

KURUKSHETRA UNIVERSITY

KURUKSHETRA

(Established by the state legislature Act XII of 1964)
A⁺ Grade NAAC Accredited)



**Scheme of Examination and Syllabus for
Under-Graduate Programme
Subject: Industrial Chemistry**

**Under Multiple Entry-Exit, Internship and
CBCS-LOCF in accordance to NEP-2020
w.e.f. 2023-24 (in phased manner)**

DEPARTMENT OF CHEMISTRY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme for Undergraduate Course Programme, Subject: Industrial Chemistry-Scheme A

FIRST YEAR: SEMESTER-1									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A	CC-1 4 credit	B23-ICH-101	Major Industrial Chemistry-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
FIRST YEAR: SEMESTER-2									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A	CC-2 4 credit	B23-ICH-201	Major Industrial Chemistry-II	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Internship of 4 credits of 4-6 weeks duration after 2nd Semester									

SECOND YEAR: SEMESTER-3									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A	CC-3 4 credit	B23-ICH-301	Major Industrial Chemistry-III	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.

SECOND YEAR: SEMESTER-4									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A	CC-4 4 credit	B23-ICH-401	Major Industrial Chemistry-IV	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

THIRD YEAR: SEMESTER-5									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A	CC-5 4 credit	B23-ICH-501	Major Industrial Chemistry-V	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
THIRD YEAR: SEMESTER-6									
Remarks	Course	Paper(s)	Nomenclature of Paper	Credits	Hours/Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A	CC-6 4 credit	B23-ICH-601	Major Industrial Chemistry-VI	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.

CC-1

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	I		
Name of the Course	Major Industrial Chemistry-I		
Course Code	B23-ICH-101		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 Gain knowledge of various unit operation in chemical technology like distillation, evaporation and filtration 2 Understand catalysis and colloidal Chemistry and their role in various chemical processes. 3 Learn about various metallurgical operations and knowledge about extraction about metals from various ores. 4 Apply material balance with chemical equations in different industries. <hr/> <p>5*. Understand good laboratory practices, calibration of apparatuses, apply to prepare standard solution of various concentration and volumetric analysis.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

Max. Marks: 70+ 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: 3 hrs. for Theory and 3 hrs. for Practical
Part B- Contents of the Course		
<u>Instructions for Paper- Setter</u>		
The examiner is requested to set 9 questions in all. <ol style="list-style-type: none"> Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two mark. Eight questions will be set from all four sections by selecting two questions from each section. Students should attempt four more question by selecting one question from each section. Each question carry equal marks.		
Unit	Topics	Contact Hours
I	Distillation Unit Process Introduction, volatility, relative volatility, general equipment for distillation, types of distillation processes, concept of batch and continuous distillation, simple steam distillation, advantages and disadvantages of steam distillation, application of steam distillation in various chemical processes. Evaporation and Drying Introduction, factors affecting the rate of evaporation and choice of evaporators, application of evaporation in chemical process industries, equipment- climbing film evaporator, Introduction of drying process, free moisture, bound moisture and equilibrium moisture content, purpose of drying, equipment- rotary dryer.	12 Hrs.
II	Filtration Introduction, filter media and filter aids, characteristics of ideal filter aids, factors affecting the rate of filtration and choice of filter media, equipment- bag filters and candle filters. Absorption Introduction, desorption or gas stripping, equipment-spray column for absorption. Material Balance Introduction, steady and unsteady state of flow processes, material balance equation without chemical reactions, flow/block diagrams for various industrially important chemical engineering operations such as distillation, absorption and	11 Hrs.

