



DEPARTMENT OF CHEMISTRY

Bachelor of Science (Industrial Chemistry)

5th Semester

Syllabi



Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH301	Title of the Course	Chromatography Techniques	L	T	P	C
Year	Third	Semester	Fifth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Students able to understand Separation techniques such as Thin layer chromatography, Paper chromatography, Gas chromatography, High performance Liquid Chromatography and Ion exchange chromatography						

Course Outcomes	
CO1	Understand the chromatographic techniques and its classification.
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Separation techniques	Chromatography, Classification of Chromatographic methods, Elution in column chromatography, chromatograms, distribution constant, retention time, stationary phase, mobile phase, principle of adsorption and partition chromatography, column chromatography; principle, adsorbents used, preparation of column, adsorption, elution.	8	1
2	Thin layer chromatography	principle, choice of adsorbent and solvent, Rf value, applications. Paper chromatography; solvents used, principle, Rf value, factors influencing Rf value, applications. Separation of amino acid mixture.	8	2
3	Gas chromatography	Introduction, Principles of gas-liquid chromatography, Instrumentation; Carrier gas system, Sample injection, Columns, Stationary phase, Detectors (Flame Ionization, Electron capture and Thermal conductivity) and Industrial applications.	8	3
4	High performance liquid chromatography	Introduction of HPLC, Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector (UV-visible absorption, Electrochemical) and Industrial applications of HPLC.	8	4
5	Ion exchange chromatography	principle, resins, action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.	8	5

Reference Books:	
CRC Handbook of Chromatography, Volume IV: Drugs, ISBN: 0849330920	
Chromatography: Basic Principles, Sample Preparations and Related Methods,	
Chromatography: Principles and Instrumentation,	
Introduction to modern liquid chromatography,	
Liquid Chromatography: Fundamentals and Instrumentation,	
e-Learning Source:	
https://microbenotes.com/chromatography-principle-types-and-applications/	
https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/basics-of-chromatography	
https://www.slideshare.net/nadeemakhter7374/chromatography-34247423	
http://www.biologydiscussion.com/biochemistry/chromatography-techniques/top-12-types-of-chromatographic-techniques-biochemistry/12730	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	2	1	3	3	3	2	-	2	-
CO2	3	2	-	2	1	2	3	3	2	-	2	-
CO3	3	2	-	3	1	3	3	3	2	-	2	-
CO4	2	3	-	2	1	3	3	3	2	-	2	-
CO5	3	2	-	2	1	3	2	3	2	-	2	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH302	Title of the Course	Process In Organic Chemicals Manufacturing	L	T	P	C
Year	Third	Semester	Fifth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Interest will be developed among students for industrial organic chemistry and introduction of basic organic chemicals' manufacturing techniques, organic reaction mechanisms and their applications in industrial chemistry will be taught.						

Course Outcomes	
CO1	Commercial preparations of nitration process to produce important organic substances of industrial use are analyzed for their procedural feasibility.
CO2	How common sulphonation reactions are applied in commercial chemicals manufacture is done along with their mechanistic action.
CO3	The application of common alkylation reactions in commercial chemical manufacturing is done in conjunction with their mechanistic action.
CO4	Esterification processes are used in conjunction with their mechanistic activity in the production of commercial chemicals.
CO5	Students develop an interest in halogenation in the context of industrial chemistry.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Nitration	Introduction - Nitrating agents and mechanism of nitration process such as nitration: i) Benzene to nitrobenzene and m-dinitrobenzene ii) Chlorobenzene to o- and p-nitrochlorobenzenes iii) Toluene. Continuous vs batch nitration.elution.	8	1
2	Sulphonation	Introduction, sulphonating agents, Chemical and physical factors affect sulphonation, mechanism of sulphonation reactions, Commercial sulphonation of benzene, naphthalene, Toluene, batch vs continuous sulphonation.	8	2
3	Alkylation	Introduction, sulphonating agents, Chemical and physical factors affect sulphonation, mechanism of sulphonation reactions, Commercial sulphonation of benzene, naphthalene, Toluene, batch vs continuous sulphonation.	8	3
4	Esterification	Introduction, Esterification by organic acids, by addition of unsaturated compounds, esterification of carboxyl acid derivatives, commercial manufacture of ethyl acetate, vinyl acetate, cellulose acetate.	8	4
5	Halogenation	Introduction - Reagents for halogenations, mechanism of halogenation, halogenation of aromatics. Commercial manufactures - chlorobenzenes, chloral, monochloroacetic and chloromethanes, dichlorofluoromethane.	8	5

