Sant Gadge Baba Amravati University, Amravati

Part A

Faculty: Science & Technology

Programme:- B.Sc. with Industrial Chemistry

POs:

At the time of graduation, Students would be able to

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSOs:

By the end of this program, students would be able to:

1. Understand the scope, methodology and application of industrial chemistry.
2. apply theoretical and practical concepts of instruments, which are commonly used in the field of industrial chemistry.
3. Plan and conduct scientific experiments and record the results of such experiments.
4. Get acquainted with heat and mass transfer, stoichiometry, unit operations, catalysis, fuels, fluid mechanics, unit processes and process equipments, chemicals manufacturing industries, pollution and management, safety, green chemistry, instrumental methods of chemical analysis etc.
5. Use industrial chemistry to solve social, economic and environmental problems and issues facing our society in energy, health etc.

Employability Potential of the Programme:

A degree in industrial chemistry allows the aspirant to develop excellent laboratory techniques. The degree program with Industrial Chemistry offers the necessary knowledge, develop skills and nurture creativity to achieve success. Further, a degree in industrial chemistry is a smart option intended for employability and earnings. Industrial Chemistry is studied in environmental as well as social context so that one can achieve its ethical implications and issues relating to environmental impact and sustainability.

Industrial chemistry for its graduates provides the skills not only in the chemical industries but also in the areas of environmental sciences, medical fields, scientific and industrial equipment sales, science communication, teaching or academic research, to list a few. Thus, a degree in industrial chemistry broadens frequent prospects and opportunities for a number of careers in many different fields like science, research, business and health care, etc. The degree course in industrial chemistry not only expands critical thinking and the ability to understand other scientific and engineering concepts more easily, but also opens new perspectives to pursue career in different fields. It offers the knowledge of unit processes, unit operations, heat and mass transfer, process equipments, various chemical manufactures, energy and fuels, pollution and management, instrumental methods of analysis, etc. Many industries like pharmaceuticals, agrochemicals, fertilizers paints, dyes, oil, plastic, rubber and many more prefer to employ chemists with background in industrial chemistry. After completion of degree programme in Industrial Chemistry, one can go for higher education or find multiple job opportunities in such industries. The

candidates can secure a position of production supervisor, production manager, chemists in quality control/assurance as well as pollution monitoring, analytical chemist, lab manager, research associate, lab testing, etc.

Apart from the subject specific knowledge, an industrial chemistry graduate also acquires fundamental professional transferable skills including:

- Effective listening, written and oral communication
- Analysis and problem solving
- Monitoring/ maintaining records and data
- Research and presentation
- Time management and organization
- Modern ICT enabled skills
- Teamwork

Future scope for B.Sc. Industrial Chemistry graduates:

- Prestigious institutions offer higher studies such M.Sc. and Ph.D.
- Likewise, foreign Universities also accept industrial chemistry graduates for higher studies.
- Industrial chemistry student can become entrepreneur (own industry).
- Union and State Public service commissions like UPSC, MPSC, Bank Probationary officers, other competitive examinations, etc. offer a multitude of jobs and positions like Drug Inspector, Lab chemist, Forensic analyst, etc. for industrial chemistry graduates.
- Students can take teaching jobs at Kendriya Vidyalaya, Navodaya Vidyalaya, High Schools after completing B.Ed. or respective eligibility criteria.
- Laboratory technician in various public sector units like ONGC, IOCL, NTPC, BARC, and private sector industries.
- Students can become Content Developer for IT industries.
- Students can become Quality Control Chemists/ Food Inspector at Food Co-operation of India, Food Safety and Standards etc
- Research Scientist/ Operations Manager/ Chemists / Quality Manager / Research Manager at various industries like Pharmaceuticals, Cement, Plastic, Drugs, Paint, Dyes, Agricultural sector, etc.
- Employee at Security Printing and Minting co-operation of India.
- Employee at Office of Controller general of Patent design and trade work.

Syllabus Prescribed for B.Sc. First Year UG Programme

Programme: B.Sc.

Semester -1

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
INC(1S) –T	Industrial Chemistry 1S	84

COs

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

1. Apply material balance equations and solve associated numerical problems of some important unit operations.
2. Solve the numerical problems on stoichiometry, mole concepts and unit conversions.
3. Describe the conventional and nonconventional energy sources and calculate heat of reactions.
4. Analyze the different types of fuels.
5. Apply the knowledge gained by studying the components of heat transfer, energy sources and fluid mechanics.