	crystallization and their overall material balance equation. (Numerical problems excluded).	
III	<p>Metallurgical operations Definition, crushing and pulverization, concentration methods- gravity separation, magnetic concentration, froth flotation process, chemical methods- calcination and roasting, reduction using carbon and carbon monoxide, Alumino thermite reduction, auto reduction, reduction using precipitation method, refining methods polling, parting and electrolyte refining.</p> <p>Metallurgical Extraction Metallurgical extraction and refining of the following metals from their important ores: Lead from galena, Aluminum from bauxite and Zinc from Zinc blende.</p>	11 Hrs.
IV	<p>Catalysis: Definition, positive and negative catalyst, homogeneous and heterogeneous catalysis, theories of catalysis- adsorption theory and intermediate complex formation theory, characteristics of catalytic reactions, catalytic inhibitors, catalytic promoters, auto catalysis, introduction to enzyme catalysis, optimum pH and optimum temperature.</p> <p>Colloidal Chemistry Colloidal dispersion, definition, types, emulsions and types, applications of emulsions, Gel formation and its types, their importance, micelles, types, preparation and uses.</p>	11 Hrs.
V*	<p>Practical paper Syllabus: Basic Analytical Techniques</p> <ul style="list-style-type: none"> ❖ Good Laboratory Practices, Calibration of thermometer and burette. ❖ Simple Laboratory Techniques: Crystallization, fractional crystallization, distillation, filtration and evaporation. <ul style="list-style-type: none"> ✓ To purify CuSO₄ by the process of crystallization. ✓ To purify Potash Alum by the process of crystallization. ✓ To purify the given organic solvent by distillation process. ✓ To separate the different components of a solid mixture by the process of Filtration and evaporation. ❖ Standardization of solutions <ul style="list-style-type: none"> ✓ Prepare and standardize the solution of sodium hydroxide. ✓ Prepare and standardize the given solution of KMnO₄. ✓ Prepare and standardize the given solution of hydrochloric acid against standard Sodium hydroxide solution. ✓ Prepare standard solution of KMnO₄ and ferrous ammonium sulphate Solution. Find out the strength of unknown ferrous ammonium sulphate Solution. 	30 Hrs.

Suggested Evaluation Methods	
<p>Internal Assessment:</p> <ul style="list-style-type: none"> ➤ Theory (20 Marks) <ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) <ul style="list-style-type: none"> • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil 	<p>End Term Examination:</p> <p>50 Marks</p> <p>20 Marks</p>
Part C-Learning Resources	
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> ✓ Physical chemistry by B.R Puri, I.R Sharma and M.S Pathania. ✓ Study Material in Vocational Subject to Industrial Chemistry (B.Sc. I, UGC) Sponsored (Text Book) ✓ Principles of Extractive Metallurgy, Herbashi Vol. 1 and 2. ✓ Introduction to Chemical Engineering W.L. Badger and J.T. Banchero, Mc Graw- Hill Book Co.,USA. ✓ Unit Operations in Chemical Engineering W.L. McCabe and J.C Smith, Mc Graw- Hill Books co.,New York. ✓ Physical Chemistry, G.M. Barrow, Tata McGraw-Hill. ✓ Riegel's Handbook of Industrial Chemistry, J.A. Kent, J.A.(ed), CBS Publishers, New Delhi. ✓ Saxena Ruchi, Srivastava Alok Kumar, "Read & Do Practical Chemistry", Kitab Mahal, New Delhi, India (2016). ✓ Skoog D. A., West. D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia (2010). ✓ G. Larry Hargis, "Analytical Chemistry: Principles and Techniques" Pearson© (1988) <p>Suggested links for e-resources:</p> <ul style="list-style-type: none"> ✓ https://swayam.gov.in/ ✓ https://nptel.ac.in/courses/112/104/112104113/ ✓ https://onlinecourses.nptel.ac.in/noc19_ph14/preview ✓ http://heecontent.upsdc.gov.in/Home.aspx ✓ https://ncert.nic.in/textbook.php?kech1=0-7 ✓ https://www.labster.com/chemistry-virtual-labs/ ✓ http://chemcollective.org/vlabs 	

*Applicable for courses having practical component.