Reference Books:

- Process In Organic Chemicals Manufacturing, ISBN: 9780071410373
- Handbook of Industrial Chemistry: Organic Chemicals 16 January 2005, by Bassam El Ali, M. Ali
- Industrial Organic Chemicals, Third Edition, ISBN:9780470537435
- Shreves Chemical Process Industries, 5th Edition,
- Sre Shreves Chemical Process Industries Handbook, 5/E 16 January 1999, by Nicholas Basta
- Industrial Chemistry by B. K. Sharma

e-Learning Source:

- <https://www.britannica.com/technology/chemical-industry/Organic-chemicals>
- <http://www.ilocis.org/documents/chpt77e.htm>
- <https://www.accessengineeringlibrary.com/browse/handbook-of-industrial-chemistry-organic-chemicals/c9780071410373ch01>
- <http://www.chemistryexplained.com/Hy-Kr/Industrial-Chemistry-Organic.html>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	2	1	2	2	3	3	-	2	2
CO2	3	2	-	2	1	2	2	2	3	-	2	2
CO3	3	2	-	2	1	2	2	3	3	-	2	1
CO4	3	2	-	2	1	2	2	3	3	-	2	2
CO5	3	2	-	2	1	2	2	2	2	-	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH303	Title of the Course	Phytochemistry	L	T	P	C
Year	Third	Semester	Fifth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Students will be acquainted with important terpenoids, alkaloids and hormones their synthesis and structure elucidation is done in context with industrial chemistry. A special emphasis will be laid on plant based phytochemicals and their medicinal utility.						

Course Outcomes	
CO1	Isolation and separation procedures are understood to separate individual components (terpenoids) in natural products chemistry.
CO2	Structure elucidation of various alkaloids, terpenoids is done to better understand the fundamentals of phytochemistry.
CO3	Physiological action of important steroids and hormones is evaluated.
CO4	Classification and structure of vitamins is understood and utility of vitamins is applied in biological structures.
CO5	Phytopharmaceuticals and their utility is analysed in context with industrial chemistry

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Terpenoids	Introduction, nomenclature, occurrence, general properties, classification, and isolation of terpenoids, isoprene rule; synthesis of Citral and Menthol. Carotenoids: Introduction, classification, and isolation of carotenoids.	8	1
2	Alkaloids	Introduction occurrence, functions, nomenclature, chemical classification, isolation, and general properties of alkaloid. Introduction and physiological action; Ephedrine, Adreneline or Epinephrine, Nor adreneline or Nor epinephrine, Nicotine, atropine.	8	1,2
3	Steroids and hormones	Introduction, occurrence, structure and physiological action; cholesterol, Ergosterol. Steroidal ormones; Progesterone, Testosterone, Androgen, Oestrogens.	8	3
4	Vitamins	Introduction, Classification, Sources of vitamins and their deficiency diseases. Physiological function of water and fat soluble vitamins. Structure and uses; Vit. A, Vit. B1, B2 B6, and Vit. C.	8	4
5	Phytopharmaceuticals	Recent development and commercialization of plant derived natural products. Structure and medicinal uses of caffeine, theophylline and theobromine.	8	5

Reference Books:

Textbook of Pharmacognosy and Phytochemistry,
 A Textbook of Pharmacognosy and Phytochemistry,
 Phytochemistry: Volume 1: Fundamentals, Modern Techniques, and Applications,
 Pharmacognosy and Phytochemistry – I,
 Medicinal Chemistry by Ashutosh Kar,
 An Introduction to Medicinal Chemistry,

e-Learning Source:

<https://medlineplus.gov/vitamins.html>
https://www.health.harvard.edu/staying-healthy/listing_of_vitamins
<https://medlineplus.gov/steroids.html>
<https://www.versusarthritis.org/about-arthritis/treatments/drugs/steroids/>