Unit	Content
Unit I	**A] Dimensions and Units:** Fundamental and derived quantities, Interconversions of units. **B] Mole Concept:** Mole, Atomic weight, Molecular weight, Equivalent weight, Methods of expressing compositions of i)solid mixtures, ii) liquid solutions, iii) gaseous mixtures Problems based on these. **(14 Periods)**
Unit II	**A] Material Balance without Chemical Reactions:** Distillation, Crystallization, Evaporation, Extraction, Filtration with flow sheet diagram and Problems **B] Material Balance with Chemical Reactions:** Stoichiometric equation, Stoichiometric coefficient, Conversion, Yield, Selectivity, Limiting and excess reactants, Problems. **(14 Periods)**
Unit III	**A] Energy :** General idea about conventional energy sources, and non-conventional Energy Sources –Solar energy, Space heating and water heating by solar energy, Production of electricity by solar energy, Tidal power, Wind energy , Biomass energy **B] Energy Balance:** Heat capacity, Cp, Cv, Molar heat capacity, Heat of reaction, formation, combustion, neutralization, Heat of solution, Hess's law of constant heat summation. Problems based on heat of reaction, heat of vaporization, fusion. **(14 Periods)**
Unit IV	**Fuels: Classification, Units of heat and calorific value** **A] Solid fuels:** Coal-Types of coal, Coal formation, Coal analysis (proximate and ultimate), Destructive distillation of coal, Coal tar distillation, uses of coal tar products, Manufacturing of coal gas and water gas. **B] Liquid fuels:** Petroleum-Origin and classification, Fractional distillation of crude oil, Cracking, Mining of petroleum, natural gases, Uses of petroleum. **(14 Periods)**
Unit V	**Heat Transfer:** Fundamentals of heat transfer: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzmann's law, Problems. Concept of heat conduction, General heat conduction equation, Thermal conductivity, Thermal diffusivity. Nature of heat transfer by convection, Forced and free convection, Phenomenon of pool boiling, Filmwise and dropwise condensation. Nature of heat transfer by radiation, Absorptivity, Reflectivity and Transmissivity, Kirchoff's law, Emissive power and emissivity, Concept of black body, Planck's law and Wien's displacement law. Heat exchangers, Classification of heat exchangers on the basis of direction of fluid flow, U-tube heat exchanger, Kettle reboiler. **(14 Periods)**
Unit VI	**Fluid Mechanics:** Definition and classification of fluids, Types of fluid flow- Laminar and Turbulent fluid flow, Equation of continuity, Bernoulli's equation, Pipe joints and fittings, Valves and pumps, Reciprocating and centrifugal pump, Venturi meter, Orifice meter, Pitot-tube, rotameter, Manometer, Reynolds's number, Reynold's experiment. **(14 Periods)**

***SEM-** 1. Convert different units from one system to other. 2. Preparation of solutions of different concentrations. 3. Solving numerical problems on material balance equations with and without chemical reactions, stoichiometry, mole concepts, heat of reaction and heat transfer. 4. Compare and demonstrate conventional and nonconventional energy sources. 5. Analyze solid and liquid fuels. 6. Create models associated with nonconventional energy sources. 7. Classify the components of fluid mechanics and heat exchange.
COs: By the end of this module, student will be able to: 1. Solve the numerical associated with stoichiometry, unit conversions, material balance, heat of reaction and heat transfer. 2. Create models associated with non-conventional energy sources, analyze solid and liquid fuel samples.

**Activities	Model creation, Chart preparation, Memory maps, Class tests, assignments, 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. Unit Operations- I & II by K.A.Gavhane, Nirali Prakashan.
2. Introduction to Process Calculations (Stoichiometry) by K.A.Gavhane, Nirali Prakashan.
3. A Text Book of Physical Chemistry by P.L.Soni, Sultan Chand & Sons.
4. A Text Book of Engineering Chemistry by S. S. Dara, S.Chand and Co.

Reference Books:

1. Stoichiometry by B. I. Bhatt and S. M.Vora, Tata McGraw-Hill Pub. Co.
2. Chemical Process Principles, Part- I by O. A. Hougen, K. M. Watson, R.A. Ragatz, CBS Publishers.
3. Non-conventional Energy Sources by G.D.Rai, Khanna Publishers.
4. Principles of Physical Chemistry by B.R. Puri, M.S. Patahnia and L.R. Sharma, Vishal Publishing Co.
5. Engineering Heat Transfer by Gupta and R.Prakash, Nem Chand and Bros.

Weblink to Equivalent MOOC on SWAYAM if relevant:--

Weblink to Equivalent Virtual Lab if relevant:--

Any pertinent media (recorded lectures, YouTube, etc.) if relevant:--

Syllabus Prescribed for First Year UG Programme

Programme: B.Sc.