CC-II

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	II		
Name of the Course	Major Industrial Chemistry-II		
Course Code	B23-ICH-201		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes (CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 Understand fundamental of Organic Chemistry, intermediates and reaction mechanism. 2 Get knowledge of various titration methods to estimate the purity of various compounds. 3 Understand about the various types of fuels, coal and their chemical analysis. 4 Learn about the petroleum industry and its products. <p>5*. Estimate various natural ores, alloys and other compounds. Analyse and estimate iodine value of an oil sample, saponification value of oil and how to prepare different emulsions.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70+ 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: 3 hrs. for Theory and 3 hrs. for Practical	

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	Fundamentals of Organic Chemistry Cleavage of bonds (homolysis and heterolysis), reaction intermediates (carbocation, carbanion and free radicals), electrophiles and nucleophiles, inductive effect, electrometric effect, mesomeric effect, resonance effect, hyperconjugation effect and steric effect. Halogenation Unit Process Introduction, types of halogenation reaction, halogenating agents, kinetics and mechanism of halogenation, manufacturing process of chlorobenzene. Sulphonation Unit Process Introduction, types of sulphonation reaction, sulphonating agents, commercial sulphonation of alkyl benzene.	12 Hrs.
II	Titrimetric Analysis Primary and secondary standards, normality, molarity. Molality, indicators, mixed indicators, neutralization indicators, universal indicators, choice of indicators in neutralization reactions, complexation titrations and precipitation titrations. Heat Transfer Introduction, mode of heat transfer, Fourier's law of heat conduction, convection, types of convection, scraped surface heat exchanger. Steam Basic specification of water used for steam production, various applications of steam in industrial processes.	11 Hrs.
III	Corrosion Definition, oxidation corrosion, nature of corrosion layer formed, corrosion by hydrogen, concentration cell corrosion, microbiological corrosion, factors influencing corrosion,	

	<p>position of the metal in galvanic series, relative cathodic and anodic area, nature of the surface film formed and nature of the medium.</p> <p>Corrosion Control Proper designing, cathodic protection, modification of the environment, use of cathodic and anodic inhibitors.</p>	11 Hrs.
IV	<p>Fuels Definition and classification, calorific value, higher or gross calorific value, lower or net calorific value, characteristics of a good fuel.</p> <p>Coal Analysis of coal, proximate analysis, determination and importance of moisture content, volatile matter, ash content and fixed carbon. Ultimate analysis, determination and importance of carbon, hydrogen and impurity like sulphur, nitrogen, ash and oxygen in coal.</p> <p>Petroleum Fractional distillation of crude oil using fractionating column, cracking- thermal and catalytic cracking of petroleum products, reforming- thermal and catalytic reforming.</p>	11 Hrs.
V*	<p>Practical paper: Quantitative and Qualitative Analysis</p> <ul style="list-style-type: none"> ❖ Analysis of Dolomite ore. ❖ Analysis of Calcite ore. ❖ Analysis of lime stone. ❖ Analysis of Brass sample. ❖ Analysis of Lunar caustic. ❖ Determination of percentage of Fe in Mohr's salt. ❖ Determine the Iodine value of a given oil sample. ❖ Determine the saponification value of a given oil sample. ❖ Prepare a sample of an emulsion- Oil in water. ❖ Prepare a sample of an emulsion – Water in oil. 	30 Hrs.
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <ul style="list-style-type: none"> ➤ Theory (20 Marks) <ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) <ul style="list-style-type: none"> • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil 		<p>End Term Examination: 50 Marks</p> <p>20 Marks</p>

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Study Material in Vocational Subject to Industrial Chemistry (B.Sc. I, UGC) Sponsored (TextBook)
- ✓ Introduction to Chemical Engineering W.L. Badger and J.T. Banchero, Mc Graw- Hill Book Co., USA.
- ✓ Unit Operations in Chemical Engineering W.L. McCabe and J.C Smith, Mc Graw- Hill Books co., New York.
- ✓ Physical Chemistry, G.M. Barrow, Tata McGraw-Hill.
- ✓ Riegel's Handbook of Industrial Chemistry, J.A. Kent, J.A.(ed), CBS Publishers, New Delhi.
- ✓ Reaction Mechanism in Organic Chemistry, S.P. Singh, OM, Prakash, Trinity Press imprint of Laxmi Publication Pvt. Ltd.
- ✓ Industrial Chemistry, B.K. Sharma, Krishna's Educational Publishers.
- ✓ Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher (2009)
- ✓ Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education (2012).
- ✓ Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson (2009)
- ✓ A.I. Vogel, A.R. Tatchell, B.S. Furnis, A.J. Hannaford, P.W.G. Smith, Vogel's Textbook of Practical Organic chemistry (1989).

