DEPARTMENT OF CHEMISTRY

Bachelor of Science

(Industrial Chemistry)

3rd Semester

Syllabi

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH201	**Title of the Course**	Industrial Aspects of Physical Chemistry	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	The purpose of this course is to study the use of simple models for predictive understanding of physical phenomena associated to chemical thermodynamics and adsorption and absorption kinetics and to develop deep understanding of theory for degradation and corrosion of materials in various environments and to present existing protection strategies for prevention of corrosion in different contexts with kinetics.						

Course Outcomes	
CO1	Students will gain an understanding of the thermodynamic and kinetic forces involved in chemical reactions which determine how much and how soon products are formed.
CO2	Students will be able to evaluate the chemical kinetics, how reaction rates are measured and represented in rate laws, and applications of chemical kinetics in studying enzyme mechanisms.
CO3	Students will gain an understanding of methods for determining molecular mass based upon colligative properties.
CO4	Students will create the own understanding approaches to the finding of unknown composition of analyte from critical solute temperature graph.
CO5	Students will gain an understanding of approaches to the development of dry & wet corrosion and its prevention.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Adsorption	Physisorption and Chemisorptions, Applications of adsorption, Adsorption of gases by solids, Freundlich adsorption isotherm, Langmuir's theory of adsorption, BET theory of multilayer adsorption, Determination of surface area, Adsorption isotherms.	8	1
2	Catalysis	General characteristics of catalytic reactions Acid-base catalysis, Enzyme catalysis, Mechanism and kinetics of enzyme catalyzed reactions, Michaelis-Menten equation, Effect of temperature on enzyme catalysis, Heterogeneous catalysis, Surface reactions, Kinetics of surface reactions.	8	1,2
3	Colligative Properties	Lowering of vapour pressure, Raoult's law, Determination of molecular mass of solute from lowering of vapour pressure, Elevation of boiling point, Relation between elevation of boiling point and lowering of vapour pressure, Determination of molecular mass of solute from elevation of boiling point, Depression of freezing point, Relation between depression of freezing point and lowering of vapour pressure, Determination of molecular mass of solute from depression of freezing point, Osmosis and osmotic pressure, van't Hoff's equation.	8	3
4	Azeotropic Mixtures	Distillation of immiscible liquids, Solubility of partially miscible liquids, Phenol water system, CST and effect of impurities on CST.	8	1,4
5	Corrosion and its control	Introduction, Economic aspects of corrosion, Dry or Chemical Corrosion, Wet or electrochemical corrosion, Mechanism of Electrochemical Corrosion, Prevention from corrosion.	8	1,5

Reference Books:

Admson, A.W., Physical Chemistry of Surfaces, 4th edition, Pubs: John Wiely & Sons, New York, 1982.
Austin H. T., Shreve's Chemical Process Industries, Pubs: McGraw Hill Book Company, New York(1984).
Kent James A. (ed.), Reigel's Handbook of Industrial Chemistry, Pubs: Van Nostrand inhold Company, London (1983).
Pandey C.N., Text Book of Chemical Technology, Vol. I & II, Pubs: Vikas Publishing House, Pvt. Ltd., New Delhi (1999).
Buchner V., Sohliebs P., Winter G. & Buchel K.H., PhysicalS Chemistry, Pubs: V. Ch. Publishers, New York (1989).

e-Learning Source:

http://nsdl.niscair.res.in/jspui/handle/123456789/351
https://pubs.acs.org/doi/full/10.1021/ie50157a002
https://www.omicsonline.org/industrial-chemistry.php
http://nsdl.niscair.res.in/jspui/handle/123456789/351?mode=full

	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	1	3	1	2	1
CO2	3	3	-	1	1	1	1	1	3	1	1	1
CO3	3	2	-	2	2	1	2	2	3	1	2	1
CO4	2	2	-	1	1	1	1	1	2	1	1	1
CO5	2	3	1	1	1	1	1	1	1	1	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH202	**Title of the Course**	Industrial Aspects of Inorganic Chemistry	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To acquaint the students with basic metallurgical processes and their applications in industries along with an overview of alloys, their applications and extraction of important metals from their ores.						

Course Outcomes	
CO1	Basic understanding of important aspects of inorganic chemistry application such as metallurgical processes is created among students.
CO2	How inorganic materials are important for industrial chemistry is evaluated through suitable examples.
CO3	Evaluation of commercial preparations of alloys, their merits and demerits and how they can be applied in industrial chemistry is done.
CO4	Importance and application of metallurgical processes in industrial chemistry is learnt.
CO5	Important applications of inorganic materials (zeolites, alumina etc.) and adhesive are evaluated by their reactions and properties.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Metallurgy	Basic metallurgical operations- crushing and pulverization, concentration, calcinations, roasting, types of roasting, reduction and refining.	8	1
2	Physico-chemical principles of extraction	Methods of extraction and refining of Copper, lead, aluminium and Zinc from their ores.	8	2
3	Inorganic materials of industrial importance	Availability, forms, structure and modification. Alumina, silica, silicates, zeolites.	8	2,3
4	Metals and alloys	Important metals and alloys, iron, copper, aluminium, lead, nickel, titanium and their alloys, mechanical and chemical properties and their applications.	8	3,4
5	Adhesive	Introduction, Classification of adhesives, adhesives action, development of adhesive strength, chemical factors influencing adhesive action. from corrosion.	8	4,5

Reference Books:

Austin H. T., Shreve's Chemical Process Industries, Pubs: McGraw Hill Book Company, New York (1984).

Kent James A. (ed.), Reigel's Handbook of Industrial Chemistry, Pubs: Van Nostrand Hold Company, London (1983).

