify major Engineering problems involved during manufacturing processes.

Unit	Content
Unit I	<p>Manufacturing of the following: - Ammonia, nitric acid, ammonium sulphate, ammonium nitrate, caustic soda, chlorine, ammonium phosphate, superphosphate, triple superphosphate with reference to following considerations:</p> <p>i) Consumption pattern ii) Raw materials iii) Major engineering problems.</p> <p style="text-align: right;">(14 Periods)</p>
Unit II	<p>Manufacturing of the following: - Lime, calcium carbide, silicon carbide, fluorine, sodium carbonate, sulphuric acid, hydrochloric acid, soda ash by Solvay process, urea with reference to following considerations:-</p> <p>i) Consumption pattern ii) Raw materials iii) Major engineering problems.</p> <p style="text-align: right;">(14 Periods)</p>

Unit III	<p>A) Essential Oils: - Introduction, extraction methods of essential oils -: Steam distillation, solvent extraction, and expression. Uses of following essential oils- menthol, citral, camphor, turpentine.</p> <p>B) Edible Oil: - Manufacturing of Soyabean oil by solvent extraction process, refining of crude vegetable oil. Hydrogenation of vegetable oil (Dry and wet processes), saponification value, iodine value, acid value and ester value.</p> <p>C) Manufacturing of soap, recovery of glycerin, cleansing action of soap.</p> <p style="text-align: right;">(14 Periods)</p>
Unit IV	<p>Fischer Tropsch synthesis with examples, chlorination of methane and its major engineering problems, manufacturing of mono, di, triethanolamines and its uses. Manufacturing of acetylene, ethylene, vinyl acetate, isopropanol, vinyl chloride with reference to following considerations:-</p> <p>i) Raw materials ii) Major engineering problems iii) Uses.</p> <p style="text-align: right;">(14 Periods)</p>
Unit V	<p>A) Industrial gases: - Introduction, Manufacturing and uses of following industrial gases - Oxygen and nitrogen, carbon dioxide liquification of CO₂ (Dry Ice).</p> <p>B) Safety: - Introduction, concern for chemical safety, hazards and their control in petrochemical industries, hazards in storage, handling and uses of chemicals.</p> <p style="text-align: right;">(14 Periods)</p>
Unit VI	<p>Process Economics</p> <p>A) Cost Estimation: - Cash flow for industrial operations, cumulative cash position, factors affecting investment and production cost.</p> <p>B) Interest: - Simple and compound interest, nominal and effective interest</p> <p>C) Depreciation: - Introduction, service life, salvage value. Methods for depreciation- straight line method, declining balance method, sum of years digits method.</p> <p>D) Profitability, profitability evaluation: - Rate of return on investment and discounted cash flow method. Break even point.</p> <p style="text-align: right;">(14 Periods)</p>
<p>*SEM-V</p> <ol style="list-style-type: none"> To prepare flow charts for the manufacturing of processes. To compare various processes involved in manufacturing of Fertilizers. To calculate depreciation by using declining balance method. 	
<p>COs:</p> <p>By the end of this module, student will be able to:</p> <ol style="list-style-type: none"> Understand the industrial equipment's used for various processes. Understand Industrial Processes involved in manufacturing of heavy and fine chemicals. Analysed Flow-sheet diagram. 	
**Activities	<p>Class tests, assignments, Flow diagram of processes, Project, Survey, Group discussion, Industrial visit, or any other innovative pedagogical method.</p> <p>Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.</p>

Course Material/Learning Resources

Text books:

- Handbook of industrial chemistry – K.H. Davis and F.S. Berner Vol. I and II. CBS publishers and distributors New Delhi.
- Shreves chemical process industries – George T. Austin. McGRAW HILL International Edition.
- Industrial Chemistry- B.K. Sharma. Goyal publishing house.
- A Text book of Engineering chemistry- S.S. Dara.

Reference Books:

- Heavy organic chemicals- A.J. Gartc. Pargmon Process U.K.
- Chemical process industries- S.C. Bhatiya. CBS publishers and distributors New Delhi.
- Plant design and economics for chemical engineers. Max S. Peters, K.D. Timmerhaus. Mc GRAW HILL International Edition

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Syllabus Prescribed for Three Years UG Program

Program: B.Sc. with Industrial Chemistry

Semester 5

5S Industrial Chemistry (Regular/Vocational)

Code of the Course/Subject	Title of the Course/Subject	Number of Lectures/Week
INC (5S) PR	Industrial Chemistry 5S	06

COs:

By the end of the laboratory/Practical Course students will able to

1. Estimate purity of the organic compounds.
2. Synthesis various organic Compounds.
3. Understand the various organic processes.
4. Understand the mechanism of the organic processes.