Suggested links for e-resources:

- ✓ <https://swayam.gov.in/>
- ✓ <https://nptel.ac.in/courses/112/104/112104113/>
- ✓ https://onlinecourses.nptel.ac.in/noc19_ph14/preview
- ✓ <http://heecontent.upsdc.gov.in/Home.aspx>
- ✓ <https://ncert.nic.in/textbook.php?kech1=0-7>
- ✓ <https://www.labster.com/chemistry-virtual-labs/>
- ✓ <http://chemcollective.org/vlabs>

*Applicable for courses having practical component.

CC-3

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	III		
Name of the Course	Major Industrial Chemistry-III		
Course Code	B23-ICH-301		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 Understand about various inorganic chemical industries like ceramics, refractories, glass and cement industry. 2 Apply knowledge of various material balance equation involving chemical reactions. 3 Apply skill related to various pollutants from the industries, their statutory limit and knowledge about air pollution, pesticide pollutions, noise pollution and radiation pollution. 4 Understand about unit process of crystallization in various industries. <hr/> <p>5*. Analyze alkalinity, acidity, hardness, permanent hardness, temporary hardness, total solids, dissolve solids, suspended solids and dissolved oxygen of water. Students will create various organic compounds in lab.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70+ 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: 3 hrs. for Theory and 3 hrs. for Practical	

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	Ceramic Industry Introduction, types of clay products, properties of clay, plasticity of clay, manufacturing of white wares, applications of white wares. Refractories Introduction, classification, properties of refractories body, manufacturing of silica bricks, high alumina bricks, dolomite bricks, carbon bricks, graphite bricks and their applications. Cement Industry Introduction, types of cement, chemical composition Portland cement, manufacturing process of Portland cement.	12 Hrs.
II	Crystallization Introduction, concept of super saturation, nucleation, primary nucleation and secondary nucleation, crystal growth, caking of crystals, factors affecting caking and prevention of caking, equipment- circulating liquid evaporator crystallizers. Material balance involving chemical reactions Introduction, conceptual study of terms involved- stoichiometric equation, stoichiometric coefficients, limiting reactant, excess reactant, conversion, recycling operations and need for their adoption in process industries.	11 Hrs.
III	Air pollution Air pollutants gases- sulphur dioxide, sulphur trioxide, oxides of nitrogen, carbon monoxide, particulate matter- dust, smoke, smog their sources and bad effects, remedial measures to control air pollution, processing of air using electrostatic precipitator. Greenhouse effect and its consequences, deforestation and its consequences. Industrial specification and uses of air. Thermal pollution	11 Hrs.

	Definition, sources of thermal pollution and bad effects of thermal pollution.	
IV	<p>Noise pollution Definition, noise level bearable limit, sources of noise pollution, bad effects of noise pollution and prevention of noise pollution. (4Hrs)</p> <p>Pesticide pollution Classification of pesticides, sources of pesticides pollution, bad effects of pesticides and control measures of pesticides pollution.</p> <p>Radiation pollution Sources, hazards of nuclear radiations and methods of disposal of radioactive waste.</p>	11 Hrs.
V*	<p>Practical paper: Water Analysis and Organic Synthesis</p> <ul style="list-style-type: none"> ❖ Determination of alkalinity of given water sample. ❖ Determination of acidity of given water sample. ❖ Determination of total hardness of given water sample. ❖ Determination of temporary and permanent hardness of water sample. ❖ Determination of dissolved oxygen of given water sample. ❖ Determination of calcium ions in a given water sample. ❖ To prepare a pure sample of m-dinitrobenzene. ❖ To prepare a pure sample of anthraquinone from anthracene. ❖ To prepare a pure sample of 1-phenyl azo B naphthol. ❖ To prepare a pure sample of anthranilic acid from phthalic anhydride 	30 Hrs.
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <ul style="list-style-type: none"> ➤ Theory (20 Marks) <ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) <ul style="list-style-type: none"> • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil 		<p>End Term Examination: 50 Marks</p> <p>20 Marks</p>