Pandey C.N., Text Book of Chemical Technology, Vol. I & II Pubs: Vikas Publishing House, Pvt. Ltd., New Delhi (1999).

Buchner V., Sohliebs P., Winter G. & Buchel K.H., Industrial Inorganic Chemistry, Pubs: V. Ch. Publishers, New York (1989).

Fumer I.E. and Zaitsev V.N., General Chemical Engineering, Pubs: Mir Publishers, Moscow (1961).

Badger W.L. and Bancher J.T., Introduction to Chemical Engineering, Pubs: McGraw-Hill Co., U.S.A, 1986.

Buchner V., Sohliebs P., Winter G. & Buchel K.H., Industrial Inorganic Chemistry, Pubs: V. Ch. Publishers, New York (1989).

McCabe W.L. and Smith J.C., Unit Operations in Chemical Engineering, Pubs: McGraw-Hill Book Company, New York, 1984. 8. Perry J.H., Chemical Engineering.

e-Learning Source:

https://www.degruyter.com/view/title/304228

https://books.google.com/books/about/Industrial_inorganic_chemistry.html?id=y43xAAAAMAAJ

https://oer.avu.org/bitstream/handle/123456789/743/CHE%2012_EN%20Inorganic%20Chemistry.pdf?sequence=1&isAllowed=y

https://organic-chemistry.chemistryconferences.org/events-list/industrial-inorganic-chemistry

	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	3	-	1	1	1	2	3	2	2	1	2
CO2	2	3	-	2	-	1	2	3	3	2	1	1
CO3	1	3	-	1	-	2	2	3	2	2	2	1
CO4	2	2	-	2	1	1	3	2	2	1	1	2
CO5	2	2	-	2	-	1	3	2	1	1	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH203	**Title of the Course**	Industrial Aspects of Organic Chemistry	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To study the various properties and role of organometallic reagents in the synthesis of organic compounds such as Grignard reagents, organo- lithium, Zinc, Copper, Palladium, Nickel compounds, Lithium aluminum hydride, Sodium borohydride, Alkoxides, Boron aluminum hydride, Organo-silicon, Organo- palladium and Lithium organo-cuprates compounds. Also introduce the carbon nanotubes: synthesis, structure, characterization, mechanism, modification and applications.						

Course Outcomes	
CO1	The study of various techniques used in the organic synthesis gives additional strength and understanding regarding bio-transformations, enzyme-catalyzed and microwave-induced reactions.
CO2	To create the capability of the synthesis and applications of different organometallic reagents such as Grignard reagents, Organo-lithium, Zinc, Copper, Palladium and Nickel compounds along with homogeneous catalytic reactions, hydrogenation and hydroformylation.
CO3	Students can analyze the synthesis and applications of organo-silicon, Organo-palladium and lithium organo-cuprates compounds.
CO4	Evaluation and analysis of various chemical reactions: reduction with Lithium aluminum hydride, Sodium borohydride, Alkoxides, Boron aluminum hydride creates a new dimension in the study. Dissolving metal reductions and non-metallic reducing reactions also an additional benefit.
CO5	Synthesis, structure, characterization, mechanism, modification and applications carbon nanotubes give additional support to the students to understand the carbon nanotubes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Techniques in organic synthesis	Bio-tranformatons – Enzyme catalysed reactions, Microwave induced reactions- Principle, conditions, advantages over conventional heating methods- Applications, sonication.	8	1
2	Organometallic reagents	Synthesis and applications of Grignard reagents-organolithium, Zinc, Copper, Palladium, Nickel compounds in organic synthesis- Homogeneous catalytic reactions hydrogenation, hydroformylation.	8	1, 2
3	Methods in organic synthesis –I	Organosilicon Compounds: Preparation and applications in organic synthesis; Applications of Pd (0) and Pd (II) complexes in organic synthesis- Suzuki and Sonogashira coupling, Heck reaction, Preparation and applications of lithium organocuparates.	8	3
4	Methods in organic synthesis – II	Reduction with lithium aluminium hydride, sodium borohydride, alkoxides, bismethoxyethoxyaluminium hydride, boron aluminium hydride and derivatives-catalytic metal hydrogenation-dissolving metal reductions, Non-metallic reducing agents including enzymatic and microbial reductions.	8	4
5	Carbon nanotubes	Synthesis, Single walled carbon nanotubes, Structure and characterization, Mechanism of formation, chemically modified carbon nanotubes, Doping, Functionalizing nanotubes, Applications of carbon nanotubes.	8	5

Reference Books:

McCabe W.L. and Smith J.C., Unit Operations in Chemical Engineering, Pubs:McGraw-Hill Book Company, New York,1984.

Perry J.H., Chemical Engineering Handbook, Pubs: McGraw-Hill Book Company, NewYork, 1993.

Rao, C. N. R, Muller,A and Cheetam, A.K. (Eds) (2004): The Chemistry of Nanomaterials, Vol.1, and 2, Wiley – VCH, Weinheim.

Poole,C. P and Owens,Jr: F. J (2003): Introduction to Nanotechnology Wiley Interscience, New Jersey.

Kenneth J. Klabunde (Ed) (2001), Nanoscale materials in Chemistry, WileyInterscience, New York.