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	-	2	1	2	2	3	3	-	2	-
CO2	3	3	-	2	1	3	2	3	3	-	2	-
CO3	3	2	-	3	1	3	2	3	3	-	2	-
CO4	3	3	-	3	1	3	2	3	3	-	3	-
CO5	2	2	-	2	1	2	1	2	2	-	2	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH304	Title of the Course	Unit Operation in Chemical Industry	L	T	P	C
Year	Third	Semester	Fifth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	The purpose of this course is to develop the deep understanding of theory distillation and several column separations techniques and to comprehend the filtration and drying of mixed component in a binary/ ternary component with the context of industrial separation techniques including solid state chemistry with nucleation, growth and crystallization mechanism of solid crystal for industrial perspective.						

Course Outcomes	
CO1	Students will develop an understanding of the application of an analysis related to a question of relevance based on experience in distillation.
CO2	Based on their evaluation experience, students will have a grasp of how to apply an analysis to a relevant question.
CO3	Students will be able to understand about the ingredients of filtering and drying of the commercial products.
CO4	Students will have a firm foundation in the fundamentals and applications of crystallization process.
CO5	Students will gain an understanding of extraction of the compounds in mixtures.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Distillation	Introduction, Bath and continuous distillation, Separation of azeotropes, Plates columns and packed columns Absorption: Introduction: Equipments- packed columns spray Columns, bubble columns, packed bubble columns, mechanically agitated contractors.	8	1
2	Evaporation	Introduction, equipment's- short tube (standard) Evaporator forced circulation evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporator.	8	2
3	Filtration	Filtration: Introduction, filter media and filter aids, equipment's- plate and frame filter press, notch filter, rotary drum filter, sparkler filter, candle filter, bag filter, centrifuge Drying: Introduction, free moisture, bound moisture drying curve; equipment's- tray dryer, rotary dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer.	8	3
4	Crystallization	Introduction: solubility, super-saturation nucleation, crystal growth; Equipment- tank crystallizer, agitated crystallizer, evaporator, crystallizer, draft tube crystallizer.	8	4
5	Extraction	Introduction: selection of solvent; Equipments- Spray column, packed column rotating disc column, mixer-settler. Mixing- Introduction; mixing of liquid-liquid solid- Solid, liquid-solid systems.	8	5

Reference Books:	
Textbook of Pharmacognosy and Phytochemistry,	
A Textbook of Pharmacognosy and Phytochemistry,	
Phytochemistry: Volume 1: Fundamentals, Modern Techniques, and Applications,	
Pharmacognosy and Phytochemistry – I,	
Medicinal Chemistry by Ashutosh Kar,	
An Introduction to Medicinal Chemistry,	
e-Learning Source:	
https://sites.google.com/a/sdsenthil.com/chemical-technology/chemical-processing-unit-operation	
https://ceng.tu.edu.iq/ched/images/lectures/chem-lec/st4/c5/lec%201.pdf	
https://www.unibo.it/en/teaching/course-unit-catalogue/course-unit/2016/367440	
https://www.youtube.com/watch?v=H_Nc7SJwDco	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	2	1	2	3	3	3	-	2	1
CO2	3	3	-	2	1	2	3	3	3	-	3	1
CO3	3	3	-	3	1	2	3	3	3	-	3	1
CO4	3	3	-	3	1	2	3	3	3	-	2	1
CO5	2	2	-	2	1	2	3	3	3	-	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH305	Title of the Course	Pulp, Paper, Leather and Textile Industry	L	T	P	C
Year	Third	Semester	Fifth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	To provide a basic understanding of the nature of chemical materials and the emerging trend. In addition, it seeks to address the massive drive to understand these materials and improve their properties in order to meet material requirements.						