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Industrial Chemistry, B.K. Sharma, Goel, Publishing House.
- ✓ Industrial Pollution and Environmental Management, R.K, Trivedy, N.S. Raman, Scientific Publishers Journals. Environmental and Pollution Science, M. Brusseau, I. Pepper, C. Gerba, Third Edition, Elsevier Science.
- ✓ Study material in Vocational subject of Industrial Chemistry (B.Sc II UGC) sponsored text book.
- ✓ Engineering Chemistry, Jain & Jain, Dhanpat Rai Publishing Co.
- ✓ M. M. Benjamin, D. F. Lawler, Water Quality Engineering: Physical / Chemical Treatment Processes by La - John Wiley & Sons (2013).

Suggested links for e-resources:

- ✓ <https://swayam.gov.in/>
- ✓ <https://www.coursera.org/learn/physical-chemistry>
- ✓ <https://nptel.ac.in/courses/104/108/104108124/>
- ✓ <https://nptel.ac.in/courses/104/106/104106122/>

*Applicable for courses having practical component.

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	IV		
Name of the Course	Major Industrial Chemistry-IV		
Course Code	B23-ICH-401		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 Understand processing of industrial products like pulp and paper and sugar from sugar cane. 2 Prepare various organic compounds by applying the knowledge of unit processes like hydrogenation, oxidation, nitration and alkylation methods. 3 Understand various sources of water pollution and its management. 4 Understand about the solid waste management in various industries and apply the knowledge of various instruments for its analysis. <hr/> <p>5*. Determine the viscosity, surface tension, refractive index and molar refractive index of any liquid and qualitatively analyze various chemical processing industries like petroleum, food, oils and pharmaceutical industries.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75

Max. Marks: 70+ 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: 3 hrs. for Theory and 3 hrs. for Practical
Part B- Contents of the Course		
<u>Instructions for Paper- Setter</u>		
<p>The examiner is requested to set 9 questions in all.</p> <ol style="list-style-type: none"> 1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks. 2. Eight questions will be set from all four sections by selecting two questions from each section. <p>Students should attempt four more question by selecting one question from each section. Each question carry equal marks.</p>		
Unit	Topics	Contact Hours
I	Pulp and Paper Industry Introduction, methods of pulping, manufacturing of wood pulp by sulphate process, bleaching of wood pulp, refining of pulp, sizing, coloring and manufacturing of paper by fourdrinier machine. Sugar Industry Introduction, manufacturing and refining of sugar from sugar cane.	12 Hrs.
II	Hydrogenation Unit Process Introduction, types of catalysts used for hydrogenation, commercial process of hydrogenation of vegetable oil. Alkylation Unit Process Introduction, types of alkylation reactions, alkylating agents, manufacturing process of ethyl benzene. Oxidation Unit Process Introduction, types of oxidation reactions, oxidizing agents, commercial manufacturing process of benzoic acid and acetic acid. Nitration Unit Process Introduction, types of reaction, nitrating agents, mechanism of nitration and manufacturing process of nitrobenzene.	11 Hrs.
III	Water pollution Definition, sources and bad effects of water pollution, water analysis, determination of alkalinity, acidity, hardness, dissolved oxygen and chloride content.	