Cary, F. A and Sundberg,R. I. (2009) :Advanced Organic Chemistry, Part A and B, 5th Edition, Springer.

e-Learning Source:

https://www.chem.ubc.ca/chemistry-412-industrial-organic-chemistry

https://www.britannica.com/technology/chemical-industry/Organic-chemicals.

http://www.uab.cat/guiesdocents/2019-20/g102495a2019-20iENG.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	3	2	3	-	1	3	2	3	1	2	1
CO2	2	3	1	2	-	2	2	1	2	1	2	2
CO3	3	3	1	3	-	2	3	2	3	1	2	1
CO4	3	3	2	3	-	2	3	2	3	1	2	2
CO5	2	2	1	2	-	2	2	1	2	1	2	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH204	**Title of the Course**	Materials and Energy Balance	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	The purpose of this course is to study the basic concepts of mole, significant figures, solution chemistry and understanding the principles of solving problems on molarity, normality mole fraction concept etc. Thereafter apply the materials balance & energy balance concept and its calculations to chemical industries unit operations.						

Course Outcomes	
CO1	Students will be able to analyze the mathematical interdisciplinary numerical problem and chemical reactions and strategies to balance them.
CO2	Students will be able to evaluate the solution chemistry numerical for titrimetric analysis.
CO3	Students will have a firm foundation in the fundamentals and application of Choice of system and basis of molecular processes with chemical reactions.
CO4	Students will have a firm foundation in the fundamentals & applications materials and energy balance for the particular reaction and its scheme.
CO5	Students will be able to clearly communicate the results of scientific work in chemical engineering operations such as distillation, evaporation, absorption and crystallization.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Units and dimensions	Introduction, Dimensions & Systems of Units, Fundamental quantities, Derived Quantities, Conversions & Problems.	8	1, 2
2	Basic chemical calculation	Introduction, Concept of atom, Mole and mole fraction, Methods of expressing the composition of mixtures (mass percent, volume percent, mole percent), equivalent weight, normality, molarity, molality.	8	1, 2
3	Material balance	Process classification, Choice of system and basis of molecular processes with chemical reactions, Material balance calculations, multiple unit processes, Recycle and bypass.	8	3,4
4	Energy balance	Energy balance: Forms of energy, Energy balance, Energy changes in physical processes, Energy changes in reactions, Energy balance Calculations.	8	3,4
5	Material balance without chemical reactions	Material Balance without chemical reactions: Flow diagram for material balance, simple material balance without recycles or bypass for chemical engineering operations such as distillation, evaporation, absorption and crystallization.	8	5

Reference Books:

B.I. and Vora S.M., Stoichiometry, 3rd edition, Pubs: Tata McGraw-Hill Publishing Company Ltd. New Delhi, 1984.

Badger W.L. and Bancher J.T., Introduction to Chemical Engineering, Pubs: McGraw-Hill Co., U.S.A, 1986.

McCabe W.L.and Smith J.C., Unit Operations in Chemical Engineering, Pubs: McGraw-Hill Book Company, New York, 1984.

Perry J.H., Chemical Engineering Handbook, Pubs: McGraw-Hill Book Company, New York, 1993.

Himmelbkeause D.M., Basic principles and catenations of chemical Engineering, 6th edition, Pubs: Prentic Hall, 2003.

e-Learning Source:

https://onlinelibrary.wiley.com/doi/book/10.1002/9781118237786

https://beeindia.gov.in/sites/default/files/1Ch4.pdf

https://www.sanfoundry.com/best-reference-books-material-energy-balance-calculations/

https://books.google.com/books/about/Handbook_on_Material_and_Energy_Balance.html?id=9l3o1K2B26QC

	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	1	2	1	2	-	1	2	2	2	1	1	1
CO2	1	2	1	2	-	1	3	3	2	1	1	1
CO3	2	3	2	3	-	2	3	3	2	2	1	2
CO4	2	3	1	3	-	2	3	3	2	2	1	2
CO5	2	2	1	2	-	1	2	2	2	1	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH205	**Title of the Course**	Industrial Aspects of Microbiology	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	The main objective of this course is to study the classification and nomenclature of microorganisms, culturing and preservation of microbes, basic concept of fermentation, industrial contamination problems and production mechanism of industrial metabolites.						

Course Outcomes	
CO1	Students will be able to understand the concept of microorganism classification and nomenclature, general characteristics and importance of Viruses, Bacteria, Actinomycetes, algae and fungi and their applications in fermentation industry
CO2	Students will be able to grasp the concept Growth kinetics of microbes culturing and their preservation techniques as well as factors affecting the growth
CO3	Students will be introduced to fermentation: which includes general structure of a fermenter and its types. Build the firm foundation of USP & DSP and its purification methods
CO4	Evaluate mechanisms and process for the industrial production of metabolites such as Antibiotics, Enzymes, Solvents, Vitamins and Organic Acids.
CO5	Introduction to the concept of industrial contamination problems: microbiological examination of contaminants and their control through sterilization techniques.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Classification and nomenclature of microorganisms	Concept of kingdom-protista, prokaryotes and eukaryotes, Introduction to Microbial Diversity: General characteristics and importance of Viruses, Bacteria, Actinomycetes, algae and fungi. Use of microorganisms in fermentation industry.	8	1
2	Pure culture and preservation of microbes	Growth phases – kinetics, asynchronous, synchronous, batch and continuous culture. Factors affecting growth. Bacterial Nutrition & Fermentation media: Components, Natural and synthetic media. Microbiological Assay: Bioassay of growth supporting substances- Amino acids and Vitamins.	8	2, 3
3	Basic concepts of fermentation	Types of fermentation. General Structure of a Fermenter. Introduction to upstream and downstream processing. Unit operations in Downstream processing (DSP): Disintegration of cells, Separation, Extraction, Concentration and purification of products.	8	2, 3
4	Industrial production	Production of antibiotics- Penicillin and semi-synthetic penicillins. Production of enzymes- Amylase. Immobilization of enzymes and applications of immobilized enzymes. Production of solvent- Ethanol. Production of Vitamins- Cyanocobalamin. Production of Organic Acids- Acetic Acid. Production of Amino Acids- Glutamic Acid.	8	4, 5
5	Contamination problem in fermentation	Microbiological examination of water and common contaminant. Food poisoning. Control of microorganisms, Sterilization, inhibiting substances- Antibiotics, Minimum inhibitory concentration.	8	4, 5

Reference Books:

Medical Microbiology, Vol. 1: Microbial Infection, Vol. 2 : Practical Medical Microbiology, Authors- Mackie and McCartney.