Course Outcomes	
CO1	Student will be able to apply the knowledge to produce various types of pulp and papers.
CO2	Student will be able know the processing techniques to produce special types of papers.
CO3	Student will be able to demonstrate the basic mechanism and processes involved in leather industry.
CO4	Student will be able to know about a challenge which arises from leather industries and their handling.
CO5	Student will able to know about Indian industries and products.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Pulp and paper	Introduction - Manufacture of pulp, Sulphate or Kraft pulp, Soda pulp, Sulphite pulp Rag pulp, Beating, refining, filling, sizing and coloring , manufacture of paper and paper making additives; processing aids, functional additives, strength additives and binders.	8	1
2	Special types of papers and their manufacturing process	Ammonia paper, Art paper, Bituminized water proof paper, Emery Paper, Toilet paper, Wall paper , Wax coated paper and polymeric modified papers.	8	2
3	Leather Industry-I	Introduction - Constituents of Animal Skin - Preparing skins and hides - Cleaning and soaking - Liming and degreasing.	8	3
4	Leather Industry-II	Introduction, Manufacture of leather, Preparation of hides for tanning, Vegetable, chrome and oil tanning - Byproduct.	8	4
5	Textiles Chemistry	Indian textile industries, general consideration of textile fibres: cotton, wool, silk, and rayon fibres; General considerations of synthetic fibres; Indetification of textile fibres; Water soluble resins, and epoxy resins.	8	5

Reference Books:

- Chemical process industries N.R Nerris shreve
- Chemical process principales: part I & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)
- Shrev's Chemical process Industries: 5th edition – George T. Austin, Mc Graw Hill Book Co.
- Handbook of industrial chemistry: Volume I & II , KH Davis , FS Berner, CBS Publication.
- Plastic Additives Technology Hand Book: Himadri Panda, Engineers India Research Institute.
- Industrial Chemistry B.K.Sharma, goel publishing house

e-Learning Source:

- <https://www.youtube.com/watch?v=4pWBknxLTYw>
- <https://www.youtube.com/watch?v=z6QnUCc7ZCg>
- https://www.youtube.com/watch?v=5Lusmpg_TdA
- <https://www.youtube.com/watch?v=Lu31Zt8f3xo>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	2	1	3	3	3	3	-	3	-
CO2	2	2	-	1	1	2	2	3	2	-	2	-
CO3	3	3	-	2	1	3	3	3	3	-	3	-
CO4	2	2	-	1	1	2	2	3	2	-	2	-
CO5	3	3	-	2	1	3	3	3	3	-	3	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH306	Title of the Course	Dyes	L	T	P	C
Year	Third	Semester	Fifth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Students will be able to understand era and history, color and chemical constitution Develop basic chemical reaction and synthesis of azodyes and applications of some typically used dye.						

Course Outcomes	
CO1	Remember the era of dyes and synthesis of benzene intermediates.
CO2	Understand the chemistry of the dyes with respect to general structural features, mode of application to fiber, color shades, classification, mode of application, Color and chemical constitution
CO3	Able to evaluate different types of Anthraquinone Dyes like Anthraquinone mordant dyes, Anthraquinone vat dyes, Anthraquinone acid dyes, Anthraquinone Disperse dye.
CO4	Able to create basic Knowledge of azodyes, Diazotization, Diazo Coupling, Acidic azo dyes, Basic azo dyes, Direct or substantive azodyes, Mordant azodyes
CO5	Analyze the important applications of Phenolphthalein, fluorescein, Eosin, Malachite green, Methylene blue, Indigo. Naphthol yellow-S, Crystal violet, fibres; Water soluble resins, and epoxy resins.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Chemistry of intermediates	Introduction of the History of Dyes. Landmarks in the historical development from Natural to synthetic dyes. Benzene intermediates-Chloronitrobenzenes, Nitroanilines, Bromonitroanilines, Nitroanisole.	8	1
2	Classification	Introduction and classification of dyes on the basis of structure and the mode of application to the fibre. Colour and chemical constitution of dyes; Chemistry of the dyes with respect to general structural features, mode of application to fibre, colour shades, synthesis of typical 4-5 dyes., uses.	8	2
3	Anthraquinone dyes	Anthraquinone mordant dyes; Alizarin, Alizarin Orange, Alizarin Red S. Anthraquinone vat dyes; Indanthrone blue, Pyranthrone. Anthraquinone acid dyes, Anthraquinone Disperse dye.	8	3
4	Azo dyes	Diazotization, Diazo Coupling, Types of Azo dyes; Acidic azo dyes (Methyl Orange, Tartrazine). Basic azo dyes; aniline, butter yellow. Direct or substantive azodyes; Congored. Ingrain azodyes; para red. Mordant azodyes; Eriochrome Black-T. synthetic fibre dyes; red disperse dye.	8	4
5	Miscellaneous dyes	Structure and uses; Phenolphthalein, fluorescein, Eosin, Malachite green, Methylene blue, Indigo. Naphthol yellow-S, Crystal violet.	8	5