List of Practical

Sr. No.	Exercise 1
1	Determination of acid value of edible oil.
2	Determination of saponification value of edible oil.
3	Determination of iodine value of edible oil.
4	To determine the strength of hydrogen peroxide solution.
5	To determine the strength of aniline solution.
6	To determine the strength of formalin solution.

Sr. No.	Exercise 2
1	Preparation of 3- nitroaniline.
2	Preparation of 4- bromoaniline.
3	Preparation of 4- nitrobenzoic acid.
4	Preparation of soap.
5	Preparation of phthalimide.
6	Extraction of oil from oil seeds.

Distribution of Marks for Practical Examination

Time: 04 hours (One Day Examination)

Total Practical Marks 50, Duration of Exam 04 Hours	
Internal Practical Exam (25 Marks)	External Practical Exam (25 Marks)
Attendance, Students Performance, Activity, Practical Record Book /Laboratory Manual/Journal Report: 20 Internal Viva/Assignment / Quiz/Test: 05	Experiment 1 Performance/Demonstration: 10 Experiment 2 Performance/Demonstration: 10 External Viva (by External and Internal Examiner): 05
Total: 25	Total: 25

Sant Gadge Baba Amravati University Amravati
Syllabus Prescribed for Three Years UG Program
Program B.Sc. with Industrial Chemistry
Semester 6
6S Industrial Chemistry (Regular/Vocational)
Instrumental Methods of Chemical
Analysis, Green chemistry (DSE-I)

Total Lectures :84

Marks :80

Code of the Course/Subject	Title of the Course/Subject	Total number of Lectures
INC (6S) T (DSE-I)	Industrial Chemistry 6S	84

COs:

By the end of this module student will be able to:

1. Apply knowledge to select Sampling methods as per the material.
2. Select proper equipment for sampling of solid, liquid and gases.
3. Understand principles of various chromatographic techniques.
4. Apply the knowledge in selection of proper chromatographic technique for analysis.
5. Understand the importance of Green Chemistry.

Unit	Content
Unit I	<p>A) Sampling procedures, sampling of bulk materials, techniques of sampling solids, liquids, gases. Collecting and processing of data.</p> <p>B) Errors: - Types of errors, nature and origin of error. Accuracy, precision, mean deviation, standard deviation, relative standard deviation and confidence limits.</p>
Unit II	<p>Chromatography: - Theories of chromatography- plate and rate theory, classification of chromatographic techniques.</p> <p>Paper chromatography and TLC: - Introduction, principles, types of migration parameter (R_f value). Experimental details, applications.</p> <p>GLC and HPLC: - Introduction, principles, instrumentation, apparatus and materials, column efficiency and selectivity, applications.</p> <p>Liquid-Liquid partition chromatography and adsorption chromatography (14 Periods)</p>
Unit III	<p>A) Column chromatography: - Principle, experimental details, column efficiency, factors affecting column efficiency, applications.</p> <p>B) Ion Exchange: - Classification of ion exchangers, ionexchange equilibria, ion exchange capacity, chelating ion exchanger, factors affecting the separation of ions and applications in analytical chemistry.</p> <p>C) Solvent Extraction: - Classification of solvent extraction systems, basic principles involved in extraction. Factors affecting extraction, techniques of extraction, applications of solvent extraction in industries. (14 Periods)</p>