Epidemiology and Infections, Author- Smith

Microbiology in Clinical Practice, Author- D.C. Shanson.

Diagnostic Microbiology, Authors- Baron, Peterson and Finegold.

Industrial Microbiology, Author- L. E. Cassida

e-Learning Source:

https://www.youtube.com/watch?v=V0BzQQCCwgo

https://www.youtube.com/watch?v=lm76h4h1R6k

https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology

https://courses.lumenlearning.com/boundless-microbiology/chapter/industrial-microbiology/

	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	1	2	-	3	2	3	2	-	2	1
CO2	3	3	1	2	-	2	1	2	1	-	2	1
CO3	2	3	1	2	-	3	2	3	2	-	2	1
CO4	3	3	2	3	-	2	3	2	1	1	3	2
CO5	2	2	1	2	-	3	1	3	2	1	3	2

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH206	**Title of the Course**	Biochemistry	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	Understand the concept of Biochemistry regarding BiomoleculesCarbohydrates, proteins, lipids, Nucleic acids, Enzymes.						

Course Outcomes	
CO1	The students will able to explain about the chemical structures of carbohydrate, and their classification and uses.
CO2	Student will able to know about amino acids and primary, secondary, tertiary, quaternary structure of proteins
CO3	The student will able to know about enzymes and their characteristics. They also will be able to know the importance of enzymes in chemical industries.
CO4	The students will explain the structure and function of lipids, circulating lipids and inflammatory lipid mediators etc.
CO5	The students will understand about the structure and function of nucleosides and nucleotides.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Carbohydrates	Introduction and classification, monosaccharide (glucose and fructose) physical and chemical properties and their uses. Disaccharides (Sucrose), Physical and chemical properties and their uses. Polysaccharides (Starch and Cellulose); Physical and Chemical Properties and their uses.	8	1
2	Amino acids, pptides and proptiens	Introduction, Classification, and Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitter ion and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.	8	2
3	Enzymes	Introduction and Characteristic features of enzymes. Factors influencing enzyme activity, Coenzymes, prosthetic group, Lock and key hypothesis, induced fit hypothesis. Introduction to Biocatalysis: Importance in "Chemical Industry.	8	3
4	Lipids	Introduction, Classification, Triglycerides, Fatty acids, Hydrogenation of Triglycerides, Saponification of Triglycerides, Reaction of carboxyl groups of fatty acids, Structure and Biological importance of Prostaglandins.	8	4
5	Nucleic acid	Introduction, Nucleosides and nucleotides; Heterocyclic aromatic amine bases, monosaccharides (D-ribose or 2-deoxy-D-ribose) and phosphate ions, Structure of primary and secondary (double helix model) of DNA.	8	5

Reference Books:

Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition, Pearson publication.

Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, Second edition, Oxford Publication.

Organic Chemistry by T.W.Graham Solomons, and Craig B. Fryhle, Ninth edition, Wiley Publication.

Organic Chemistry by IL Finar, Volume 1 & 2, Sixth edition, Pearson Publication.

J.M. Berg, J.L. Tymoczko and L. Stryer, Biochemistry, 6th Edn. W.H. Freeman and Co. (2006).

e-Learning Source:

https://www.youtube.com/watch?v=uM1t0mWXU30

https://www.youtube.com/watch?v=dKT_9AjO9BE

https://www.youtube.com/watch?v=Q6R4o-oECxs

https://www.youtube.com/watch?v=FoswKE7tUH8

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	-	2	3	2	2	1	1	3
CO2	3	3	1	2	-	2	3	2	2	1	1	3
CO3	3	3	1	2	-	2	3	2	2	1	1	3
CO4	3	3	1	2	-	2	3	2	2	1	1	3
CO5	3	3	1	2	-	2	3	2	2	1	1	3

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH207	**Title of the Course**	Industrial Chemistry Lab – 3	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	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 themanner which is required in laboratory.
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.
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. Determine the density or specific gravity of an unknown liquid. 2. To determine the water equivalent of calorimeter. 3. Conductometric titration. 4. Preparation of chrome alum. 5. Preparation of borax/ boric acid. 6. Estimatio n of Calcium in Chalk by permagnatometry. 7. To study the absorption of acid an activated charcoal. 8. To determine the pH of given HCl solution by using pH meter. 9. Microbiology and Biochemistry: a. Qualitative test of protein & amino acid by any two methods (Millon's test, Biuret test, Ninhydrin test, Xanthoprotein's test, hopkin'scole test). b. Qualitative test of carbohydrate by any two methods (Molish test, Fehling's test, Benedict's test, Barfoed's test, Phenyl Hydrazine test, iodine test, Seliwanoff's test, Music acid test, Bail's test, Nelson Somogy's method). c. Methods of sterilisation and preparation of various culture media. Identification of isolated bacteria, Gram staining and gram staining method. Find out the isoelectric point of protein. d. Protein separation by polyacrylamide gel electrophoresis. e. Enumeration of microorganism from water/soil sample, colony purification. f. Purification techniques serial dilution, pour plate and streak plate method	40	1, 2, 3, 4, 5