Reference Books:

- The Complete Book on Natural Dyes & Pigments, ISBN:9788178330327, 8178330326
- Dyes, Colors & Pigments By Tarek Ismail Kakhia
- Dyes and Pigments Novel Applications and Waste Treatment, ISBN:9781839686146, 1839686146
- Handbook of industrial chemistry: Volume I & II , KH Davis , FS Berner, CBS Publication.
- Industrial Dyes Chemistry, Properties, Applications, ISBN:9783527606061, 3527606068
- Industrial Chemistry B.K.Sharma, goel publishing house

e-Learning Source:

- <https://www.britannica.com/technology/dye>
- <https://www.ncbi.nlm.nih.gov/books/NBK385442/>
- <https://www.worldofchemicals.com/407/chemistry-articles/colors-family-inks-dyes-and-pigments.html>
- <https://textilelearner.blogspot.com/2015/01/different-types-of-dyes-with-chemical.html>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
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CO3	3	3	-	2	1	2	2	3	3	-	3	1
CO4	3	3	-	2	1	2	2	3	3	-	3	1
CO5	2	2	-	1	1	1	1	2	2	-	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH307	Title of the Course	Industrial Chemistry Lab – 5	L	T	P	C
Year	Second	Semester	Fourth	0	0	8	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Student will be able to work effectively and safely in a laboratory environment, practical/technical/ communication skills, and concepts to solve qualitative and quantitative problems, transferable skills like ability to work in teams as well as independently.						

Course Outcomes	
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.
CO2	Able to Evaluate water quality parameters like DO, BOD, COD, TDS and alkalinity.
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO4	Explain the principles of chromatographic techniques.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
	Experiments	1. Separation of amino acid by Thin layer chromatography. 2. Separation of amino acid by paper chromatography. 3. Separation of sugar by Thin layer chromatography. 4. Isolation of lactose & casein. 5. Isolation of lycopene from tomato. 6. Isolation of caffeine from tea. 7. Isolation of piperine from black pepper. 8. Isolation of eugenol from cloves. 9. Isolation of nicotine from tobacco. 10. Determination of protein content of food. 11. Determination of fat content of food. 12. Determination of acetic acid content of vinegar. 13. Determination of acid value of oil. 14. Preparation of methyl orange.	40	1, 2, 3, 4, 5

Reference Books:

Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition.

Practical Organic Chemistry, A.I.Vogel.

Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.

Experimental Inorganic Chemistry –W.G.Palmer.

e-Learning Source:

<https://www.youtube.com/watch?v=MTsn1-ToKqQ2>.

http://www.bellevuecollege.edu/wp-content/uploads/sites/140/2014/06/aspirin_tablets_titration.pdf

<https://www.frontiersin.org/articles/10.3389/fonc.2015.00196/full>

<https://www.youtube.com/watch?v=1tmqUVSVPo4>

<https://www.youtube.com/watch?v=KZ35K05SA7g>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
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CO2	3	3	-	2	1	2	3	3	2	1	2	2
CO3	2	2	-	1	1	1	2	3	3	1	3	3
CO4	2	2	-	1	1	1	2	3	2	1	2	2
CO5	3	3	-	2	1	2	3	3	3	1	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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DEPARTMENT OF CHEMISTRY

Bachelor of Science (Industrial Chemistry)

6th Semester

Syllabi



Integral University, Lucknow

Effective From Session: 2017-2018							
Course Code	CH308	Title of the Course	Spectroscopic Techniques	L	T	P	C
Year	Third	Semester	Sixth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Students able to understand the interaction of electromagnetic radiation with the materials, spectroscopic techniques like Ultraviolet, FT-IR, Nuclear Magnetic Resonance spectroscopy and mass spectrometry.						