Semester 1

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
INC(1S) Pr	**Industrial Chemistry**	**Total 26 per Semester**

COs:

By the end of the Lab/Practical Course, generally students would be able to:

1. Prepare standard chemical solutions of different concentrations.
2. Identify and calculate the viscosity of a lubricant, moisture and ash content in a coal sample, flash, fire and aniline point of a fuel sample and infer the methodology in analytical work.
3. Illustrate the practical skills in the volumetric and instrumental analysis and plan projects.
4. Develop an understanding of how to follow lab procedures safely and develop, construct, solve and interpret the experimental data.
5. Define the methodologies and calculations to produce useful materials or devices.
6. Implement and build experimental processes logically in research and training programs.
7. Perform stoichiometric calculations and interconversion of units.

*** List of Practical/Laboratory Experiments/Activities etc.**

1	Problems based on mass relation.
2	Numerical problems on units and conversions.
3	Preparation of standard solution of Oxalic acid.
4	Preparation of standard solution of copper sulphate
5	Standardization of sodium hydroxide solution.
6	Standardization of sodium thiosulphate solution.
7	Determination of molecular weight of given sample by Rast's method.
8	Determination of viscosity of lubricant oil by Redwood viscometer.
9	Determination of aniline point of diesel.
10	Determination of moisture content in the given coal sample.
11	Determination of ash content in the given coal sample.
12	Determination of flash point and fire point of given fuel sample.

Distribution of Marks for Practical Examination.

Time: 4 hours (One Day Examination) **Marks: 50**

Numericals	…….. 06
Exercise No.2 (Practical Expt.)	…….. 12
Exercise No.2 (Practical Expt.)	…….. 12
Viva-Voce	…….. 10
Record	……10

Total:	**50**

Sant Gadge Baba Amravati University, Amravati

Faculty: Science & Technology

Programme:- B.Sc. with Industrial Chemistry

Syllabus Prescribed for B.Sc. First Year UG Programme

Programme: B.Sc. in Industrial Chemistry

Semester -2

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
INC(2S)-T	Industrial Chemistry 2S	84

COs

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

1. Apply the knowledge gained by studying unit operations like distillation, evaporation, extraction, leaching, crystallization, and drying.
2. Choose the correct mechanical separation techniques like size reduction, screening, mixing, and agitation.
3. Solve the conceptual questions by acquiring the knowledge of colloidal systems and their preparation and properties.
4. Apply the concept of catalysis.

Unit	Content
Unit I	**A) Distillation:** Introduction, Flash distillation, Differential distillation, Steam distillation, Azeotropic distillation, Continuous distillation with rectification and stripping, Plate column, Packed column, Overall material balance. **B) Evaporation:** Introduction, Single and multiple effect evaporation, Short tube evaporator, Long tube evaporator, Forced circulation evaporator, Falling film evaporator, Climbing film evaporator (Upward flow evaporator), Agitated film evaporator, Evaporator capacity. Evaporator economy, Boiling point elevation. **(14 Periods)**
Unit II	**A) Extraction:** Introduction, Selection of solvent, Single stage and multistage extraction, Spray column, Packed column, Mixer settlers, Rotating disc column, Centrifugal extractor. **B) Leaching:** Introduction, Single stage leaching, Percolation tank, Counter current multiple contact (Shank's system), Continuous counter current decantation, Agitated vessels, Rotocel, Kennedy extractor. **(14 Periods)**
Unit III	**A) Crystallization:** Introduction, Solubility, Saturation, Supersaturation, Nucleation, Crystal growth, Agitated tank crystallizer, Vacuum crystallizer, Swenson-Walker crystallizer, Oslo cooler crystallizer. **B) Drying:** Introduction, Free moisture, Bound moisture, Moisture content on wet and dry basis, Equilibrium moisture content, Critical moisture content, Constant rate period, Falling rate period , Drying Equipments-Tray dryer, Drum dryer, Fluid bed dryer, Spray dryer, Rotary dryer, Rate of drying, Heat transfer in dryers, Drying of porous solids. **(14 Periods)**
Unit IV	**A) Size Reduction:** Necessity of size reduction, Energy and power for size reduction, Crushing efficiency, Rittenzer's law, Kick's law, Bond's law, Types of size reduction equipments- Jaw crusher, Smooth roll crusher, Ball mill, Hammer mill. **B) Mechanical Separation:** Screening-Types of screening equipments, Grizzly's screens, Trammel's screens, Ideal and actual screens, Capacity and effectiveness of screens. Filtration-Types of filtration, Constant pressure filtration, Constant rate filtration, Filter media filter cake, Pressure filters, Plate and frame filter press, Rotary drum filter, Centrifugal filtration. **(14 Periods)**
Unit V	**Mixing and Agitation:** Mixing of liquid with liquid, Mixing of gases with liquids, Mixing of solids with liquids, Impellers, Propellers, Turbines, Paddles, Flow pattern in agitated vessels, Unbaffeled tanks, Prevention of swirling and vortex formation, Baffeling, Banbury mixer, Pung mill, Ribbon blenders, Tumbling mixer, Double arm kneader. **(14 Periods)**