Reference Books:

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

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.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf

http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf

https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

https://www.stem.org.uk/resources/collection/3959/practical-chemistry

	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	2	1	2	2	1	2	-	-	2	3	3
CO3	3	3	2	3	2	1	3	-	-	1	3	3
CO4	3	2	1	2	1	-	2	-	-	1	2	2
CO5	3	2	1	2	1	1	2	-	-	1	3	3

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

DEPARTMENT OF CHEMISTRY

Bachelor of Science

(Industrial Chemistry)

4th Semester

Syllabi

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH208	**Title of the Course**	Polymer Science	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	Students will able to understand the history of macromolecular science, polymer, types and physical state of polymers, polymer processing techniques, mechanism of polymerization, synthesis and applications of polymers.						

Course Outcomes	
CO1	Remember the history of macromolecular science and basic definition of polymer, polymerization and functionality.
CO2	To know the Classification of polymers, cross-linked copolymers, tacticity, Physical state of polymer; crystallinity, Glass Transition Temperature.
CO3	To create basic Knowledge of the mechanism of addition, condensation, copolymerization, initiators, inhibitors and living polymers.
CO4	Able to evaluate different types of polymer processing techniques as moulding, spinning, calendaring, casting.
CO5	Analyze the importance of synthesis and applications of cross-linked copolymers, addition polymers, copolymers.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Brief history of macromlecular science, general characteristics of polymers, some basic definitions (functionality, polymer, polymerization, Homo and hetero chain polymers, copolymer).	8	1
2	Classification of polymers	Natural, synthetic, inorganic, organic, thermoplastics, thermosets, elastomers, fibres, speciality, linear, branched, cross-linked copolymers (random, alternative, block and graft), tacticity (isotactic, and atactic polymers), Physical state of polymer; crystallinity, Glass Transition Temperature	8	2
3	Types of polymerization	Addition polymerization (mechanism of free-radical, anionic and cationic polymerization), initiators, inhibitors, living polymers, condensation polymerization, copolymerization, coordination polymerization (bulk, suspension, emulsion, solution).	8	3
4	Polymer processing	Compounding, vulcanization reinforcement, calendering, die-casting, filmcasting, compression moulding, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, melt spinning.	8	4
5	Polymer processing Synthesis, properties and applications	Synthesis, properties and applications of polythelene, polypropylene, polytetrafluroethylene pyolystyrene, polyvinyl chloride, polyisoprene, polybutadiene, neoprene, buna-N, buna-s, phenolformal dehyde ureaformaldehyde, polyurethanes.	8	5

Reference Books:

Polymer chemistry by R.P.Rastogi et al

Principles of polymer chemistry by Puri and Pathan

Introduction of Polymer Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.

Simplified course in polymer Chemistry, Madan & Tuli, S. Chand & Co. Ltd.

Polymer Chemistry and characterization, Sharma , Vishal Publishing Co.

e-Learning Source:

http://chemistry-chemists.com/chemister/Polimers/polymer-science-and-technology.pdf

https://byjus.com/jee/polymers/

http://chemed.chem.purdue.edu/genchem/topicreview/bp/1polymer/types.html

https://www.britannica.com/science/polymer

	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	-	1	2	2	2	1	1	1
CO2	3	2	1	1	-	1	2	2	2	1	1	1
CO3	2	2	1	1	-	1	2	2	2	1	1	1
CO4	3	3	1	3	-	2	3	3	3	2	1	1
CO5	3	3	1	3	-	2	3	3	3	2	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH209	**Title of the Course**	Medicinal Drugs Chemistry	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To study the basic fundamentals of available drugs in various fields such as antibiotics, antipyretics, analgesics, antimalarial, cardiovascular and newer drugs for the newer disease.						

Course Outcomes	
CO1	Evaluation and study of introduction, examples and uses of various antibiotics such as β-Lactam, Aminoglycosides and Chloramphenicol provided a better understanding of the antibiotics.
CO2	Study of introduction, classification, synthesis and uses of antipyretics and analgesics like Paracetamol, Aspirin, Phenazone, Phenylbutazone along with Morphine and Codeine create more knowledge about their chemistry.
CO3	Overview, structure and uses of antimalarial drugs like Chloroquine phosphate, Primaquine phosphate, Isopentaquine, Proguanil HCl, Trimethoprim as well as some new antimalarial drugs like Artemisinin and Mefloquine HCl helpful to understand about the chemistry of
CO4	Introduction, classification, structure and uses of cardiovascular drugs such as Cardiac glycosides and Digitoxin; Antihypertensive drugs: Losartan and Methyldopa; Antiarrhythmic Agents: Lorcainide HCl and Verapamil HCl gives a better understanding and analyzing ability.
CO5	Knowledge regarding newer available drugs such as Misoprostol, probucol, Tamoxifen Citrate, Flutamide, Methimazole, Ethambutol Hydrochloride, Isoniazid, Rifampicin and Linezolid for the newer disease create more understanding and become essentials of modern life.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Antibiotics	Introduction, examples and uses of β-Lactam Antibiotics; Introduction, examples and uses of first, second, third and fourth generation Cephalosporins, Aminoglycosides and Chloramphenicol.	8	1
2	Antipyretics and analgesics	Introduction, examples and uses of β-Lactam Antibiotics; Introduction, examples and uses of first, second, third and fourth generation Cephalosporins, Aminoglycosides and Chloramphenicol.	8	2
3	Antimalerials	Introduction, structure and uses of antimalarial drugs; Chloroquine phosphate, Primaquine phosphate, Isopentaquine, Proguanil Hydrochloride, Trimethoprim. New Antimalarial Drugs; Artemisinin and mefloquine Hydrochloride.	8	3
4	Cardiovascular drugs	Introduction and Classification of Cardiovascular Drugs. Structure and uses: Cardiac glycosides; digoxin and digitoxin. Antihypertensive drugs; Losartan, Clonidine Hydrochloride, Methyldopa. Antiarrhythmic Agents; Lorcainide Hydrochloride, Propranolol Hydrochloride, Bretylium tosylate, Verapamil Hydrochloride.	8	4
5	Antiarrhythmic agents	Lorcainide Hydrochloride, Propranolol Hydrochloride, Bretylium tosylate, Verapamil Hydrochloride. Newer Drugs for Newer Disease: Introduction, Structure and uses: Misoprostol, probucol, Tamoxifen Citrate, Ethambutol Hydrochloride, Isoniazid,	8	5