Course Outcomes	
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry and atomic absorption spectrophotometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), McLafferty rearrangements.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Uv spectroscopy	Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules; unsaturated carbonyl compounds, conjugated dienes and polyenes.	8	1
2	Ir spectroscopy	Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, characteristic vibrational frequencies of some organic compounds.	8	2
3	Nmr spectroscopy	Introduction, theory of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling,, Interpretation of NMR spectra of some representative compounds.	8	3
4	Mass spectroscopy	Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols and amines, ketones, aldehydes, esters, acids, anhydrides), molecular ion peak, metastable peak, McLafferty rearrangements, Nitrogen rule.	8	4
5	Atomic absorption spectrophotometry	Introduction, Principle, Instrumentation, Sample preparation, Internal standard and standard addition, calibration and applications of AAS.	8	5

Reference Books:

- Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole.
- Spectroscopic methods in organic chemistry: H. Williams and Ian Fleming, 5th Edition Tata Mc Grawhills
- Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications.
- Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.
- Principles and practice of analytical chemistry, F. W. Fifeild, D. Kealey, 5th edition, Blackwell publication.
- Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication.
- Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers.

e-Learning Source:

- <https://www.youtube.com/watch?v=2Y8pSoS0d1g>
- <http://www.infocobuild.com/education/audio-video-courses/chemistry/ApplicationOfSpectroscopicMethods-IIT-Madras/lecture-25.html>
- <https://scrippslabs.com/summary-of-spectroscopic-techniques/>
- <https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	2	1	3	3	3	2	-	2	-
CO2	3	2	-	2	1	2	3	3	2	-	2	-
CO3	3	2	-	3	1	3	3	3	2	-	2	-
CO4	2	3	-	2	1	3	3	3	2	-	2	-
CO5	3	2	-	2	1	3	2	3	2	-	2	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective From Session: 2017-2018							
Course Code	CH309	Title of the Course	Chemical Process Industry	L	T	P	C
Year	Third	Semester	Sixth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	The main objective of this course is to study the composition, preparation, properties and uses of ammonia, nitric acid, phosphorus chemical, glass, cement, ceramics and refractories and their related toxic hazards on the health of consumer.						

Course Outcomes	
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.
CO3	Understand the composition of glass and their types, properties and uses.
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.
CO5	Understand the classification, properties and uses of ceramics and refractories and their respective characteristics.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Synthetic nitrogen products	Ammonia, nitric acid, ammonium nitrate and ammonium sulphate their manufacture with reference to; consumption Pattern, Raw materials, Production process, Quality control, Hazards and safety and Effluent management.	8	1
2	Chlorine – alkali Industrial products	Caustic soda Chlorine. Phosphorus chemicals; Phosphorus, phosphoric acid, ammonium phosphate, superphosphate, triple superphosphate. Lime, gypsum, Silicon, calcium carbide.	8	2
3	Glass	Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture and Uses.	8	3
4	Cement	Introduction, Composition, Types of cement, Portland cement; raw Materials, manufacture of Cement by wet & Dry process, Reaction in the Kiln, setting of cement, Testing & Uses of cement.	8	4
5	Ceramics and refractories	Introduction, Types of ceramics materials, properties and applications. Refractories, classification of refractories, characteristics of refractories materials, properties of refractories. Neutral refractories; Silicon carbide. Acid refractories; High Alumina refractories.	8	5

Reference Books:	
Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960.	
Groggins P.M., Unit Process in Organic Synthesis, 5th edition, International student edition, Pubs: McGraw-Hill Book Co., New York, 1998.	
Dryden's outlines of Chemical Technology, edited and revised by Gopala Rao M. and Marshall S, Pubs: East-West Press, New Delhi, 2004.	
Industrial Chemistry B.K.Sharma, goel publishing house.	
Chemical process industries N.R Nerris shreve.	
Chemical process principales: part I & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)	
e-Learning Source:	
https://encyclopedia2.thefreedictionary.com/chemical+process+industry	
https://www.youtube.com/watch?v=RjZJneJ5fk	
https://www.chemicalprocessing.com/	
https://www.britannica.com/science/phosphorus-chemical-element	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	1	1	3	3	3	3	-	1	3
CO2	2	3	-	1	1	2	2	3	3	-	1	3
CO3	2	2	-	1	1	2	2	2	2	-	1	2
CO4	3	3	-	2	1	2	2	3	3	-	1	3
CO5	3	3	-	2	1	2	2	3	3	-	1	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective From Session: 2017-2018							
Course Code	CH310	Title of the Course	Fundamental Of Food Chemistry	L	T	P	C
Year	Third	Semester	Sixth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	The course focuses on providing knowledge of food constituents, food additives and food processing techniques. The study of food laws and standards appraise students about quality and safety assurance and food related hazards.						