Unit VI	**A) Surface Chemistry:** Adsorption, Mechanism of adsorption, Types of adsorption, Adsorption isotherms,-Langmuir,BET and Freundlich isotherm, Factors affecting adsorption, Applications of adsorption, Sols and their preparations, Coagulation, Emulsions, Gels, Miscelles, Surfactants. **B) Catalysis:** Introduction, Types of Catalysis-Homogeneous and heterogeneous, Mechanism, Characteristics of catalysts, Catalyst deactivation, Autocatalysis, Negative catalysis, Activation energy, Enzyme catalysis. **(14 Periods)**

***SEM- II**

1. Differentiate various distillation techniques.
2. Compare different types of evaporators.
3. Select suitable extraction and crystallization techniques.
4. Choose appropriate equipments for drying, size reduction, mixing, agitation and mechanical separation.
5. Distinguish homogeneous and heterogeneous catalysis.
6. Identify various colloidal systems**.**

COs:
By the end of this module, student would be able to:
1. Identify the appropriate equipments for various unit operations.
2. Make a distinction between various colloidal systems and types of catalysis.

**Activities	Model creation, Chart preparation, Memory maps, Class tests, assignments, 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. Unit Operations-II by K.A. Gavhane, Nirali Prakashan.

Reference Books:

1. Unit Operations of Chemical Engineering by W.L. McCabe and J. C. Smith and P. Harriott, McGraw-Hill.
2. Mass Transfer Operations by R. E.Treybal, McGraw-Hill.
3. Unit Operations- G. G. Brown, CBS Publications.
4. Catalysis: Heterogeneous and Homogeneous- B. Delmon and G.Jannes, Elsevier Science Publisher.
5. Catalysis Science and Technology- J. R. Anderson, Springer-Verlag.
6. Surface Chemistry- J.J.Bikermann, Academic Press.
7. Principles of Physical Chemistry- B.R.Puri, L.R. Sharma and M.S. Pathania, Vishal Publishing Co.

Weblink to Equivalent MOOC on SWAYAM if relevant:--

Weblink to Equivalent Virtual Lab if relevant:--

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Syllabus Prescribed for First Year UG Programme

Programme: B.Sc.

Semester 2

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
INC(2S) Pr	**Industrial Chemistry 2S**	**Total 26 per Semester**

COs:

At the end of Lab/Practical course, students would be able to -

1. Identify and calculate critical moisture content in given coal samples, amount of oil in oil seeds and infer the methodology in analytical work.
2. Investigate some unit operations like crystallization, extraction, distillation etc. and the phenomena like adsorption, coagulation etc.
3. Illustrate the practical skills in the volumetric and instrumental analysis and plan projects.
4. Develop an understanding of how to follow lab procedures safely and develop, construct, solve and interpret the experimental data.
5. Define the methodologies and calculations to produce useful materials or devices.
6. Implement and build experimental processes logically in research & training programs.

*** List of Practical/Laboratory Experiments/Activities etc.**

1. Crystallization of benzoic acid by using water as a solvent.
2. Crystallization of benzoic acid by using mixture of water and alcohol as a solvent.
3. Determination of amount of oil in given oil seed sample.
4. To study the yield of crystallization with and without seeding for copper sulphate crystals.
5. Extraction and isolation of nicotine from tobacco leaves.
6. Separation of two-component mixture of miscible liquids by simple distillation.
7. Separation of three-component mixture of miscible liquids by fractional distillation.
8. Preparation of charcoal.
9. Coagulation of suspended solid particles in a given water sample by using alum.
10. Decolourization of raw sugar by using charcoal.
11. To determine critical moisture content of a given material.
12. Determination of total acid content in lemon juice.

Distribution of marks for practical examination

Time: 4 hours (One Day Examination) **Marks: 50**

Exercise No.1(Practical Expt.)	…….. 15
Exercise No.2 (Practical Expt.)	…….. 15
Viva-Voce	…….. 10
Record	……10

Total:	**50**