Reference Books:

Medicinal chemistry by Chattwal et al

Fundamentals of medicinal chemistry by arora

Introduction of Medicinal Chemistry, Tuli, S. Chand & Co. Ltd.

Basics of Medicinal Chemistry, Madan & Tuli, S. Chand & Co. Ltd.

Medicinal Chemistry and Characterization, Sharma , Vishal Publishing Co.

e-Learning Source:

https://www.ysmubooks.am/uploads/Ph_Ch textbook.pdf

https://www.pharmacologicalsciences.us/medicinal-chemistry/classification-of-drugs.html

https://www.toppr.com/guides/chemistry/chemistry-in-everyday-life/drugs-and-their-classification/

https://www.britannica.com/science/drug

	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	2	-	2	3	2	2	1	-	1
CO2	3	2	2	3	-	3	3	2	3	2	-	2
CO3	3	2	1	2	-	2	3	3	2	1	-	1
CO4	3	2	2	3	-	3	3	3	3	2	-	2
CO5	2	2	1	2	-	2	3	2	2	1	-	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH210	**Title of the Course**	Petro – chemicals	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To provide the fundamental knowledge of origin, composition, exploration and desalting of crude oil with respect to its essentials, profile and methods of distillation. Also, introduce refining and cracking processes of petroleum. Similarly, study the preparations of different chemicals from petroleum.						

Course Outcomes	
CO1	Introduction of crude oil, exploratory methods, oil reservoirs, transportation of crude oil, the constitution of crude oil and natural gas create and enhance the understanding of the petrochemicals.
CO2	Study of the distillation of crude oil, separation of natural gas along with the meaning of terms such as-pour point depressants, drag reducers, viscosity reducers, flash point, octane number improve the evaluation and applications of petrochemicals.
CO3	Discussion of the different operations such as catalytic cracking, hydrocracking, isomerization, reforming and alkylation concerning the process, mechanism and catalyst used and their applications helpful to evaluate the quality of crude oil.
CO4	The study of various hydrocarbon fuels and their characteristics concerning the manufacturing of the ethylene, acetylene and propylene with their reactions and process diagrams provide new dimensions to the analysis.
CO5	Preparation of ethylene, ethanol, acetaldehyde, acetic acid, vinyl acetate, ethanolamines, and vinyl chloride enhance the knowledge to analyze these chemicals, its chemistry and applications.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of petrochemicals	Introduction to crude oil, exploratory methods, oil reservoirs, transportation of crude oil, Constitution of crude oil and Natural gas.	8	1
2	Distillation of petroleum	Distillation of crude oil, Separation of natural gas and different fractions based on relative volatilities, Compositions of different distillates. Meaning of terms such as-Pour point depressants, drag reducers, viscocity reducers, flash point, octane number.	8	2
3	Petroleum processing	Detailed discussion of the following operations with respect to process, mechanism, catalysts used and applications, Cracking: Catalytic cracking, Hydrocracking, Isomerization, Reforming, Alkylation.	8	3
4	Manufacturing of petroleum products	Types of hydrocarbon fuels and their characteristics. Manufacture of the following compounds: ethylene, acetylene, propylene with reactions and process diagram.	8	4
5	Manufacturing of ethylene compounds	Preparation of the following compounds from ethylene: ethanol, acetaldehyde, acetic acid, vinyl acetate, ethanolamines, and vinyl chloride.	8	5

Reference Books:

Chemistry Solutions to Challenges in the Petroleum Industry, ISBN: 0841234590 | 362 Pages

Industrial Organic Chemistry, ISBN: 1461361427

Chemistry of Fossil Fuels and Biofuels, ISBN: 0071410376

Industrial Chemistry, by B. K. Sharma

Handbook of Industrial Chemistry: Organic Chemicals ISBN: 0071410376

e-Learning Source:

https://www.britannica.com/science/petrochemical

https://energyeducation.ca/encyclopedia/Petrochemical

https://www.youtube.com/watch?v=NJbNg3GIkY4

https://ihsmarkit.com/products/petrochemical-industry-chemical-economics-handbook.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	2	2	1	1	-	2	3	2	2	2	1	2
CO2	3	2	1	2	-	2	3	2	2	2	1	3
CO3	2	2	1	3	-	2	2	3	2	2	1	1
CO4	3	2	1	2	-	3	3	2	2	2	1	2
CO5	2	2	1	1	1	2	2	1	1	1	-	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH211	**Title of the Course**	Agro– chemicals	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	To understand about Organochlorines, organophosphate and carbamates Insecticides natural organic insecticidesand their mode of action, classification and chemistry of Fungicides, synthesis, mode of action and their applicationsof aromatic acid derivatives like 2,4-D & 2,4,5-T, concepts of formulations (dry and wet)in pesticide and growth regulating hormones.						