	<p>Water Treatments Treatments of waste water, preliminary treatment- removal of solids, grit, oil and greases, primary treatment of water- sedimentation and flocculation, secondary treatment- filters i.e. trickling filter, tertiary treatment- chlorination and chemical treatment.</p>	11 Hrs.
IV	<p>Solid Waste Management Classification of solid waste, microbiology of solid waste, disposal processes- composting, sanitary land filling incineration and pyrolysis.</p> <p>Process Instrumentation Principle, construction and working of the following instruments - Glass thermometer, bimetallic thermometer, pressure manometer and Barometers. (11Hrs)</p>	11 Hrs.
V*	<p>Practical paper: Material Analysis and Organic Synthesis</p> <ul style="list-style-type: none"> ❖ Determine the Viscosity of a given liquid by Ostwald's Viscometer. ❖ Determine the Surface tension of a given liquid by Stalagmometer. ❖ Determine the Surface tension of a given liquid in the presence of surfactant. ❖ Determination of Refractive index of a given liquid by Abbe's refractometer. ❖ Determination of Molar refractivity and specific refractivity of a liquid by using Abbe's refractometer. ❖ To prepare a pure sample of Sulphanilic acid. ❖ To prepare a pure sample of m-nitroaniline from m-dinitrobenzene. ❖ To prepare a pure sample of p-nitro benzoic acid from p-nitroaniline. ❖ To prepare 4-amino benzoic acid from 4-nitrobenzoic acid. 	30 Hrs.
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <ul style="list-style-type: none"> ➤ Theory (20 Marks) <ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) <ul style="list-style-type: none"> • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil 		<p>End Term Examination: 50 Marks</p> <p>20 Marks</p>

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- ✓ Organic Chemistry, J.G. Smith, Tata McGraw-Hill Publishing Company Limited.
- ✓ Guidebook to Mechanism in Organic Chemistry, P.A. Sykes, Pearson Education.
- ✓ Advanced Organic Chemistry, J. March, Fourth edition, Wiley.
- ✓ Industrial Chemistry, B.K. Sharma, GOEL, Publishing House.
- ✓ Handbook of Pulp and Paper technology Book on Pulp and Paper Industries, K.W. Britt, 2 Ed.
- ✓ Industrial Pollution and Environmental Management, R.K, Trivedy, N.S. Raman, Scientific Publishers Journals.Environmental and Pollution Science, M. Brusseau, I. Pepper, C. Gerba, Third Edition, Elsevier Science.
- ✓ Study material in Vocational subject of Industrial Chemistry (B.Sc. II UGC) sponsored text book.

Suggested links for e-resources:

- ✓ <https://swayam.gov.in/>
- ✓ <https://www.coursera.org/learn/physical-chemistry>
- ✓ <https://nptel.ac.in/courses/104/106/104106122/>

*Applicable for courses having practical component.

CC-5

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	V		
Name of the Course	Major Industrial Chemistry-V		
Course Code	B23-ICH-501		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 Understand chromatography and accuracy analysis. 2 Know about modern instrumental analysis methods for qualitative measurements. 3 Get Knowlegde about spectrophotometer and refrectrometer. 4 Understand skills related to the instrumental analysis of various raw materials used in the industry for the production of various compounds. <hr/> <p>5*. Analyze various properties by applying instruments pH meter, Refractrometer, Polarimeter, Nephelometer and Spectrophotometer.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70+ 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: 3 hrs. for Theory and 3 hrs. for Practical	
Part B- Contents of the Course			

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more question by selecting one question from each section. Each question carry equal marks.