Course Outcomes	
CO1	Understanding of Indian food law and food standards, value of quality assurance and safety assurance
CO2	Comprehension of chemical structure, properties and argue importance of food components, including carbohydrates, protein, lipids, vitamins and minerals.
CO3	Describe the principles in food processing techniques and differentiate food preservation methods like heat preservation and cold preservation, food packaging
CO4	Able to explain different types of food additives with examples and judge its value in real life.
CO5	Analyze the importance of food safety and food related physical, chemical and biological hazards.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Governmental regulations	Introduction, Food laws and standards: Indian food safety laws and standards; Quality and safety assurance in food industry; BIS Laboratory Services and Certification by BIS.	8	1
2	Constituents of food and their nutritive aspects	Carbohydrates, Proteins, Fats and oils, Vitamins and Minerals.	8	2
3	Food processing techniques	Common unit operations, Food deterioration and their control; Heat preservation and processing, Cold preservation and processing Food dehydration, Food concentration & food packaging.	8	3
4	Food additives	Preservatives, Antioxidants, Chelating agents, Surface active agents, Stabilizing and Thickening agents, Buffering agents, Colouring agents, Sweetening agents & Flavoring agents.	8	4
5	Food safety, risks and hazards	Food related Hazards, Microbiological Considerations in food safety, Effects of processing and storage on microbial safety, Chemical hazards associated with foods, Prevention methods from food born disease.	8	5

Reference Books:

- Food Chemistry, Belitz and Gosch, Springer – Verlag Bertin Heiderberg, 2nd Edition, 1999
- Principles of Human Nutrition, Martin Eastwood, Chapman and Hall, London, I Edition, 1997.
- Food – The Chemistry of its Components, T.P. Coultate, Royal Soc. Chemistry, 4th Edition, 2002.
- Food additives, Branan, Alfred Larry, Davidson P. Michae, Food Science and Technology series (35), Morcel Dekker, Inc, 1990.
- Introduction to food science, Rick Parker, Delmar Learning, U.S.A, I Edition, 2003.
- Nutrition Science and application, Lori Smolin L.A., Saunders College Publishing, 3rd Edition.

e-Learning Source:

- <http://www.basicknowledge101.com/pdf/Food%20chemistry.pdf>
- <https://courses.foodcrumbles.com/courses/food-chemistry-basics/>
- <https://www.cabdirect.org/cabdirect/abstract/19710406009>
- <https://byjus.com/chemistry/food-chemistry/>

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	1	1	3	3	3	3	-	3	-
CO2	3	2	-	2	1	2	2	3	2	-	2	-
CO3	3	3	-	1	1	3	2	3	3	-	3	-
CO4	3	3	-	1	1	3	3	3	3	-	3	-
CO5	3	2	-	2	1	2	3	3	3	-	2	-

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective From Session: 2017-2018							
Course Code	CH311	Title of the Course	Dairy Chemistry	L	T	P	C
Year	Third	Semester	Sixth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	To introduce students to an understanding of the chemistry of milk constituents. Milk and various dairy products are discussed from the perspective of the chemical, physical and biological changes that occur during processing.						