Course Outcomes	
CO1	Remembergeneral introduction, chemical classification of Insecticides and natural organic insecticides like pyrethroids and pyrethrins.
CO2	Comprehension of concepts of formulations (dry and wet)in pesticide and synthesis, applications of rodenticides
CO3	Understanding of chemistry of fungicides and different classes of fungicides and dithiocarbamates as potent fungicides.
CO4	Able toevaluatedifferent types of commercial synthetic methodologies of 2,4-D & 2,4,5-T and rodenticides likeZinc phosphides, Warfarin, sodium monofluoroacetate.
CO5	Analyze and compare Organophosphate insecticides over Organochlorines Insecticides, Synthesis, mode of action, uses and formulation of Organochlorines, Organophosphates and carbamates insecticides.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fundamentals of pesticide	General introduction, Types of pesticides: stomach poisons, contact poisons, systemic poisons, fumigants. Chemical classification of pesticides: Insecticides, fungicides, herbicides, rodenticides, moluscicides, acaricides, nematicides. Natural organic insecticidcs: pyrethroids and pyrethrins.	8	1
2	Synthesis, mode of action and applications of Insecticides	General introduction, synthesis, mode of action and applications: (a) Organochlorine Insecticides: DDT, BHC, aldrin, endosulfon. (b) Organophosphorus insecticides: Phosphamidon (Dimecron), Malathion, methyl parathion. (c) Carbamate insecticides: Carbaryl, Carbofuran.	8	2
3	Synthesis, mode of action and applications of fungicides	General introduction, synthesis, mode of action and applications: (a) Inorganic fungicides: Sulphur, Lime sulphur, copper sulphate, Burgundy mixture, copper oxychloride, Dithiocarbamates: Ziram, thiram and Zineb.	8	3
4	Synthesis, mode of action and applications of herbicides	General introduction, synthesis, structure and applications: Herbicides: 2, 4, dichloro phenoxy acetic acid (2, 4-D), alachlor, sulphonyl urea compounds. Rodenticides- Zinc phosphides, Warfarin, sodium monofluoroacetate.	8	4
5	Fundamentals of plant growth regulators	Plant growth regulators: Gibberelic and indole acetic acids, cytokinins. Formulation of pesticides: Dry formulation: Dusts, granules, wettable powders, seed disinfectants liquid formulation: Emulsions and suspensions.	8	5

Reference Books:

Sustainable Agrochemistry: A Compendium of Technologies, ISBN: 3030178900

Handbook of Residue Analytical Methods for Agrochemicals, ISBN: 0471491942

Adjuvants and Agrochemicals: Volume 1: Mode Of Action and Physiological Acti, ISBN: 1315890380

Adjuvants and Agrochemicals: Volume 2: Recent Development, Application, and Bibliography of Agro-Adjuvants, ISBN: 1315890399

e-Learning Source:

https://www.worldofchemicals.com/629/chemistry-articles/agrochemicals-types-and-their-effects.html

https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/agrochemicals

https://www.britannica.com/technology/agrochemical

https://byjus.com/biology/effects-of-agrochemicals/

	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	-	2	3	3	3	1	1	1
CO2	3	3	1	2	-	2	3	3	3	1	1	1
CO3	3	3	1	2	-	2	3	3	3	1	1	1
CO4	3	3	1	2	-	2	3	3	3	1	1	1
CO5	2	2	1	2	-	2	2	3	3	1	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH212	**Title of the Course**	Industrial Waste Treatment	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	Basic knowledge of industrial waste management technologies, acquaintance with basic waste treatment technologies and environmental legislations to curb hazardous wastes will be taught to students.						

Course Outcomes	
CO1	Analysis working methodologies of treatment technologies to tackle waste from household and industries is done
CO2	An evaluation of hazardous impacts of wastes on climate and human health create awareness among students.
CO3	Evaluation of different remedial measures to check waste volume and strength develops a sense of sustainable environmental measures.
CO4	Awareness about waste generation, its impact and mitigation strategies would be created to remove hazardous wastes.
CO5	Remembrance of important aspects of environmental audits would lead to its application in industries.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Types of industries and industrial pollution; Characteristics of industrial wastes; Population equivalent; Bioassay studies; effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health; Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.	8	1, 2
2	Cleaner production	Waste management Approach; Waste Audit; Volume and strength reduction; Material and process modifications Recycle, reuse and byproduct recovery; Applications.	8	1, 2
3	Pollution from major industries	Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Dairy, Sugar, Paper, distilleries, Steel plants, thermal power plants; Wastewater reclamation concepts.	8	3
4	Treatment technologies	Equalisation; Neutralisation; Removal of suspended and dissolved organic solids; Chemical oxidation, Adsorption Removal of dissolved inorganics; Combined treatment of industrial and municipal wastes; Residue management; Dewatering; Disposal.	8	4, 5
5	Hazardous waste management	Hazardous wastes - Physico chemical treatment, solidification, incineration, Secure landfills.	8	4, 5

Reference Books:

Waste Treatment in the Process Industries, ISBN: 084937233X

Application of Microalgae in Wastewater Treatment: Volume 1: Domestic and Industrial Wastewater Treatment, ISBN: 3030139123

Nano and Bio-Based Technologies for Wastewater Treatment: Prediction and Control Tools for the Dispersion of Pollutants, ISBN: 1119577098