Unit IV	<p>A) Flame Photometry: - Elementary theory, instrumentation and experimental techniques, combustion flames and applications.</p> <p>B) I.R. Spectroscop: -- Principles, techniques, instrumentation and applications in chemical analysis of industrial materials.</p> <p>C) X-ray fluorescence: - Principles, techniques, flow sheet, applications for determination of heavy metals in environmental sample. (14 Periods)</p>
Unit V	<p>Dye: - Introduction, classification of dyes- on the basis of mode of applications and on chemical constitutions. Acid dyes, basic dyes, Sulphur dyes, pigment dyes. Dye intermediates. Preparation and uses of methyl orange dye, picric acid and aurine dye, indigo dye, Congo red, crystal violet and alizarin dye. Non-textile uses of dye stuffs. (14 Periods)</p>
Unit VI	<p>Green Chemistry: - Introduction, Goals of green chemistry, principles of green chemistry. Basic components of green chemistry research- Alternative starting materials or feed stock, alternative reagents or transformations, alternative reaction conditions and alternative final products or target molecules. Optimization of framework for the design of greener synthetic pathway. Green solvents, ionic liquids green fuels and E- green propellants, biocatalysis. (14 Periods)</p>
<p>*SEM- IV</p> <ol style="list-style-type: none"> 1. To prepare model for sampling of various materials. 2. To identify green solvents. 3. To design instrumental arrangements of various chromatographic techniques. 	
<p>COs:</p> <p>By the end of this module, student will be able to:</p> <ol style="list-style-type: none"> 1. Differentiate sampling of solid, liquid and gases. 2. Apply the knowledge for selection of Green solvents and reagents. 3. Apply knowledge for design of Instrumental arrangements of chromatographic techniques. 	
**Activities	<p>Class tests, assignments, Flow diagram of processes, Project, Survey, Group discussion, Industrial visit or any other innovative pedagogical method.</p> <p>Any two activities be conducted from above.</p> <p>Class tests are compulsory. Equal weightage for each activity.</p>

Course Material/Learning Resources

Text Books:

- 1) Instrumental methods of Chemical Analysis – Gurudeep Chatwal and Anand
- 2) A text book on experiments and calculations in Engineering Chemistry – S. S. Dara.
- 3) A Text book of Synthetic Dyes- O.D. Tyagi, M. Yadav. Anmol publications Pvt. Ltd.
- 4) A Text book of Engineering Chemistry- S.S. Dara.
- 5) Chromatography- Shrivastava and Shrivastava.

Reference Books:

- 1) Handbook of Industrial Chemistry – K.H. Davis and F.S. Berner Vol. I and II. CBS publishers and distributors New Delhi.
- 2) Experiments in Chemistry – D.V. Jahagirdar.
- 3) Quantitative Inorganic Analysis – A.I. Vogel

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Semester 6
6S Industrial Chemistry (Regular/Vocational)

Code of the Course/Subject	Title of the Course/Subject	Number of Lectures/Week
INC (6S) PR (DSE-I)	Industrial Chemistry 6S	06

COs:

By the end of the laboratory/Practical Course students will able to

1. Apply basic concepts to for the separation of plant pigment, dyes and ions Chromatographically.
2. Estimate component gravimetrically.
3. Apply basic knowledge for the removal of hardness by ion exchange method
4. Use solvent extraction technique for separation of ions.

6S Industrial Chemistry Practical

List of Experiments

Sr. No.	Exercise 1
1	Separation of Cu^{+2} - Ni^{+2} ions by paper chromatography.
2	Separation of plant pigments xanthophylls, chlorophyll by paper chromatography.
3	Separation of dyes by T.L.C.
4	Estimation of sodium and potassium by flame photometry.
5	Separation of amino acids by paper chromatography.
6	To detect the impurities in organic compounds by T.L.C.
7	Separation of Cu^{+2} - Ni^{+2} ions by paper chromatography.

Sr. No.	Exercise 2
1	Removal of hardness by ion exchange resins.
2	Separation of Cu^{+2} - Ni^{+2} ions by solvent extraction.
3	Separation of Co^{+2} - Ni^{+2} ions by ion exchange.
4	Preparation of picric acid dye.
5	To determine the capacity of an anion exchange and cation ex-change resin by column method.
6	Separation of Fe^{3+} and Mg^{2+} by solvent extraction.

Distribution of Marks for Practical Examination

Time: 04 hours (One Day Examination)

Total Practical Marks 50, Duration of Exam 04 Hours	
Internal Practical Exam (25 Marks)	External Practical Exam (25 Marks)
Attendance, Students Performance, Activity, Practical Record Book / Laboratory Manual/Journal Report: 20 Internal Viva/Assignment/Quiz/Test : 05	Experiment 1 Performance / Demonstration: 10 Experiment 2 Performance / Demonstration: 10 External Viva (by External and Internal Examiner): 05
Total: 25	Total: 25

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Program B.Sc. with Industrial Chemistry
Semester 6

6S Industrial Chemistry (Regular/Vocational)
POLYMER CHEMISTRY AND GREEN CHEMISTRY (DSE-II)

Total Lectures: 84

Marks :80

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
INC (6S) T (DSE-II)	Industrial Chemistry 6S	84

COs

By the end of the course, the student will be able to:

1. Understand the basics of polymers.
2. Be aware about the potential of polymer industry in India.
3. Apply knowledge for degradation of polymers.
4. Apply knowledge for synthesis of material by green method.
5. Understand the green house effect and its consequences.