Unit	Topics	Contact Hours
I	Chemometrics Accuracy and precision, classification of errors and their minimization. Significant figures and computations. Standard deviation and relative standard deviation. Chromatography Principle and classification of chromatographic method, paper chromatography, Thin layer chromatography, HPLC and gas chromatography.	12 Hrs.
II	Buffer solutions Types of buffer solutions, buffer action, buffer capacity, importance of pH and its measurement. Spectrophotometry Principle, instrumentation for absorption measurements, qualitative and quantitative applications.	11 Hrs.
III	Solvent Extraction General discussion, factors favoring solvent extraction, classification of solvent extraction systems, applications of solvent extraction. Amperometric titration Theory, types and applications of amperometric titration. Polarimetry Principle, instrumentation and applications of polarimetry.	11 Hrs.
IV	Refractometry Principle, instruments and application of refractometry. Nephelometry Principle, instruments, factors affecting intensity of scattered radiations and application of nephelometry.	11 Hrs.
V*	Practical paper : Material Analysis and Organic Synthesis ❖ Study of λ_{\max} of an absorbing sample by spectrophotometer. ❖ Determine the specific and molar rotation of an optically active substance like sucrose.	

	<ul style="list-style-type: none"> ❖ Identification of cations in the mixture by paper chromatography. ❖ Study of number of components in the organic mixture by TLC. ❖ Separation of a mixture of organic compound by column chromatography. ❖ To determine the pH value of a given solution with pH meter. ❖ To determine the turbidity of a given solution by nephelometer. ❖ To find out the partition coefficient of iodine between CCL₄ and water. 	30 Hrs.
Suggested Evaluation Methods		
<p>Internal Assessment:</p> <ul style="list-style-type: none"> ➤ Theory (20 Marks) <ul style="list-style-type: none"> • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) <ul style="list-style-type: none"> • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil 	<p>End Term Examination: 50 Marks</p> <p>20 Marks</p>	
Part C-Learning Resources		
<p>Recommended Books/e-resources/LMS:</p> <ul style="list-style-type: none"> ✓ Vogel's Text book of Quatitative Chemical Analysis, G.H. Jeffery, J. Basset, J. Mendham ✓ Study Material in vocational subject, Industrial Chemistry (UGC Sponsored) ✓ Handbook of instrumental techniques for Analytical chemistry, F.A. Settle, Prentice Hall. ✓ Quantitative Inorganic Analysis, K. Kodama Interscience Publishers, New York. <p>Suggested links for e-resources:</p> <ul style="list-style-type: none"> ✓ https://fac.ksu.edu.sa/sites/default/files/vogel_practical_organic_chemistry_5th_edition.pdf ✓ http://faculty.chas.uni.edu/~manfredi/860-121/ORG%20LAB%20MAN%20S08.pdf ✓ https://www.ipinnovative.com/media/open-access-books/Practical_Lab_Manua%20I_of_%20Pharmaceutical_Organic_Chemistry_-1_%20Low.pdf 		

*Applicable for courses having practical component.

CC-6

Session: 2023-24			
Part A – Introduction			
Subject	Industrial Chemistry		
Semester	VI		
Name of the Course	Major Industrial Chemistry-VI		
Course Code	B23-ICH-601		
Course Type: (CC/MCC/MDC/CC- M/DSEC/VOC/DSE/PC/AEC/VAC)	CC		
Level of the course (As per Annexure-I)	100-199		
Pre-requisite for the course (if any)	4.0		
Course Learning Outcomes(CLO):	<p>After completing this course, the learner will be able to:</p> <ol style="list-style-type: none"> 1 Understand the skills related to pharmaceutical industry and pharmacopoeias. 2 Learn about the various pharmaceutical excipients and their specification in various dosage forms. 3 Know about the methods of evaluation of the crude drugs, packing material and liquid dosage form. 4 Learn the techniques for bulk production of analgesic, anti-inflammatory, sulpha drugs, vitamins and sedative and hypnotic drugs and fermentation technology for the synthesis of antibiotics. <hr style="width: 50%; margin-left: 0;"/> <p>5*. Upon successful completion of this lab course students should be able to know about the various pharmaceutical preparation and evaluation of the quality of various dosage forms.</p>		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	45	30	75
Max. Marks: 70+ 30* Internal Assessment Marks: 20 + 10* End Term Exam Marks: 50 + 20*		Time: 3 hrs. for Theory and 3 hrs. for Practical	

Part B- Contents of the Course

Instructions for Paper- Setter

The examiner is requested to set 9 questions in all.