Industrial Waste Water Treatment, ISBN: 8120333500

e-Learning Source:

https://condorchem.com/en/industrial-wastewater-treatment/

https://www.chemicalprocessing.com/articles/2018/understand-industrial-wastewater-treatment/

https://www.encyclopedia.com/environment/encyclopedias-almanacs-transcripts-and-maps/industrial-waste-treatment

https://www.water.wa.gov.au/data/assets/pdf_file/0008/4040/89343.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	3	1	1	-	2	3	3	3	3	1	1
CO2	3	2	1	1	-	2	3	2	2	2	1	1
CO3	3	3	1	1	-	2	3	3	3	3	1	1
CO4	3	2	1	1	-	2	3	3	3	3	1	1
CO5	3	3	1	1	-	2	3	3	3	3	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH213	**Title of the Course**	Water Treatment And Analysis	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	3	1	0	4
Pre-Requisite	10+2 with Chemistry	**Co-requisite**	-				
Course Objectives	The aim of this course is to introduce the students to the area of water and wastewater treatment. The course will cover water chemistry; characteristics of water & wastewater; primary, secondary & tertiary treatment processes; sludge disposal; and design of water and wastewater treatment plants.						

Course Outcomes	
CO1	Ability to describe the purpose and operational steps of key water treatment processes used to improve water quality including: Coagulation, precipitation, chlorination etc.
CO2	Identify the parameters that characterize the constituents found in potable water and wastewater;
CO3	Illustrate the fundamentals of water and wastewater treatment
CO4	Recognise the common physical, chemical and biological unit operations encountered in treatment processes
CO5	Examine biological parameters of water.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Purification of water for drinking purpose	Clarification, coagulation, contact & electro chemical coagulation, sterilization & disinfections of water, precipitation, aeration, ozonisation and Chlorination.	8	1
2	Determination of hardness and softening methods for water	Determination of hardness of water: Titration methods - complexometric method using EDTA. Water softening methods: lime soda process, permutit or zeolite process, Ion exchange process or demineralization of water, Desalination of water: elecrodiaysis and Reverse osmosis.	8	2
3	Water analysis	Water analysis: sampling of water for analysis - chemical substances affecting potability - colour, turbidity odour, taste, temperature, pH and electrical conductivity. Analysis of solids present in water: suspended solids, dissolved solids, total acidity, alkalinity, free CO_2, and free chlorine.	8	3, 4
4	Analysis of chemical substances affecting health	Analysis of chemical substances indicative of pollution: Dissolved oxygen, Bio Chemical oxygen demand (BOD), Chemical oxygen demand (COD).	8	3, 4
5	Bacteriological examination of water	Bacteriological examination of water: total count test; E.coli test, E.coli index, most probable number method, Biological examination of water.	8	5

Reference Books:

Industrial chemistry (including chemical - engineering) - B.K. Sharma - Goel publishing house, Meerut.

Application of Microalgae in Wastewater Treatment: Volume 1: Domestic and Industrial Wastewater Treatment, ISBN: 3030139123

Nano and Bio-Based Technologies for Wastewater Treatment: Prediction and Control Tools for the Dispersion of Pollutants, ISBN: 1119577098

Pollution control in process industries - S.P. Mahajan - Tata Megraw - hill Publishing company Ltd., New Delhi.

e-Learning Source:

https://sswm.info/sites/default/files/reference_attachments/MCCAFFREY%20ny%20Water%20Quality%20Parameters%20&%20Indicators.pdf

https://www.youtube.com/watch?v=6Ot2t9YyzKU&list=RDCMUCYa1WtI-vb_bx-anHdmpNfA&start_radio=1&rv=6Ot2t9YyzKU&t=11

https://wedc-knowledge.lboro.ac.uk/resources/e/mn/006-Bacteriological-testing-of-water.pdf

https://www.slideshare.net/doctortvrao/bacteriology-of-water-and-analysis-basics

	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	1	2	3	2	2	2	1	1
CO2	3	3	3	2	1	2	3	3	3	3	1	1
CO3	2	2	2	1	1	3	2	2	2	2	1	1
CO4	3	3	2	1	2	2	3	3	3	3	1	1
CO5	2	2	2	1	1	2	3	2	2	2	1	1

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2016-2017							
Course Code	CH214	**Title of the Course**	Industrial Chemistry Lab – IV	**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 themanner 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	Know the preparation of resins and acetanilide.
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. Preparation of urea formaldehyde resin. 2. Preparation of Phenol formaldehyde (Bakelite) resin. 3. Preparation of Nylon 6, 6. 4. Preparation of Acetyl Salicylic acid (Aspirin). 5. Preparation of acetanilide. 6. Preparation of Methyl salicylate (oil of winter). 7. Determination of total hardness in the given water sample. 8. Determination of Dissolved oxygen (DO) in the given water sample. 9. Determination of Biological oxygen demand (BOD) in the given water sample. 10. Determination of Chemical oxygen demand (COD) in the given water sample. 11. Determination of Total dissolved solid (TDS) in the given water sample. 12. Determination of alkali content in antacid tablet using HCl.	40	1, 2, 3, 4, 5

Reference Books:

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

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.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf

http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf

https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

https://www.stem.org.uk/resources/collection/3959/practical-chemistry

	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	1	1	1	-	2	2	1	1	1	3	3
CO3	3	1	1	1	-	2	2	1	1	1	3	3
CO4	3	1	1	1	-	2	2	1	1	1	3	3
CO5	3	1	1	1	-	2	2	1	1	1	3	3

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

Name & Sign of Program Coordinator	**Sign & Seal of HoD**