Unit	Content
Unit I	Polymers: - Basic Concept, classification of polymers on the basis of structures and applications. Distinction among plastics, elastomers, and fibers, Homo and hetero polymers, copolymers, properties of polymers Molecular Weight of polymers: - Number average, weight average, sedimentation and viscosity - average molecular weights, Molecular weights and degree of polymerization. Reactions - Hydrolysis, Hydrogenation, addition, substitution. (14 Periods)
Unit II	Polymerization Techniques: - Bulk, solution, suspension & emulsion polymerization. Polymer processing - Calendaring, die casting, rotational casting. Advances in polymers: - Bio-Polymers, biomaterials, polymers in medical field, High temperature and fire-resistant polymers – Silicones. (14 Periods)
Unit III	Degradation of polymers by thermal, oxidative, mechanical and chemical methods. Polymer processing: - compression molding, casting, fiber spinning, injection molding, thermoforming, vulcanization of elastomers, polymer industry in India. (14 Periods)
Unit IV	Green Chemistry: - Introduction, Current status of chemistry and the Environment-Evolution of the Environmental movement: Public awareness - Dilution is the solution to pollution-Pollution prevention. Green Chemistry: - Definition, Principles of Green Chemistry - Why is this new area of Chemistry getting to much attention - Why should chemist pursue the Goals of Green Chemistry - The roots of innovation – Limitations (14 Periods)

Unit V	Green Analytical Methods: - Future trends in Green Chemistry - Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control. (14 Periods)
Unit VI	Greenhouse effect and Global Warming: - Introduction - How the greenhouse effect is produced - Major sources of greenhouse gases - Emissions of CO ₂ - Impact of greenhouse effect on global climate - Control and remedial measures of greenhouse effect -Global warming a serious threat - Important points. (14 Periods)
*SEM-V 1.To prepare flow charts for the manufacturing of processes. 2.To compare various methods involved in manufacturing of material by Green Method. 3.To compare various processes of degradation of Polymers.	
COs: By the end of this module, student will be able to: 1. Understand the industrial methods used for manufacturing of polymers. 2. Understand the methods for degradation of polymers.	
**Activities	Class tests, assignments, Flow diagram of processes, Project, Survey, Group discussion, Industrial visit, or any other innovative pedagogical method. Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.

Course Material/Learning Resources

Text books:

1. Polymer Science, Gowarikar. V.R. Viswanathan, N.V. Jayader Sreedhar. Wiley Eastern Ltd., New Delhi, 2005
2. Polymer Chemistry, Sharma. B. K Goel Publishing House, Meerut- 1989.
3. Polymer Chemistry. Arora M.G. Vadar M.S. - Anmol publications (p) Ltd., New Delhi 1989.

Reference Books:

1. Text Book of Polymer Science, Bill meyer F.W. Jr. John Wiley & Sons 1984.
2. Polymer Chemistry - An introduction - M.P. Stevens, oxford. Reference Books:

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Semester 6

6S Industrial Chemistry (Regular/Vocational)

Code of the Course/Subject	Title of the Course/Subject	Number of Lectures/Week
INC (6S) PR (DSE-II)	Industrial Chemistry 6S	06

COs:

By the end of the laboratory/Practical Course students will able to

1. Differentiate harmful and ecofriendly chemical products.
2. Synthesis various polymeric Compounds.
3. Determine the molecular weight of polymers.
4. Understand the mechanism of synthesis of material by green method.

List of Practical

Sr. No.	Exercise 1
1	Preparation of Phenol Formaldehyde Resin.
2	Preparation of Urea Formaldehyde Resin.
3	Preparation of Nylon 6,6.
4	Determination of Molecular weight of polymer (nylon 6,6) by end group analysis.
5	Preparation of Schiff base by microwave technique.
6	Determination of molecular weight of polymer by Viscometry.

Sr. No.	Exercise 2
1	Synthesis of zinc oxide by solution combustion method using plant extract.
2	Nitration of nitrobenzene
3	Acetylation/ Propionylation of aniline using water as ecofriendly solvent.
4	To determine silver nanoparticles by green synthesis
5	Preparation of Eco-friendly pesticides.
6	Synthesis of activated carbon from agriculture waste.

Distribution of Marks for Practical Examination

Time: 04 hours (One Day Examination)

Total Practical Marks 50, Duration of Exam 04 Hours	
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