Course Outcomes	
CO1	Students will be able to describe the composition of milk, identify the approximate content of individual types present
CO2	Students will integrate their knowledge of food chemistry and describe physicochemical characteristics of the main components.
CO3	Student will be able to explain how dairy products (such as fluid milk, yogurt, butter, powder, cheese) are made and the key functions of the processing steps involved.
CO4	Student will be able explain and apply the processing techniques to produce milk products such as butter, cream, ghee etc. and also detect the adulteration.
CO5	Students will integrate their knowledge of food chemistry to produce fermented milk products such as ice-creams milk powder etc.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Definition, Composition, Milk lipids, Milk proteins, vitamins and minerals. Factors affecting the composition of milk, adulterants, preservatives.	8	1
2	Properties of milk	Carbohydrates, Proteins, Fats and oils, Vitamins and Minerals.	8	2
3	Processing of milk	Effect of heat on milk, chemical changes taking place in milk due to processing, sterilization, homogenization and pasteurization, vacuum pasteurization and Ultra high temperature pasteurization.	8	3
4	Milk products	Cream; definition, chemistry of creaming process. Butter; definition, composition, theory of churning, desi-butter, salted butter. Ghee; major constituents, common adulterants and their detection.	8	4
5	Fermentaed milk products	Fermentation of milk; definition and conditions. Ice-creams. Composition, types, manufactures of ice - cream, stabilizers, emulsifiers, and their role. Milk powder, process of making milk powder.	8	5

Reference Books:	
Applied Chemistry-K.Bagavathi Sundari MJP Publishers Chennai. 2006.	
Principles of dairy technology - Robert Jenness	
Indian Dairy Products - Rangappa and Acharya, K.T.	
Fundamentals of Dairy chemistry - Wond. F.P. Springer.	
Outlines of Dairy Technology - Sukumar De. – Oxford University Press.	
Applied chemistry for home science & allied science - T.Jacob, Mcmillan.	
e-Learning Source:	
https://www.youtube.com/watch?v=S4brYhScYlc	
http://ouat.nic.in/sites/default/files/2-properties_of_milk_dairy_and_food_engineering.pdf	
https://www.youtube.com/watch?v=iAaRs4vM8x8	
https://www.youtube.com/watch?v=QvSw68wJpqqw	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	-	1	1	3	3	3	3	-	2	1
CO2	3	3	-	2	1	3	3	3	3	-	3	1
CO3	3	2	-	1	1	3	3	3	3	-	2	1
CO4	2	2	-	1	1	2	2	3	3	-	2	1
CO5	2	2	-	1	1	2	2	3	3	-	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CH312	Title of the Course	Project Training (3 Months)	L	T	P	C
Year	Third	Semester	Sixth	0	0	0	4
Pre-Requisite	10+2 with Chemistry	Co-requisite	-				
Course Objectives	Student will be able to work effectively and safely in a laboratory environment, practical/technical/ communication skills, and concepts to solve qualitative and quantitative problems, transferable skills like ability to work in teams as well as independently.						

Course Outcomes	
CO1	Hands on training
CO2	Integrate classroom theory with laboratory scale practice.
CO3	Understanding professional ethics of industry and code of conduct.
CO4	Explain the principles of analytical techniques and laboratory handling.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)												
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	1	3	3	3	3	2	3	3
CO2	3	3	1	3	1	3	3	3	3	2	3	3
CO3	3	3	1	2	1	2	2	3	3	2	3	3
CO4	3	2	1	2	1	2	2	3	2	2	3	3
CO5	3	2	1	3	1	3	3	3	2	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	CH313	Title of the Course	Seminar	L	T	P	C
Year	Second	Semester	Sixth	0	0	4	2
Pre-Requisite	10+2	Co-requisite	-				
Course Objectives	<ul style="list-style-type: none"> To develop students' communication and discussion skills Increase vocabulary knowledge, learn about communication style, develop learner autonomy. To build confidence to use English for oral presentation. To develop the ability to seek clarification and defend the ideas of others effectively. 						

Course Outcomes	
CO1	To develop and improve the communication skills
CO2	To develop discussion and leadership abilities
CO3	Skills for the development of demonstration abilities
CO4	To develop skills for effective power point presentation
CO5	To understand importance of gestures and body language during presentation

Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	1	-	2	-	-	3		3	2	2	3
CO2	3	3	2	-	2	2	-	3	1	2	2	1	3
CO3	3	3	1	-	1	2	-	3	2	2	2	1	3
CO4	3	3	1	-	1	2	-	3	2	2	2	2	3
CO5	3	3	1	-	1	1	-	3		2	1	-	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
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