1. Question No. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have five parts and answer should be in brief. Each part of this question is of two marks.
2. Eight questions will be set from all four sections by selecting two questions from each section.

Students should attempt four more questions by selecting one question from each section. Each question carries equal marks.

Unit	Topics	Contact Hours
I	Pharmacopoeias Introduction to pharmacopoeias, contents of pharmacopoeias, Introduction to various formulations and routes of administration. Legal aspects of drugs: Important FDA schedules. Dosage Dosage forms and their classification on the basis of physical state with important characteristics, Solid dosage forms including tablets, capsules, powders, cachets, pills and suppositories, Liquid dosage forms including injection, aromatic water inhalations, colloidions, draughts, mixtures, irrigations, lotions, mouthwashes, nasal drops, ophthalmic drops, paints and solution tablets.	12 Hrs.
II	Pharmaceuticals Excipients Various types of excipients used of tablets, capsules, emulsions, suspensions, ointments, creams, pills, powders and in menophasic liquids (clears products). Need for use of excipients in pharmaceuticals. Pharmaceuticals quality testing sterility testing, pyrogen testing, glass testing.	11 Hrs.
III	Synthesis of the bulk drugs Antimicrobial agents – Isoniazid, p-amino salicylic acid. Synthesis of Antiinflammatory and analgesic compounds – Salicylic acid and its derivatives, ibuprofen. Synthesis of Vitamins – Vitamin A, Vitamin C and Vitamin B6 (Pyridoxine) Synthesis of Sulphur Drugs – Sulfonamides, sulphamethoxazole Synthesis of Hypnotics and sedatives – barbiturates, pentobarbital	11 Hrs.
IV	Fermentation General principle, types of fermentation processes, outline of	

	fermentation process unit, preparation of inoculum, fermentation media, recovery of products. Manufacturing processes of antibiotics. Penicillin G, Rifamycin, Tetracycline and cyanocobalamine.	11 Hrs.
V*	Practical paper : Pharmaceutical preparation and analysis ❖ To prepare chloroform spirit ❖ To prepare camphor water ❖ To prepare chloroform water ❖ To prepare cetrimide cream. ❖ To prepare a sample of zinc sulphate lotion. ❖ Monograph of aspirin tablet ❖ Monograph of paracetamol tablet. ❖ To estimate the amount of aspirin in a given tablet.	30 Hrs.
Suggested Evaluation Methods		
Internal Assessment: ➤ Theory (20 Marks) • Class Participation: 05 Marks • Seminar/presentation/assignment/quiz/class test etc.: 05 Marks • Mid-Term Exam: 10 Marks ➤ Practicum (10 Marks) • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 Marks • Mid-Term Exam: Nil		End Term Examination: 50 Marks 20 Marks
Part C-Learning Resources		
Recommended Books/e-resources/LMS: ✓ L. Patrick. L. Graham, An Introduction to Medicinal Chemistry, OUP Oxford; 4th edition (2009). ✓ C. O. Wilson, O. Gisvold & R. F. Doerge, Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams and Wilkins; 8th edition (1982). ✓ W. O. Foye, T. L. Lemice and D. A. Williams Principles of Medicinal Chemistry (2019). ✓ D J. Abraham, M. Myers, Burger's Medicinal Chemistry, Drug Discovery and Development (1-8 ✓ G.L. Patrick, An Introduction to Medicinal Chemistry, Oxford; Fifth edition (2013). ✓ John T. Arnason, Rachel Mata, John T. Romeo, Phytochemistry of Medicinal Plants, Springer (2019). ✓ Medicinal Chemistry – Ashutoskar (Vol – I, Vol – II) ✓ Study material in vocational subjects of industrial chemistry (UGC sponsored) Paper – II Pharmaceuticals. Suggested links for e-resources: ✓ https://nptel.ac.in/courses/104/106/104106106/ ✓ https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy16/ ✓ https://nptel.ac.in/LocalChapter/statistics/2537		

*Applicable for courses having practical component.