



Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: M.Sc. Industrial Chemistry

Semester: First

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub Tot.	Credit	Total Credits	Attributes							
				L	T	P	CA		Total	ESE				Employ ability	Entrepre neurship	Skill Develop ment	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
							UE	TA													
THEORIES																					
1.	CH401	Physical Chemistry	Foundation Course	03	01	00	40	20	60	40	100	3:1:0	4	✓		✓		✓			
2.	CH402	Inorganic Chemistry	Foundation Course	03	01	00	40	20	60	40	100	3:1:0	4	✓		✓					
3.	CH403	Organic Chemistry	Foundation Course	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓			
4.	CH404	Environmental Chemistry	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓	✓		
5.	CH405	Modern Analytical Techniques	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓					
6.	CH406	Industrial Chemistry Practical-1	Core	00	00	08	40	20	60	40	100	0:0:4	4	✓	✓	✓		✓		✓	
Total				15	05	08	240	120	360	240	600	24	24								

Semester: Second

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub Tot.	Credit	Total Credits	Attributes							
				L	T	P	CA		Total	ESE				Employ ability	Entrepre neurship	Skill Develop ment	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
							UE	TA													
THEORIES																					
1.	CH407	Heavy & Fine Chemicals	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓				✓	✓		
2.	CH408	MIMA & Computational Techniques	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓		✓	
3.	CH409	Chemistry of Natural Products	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓			
4.	CH410	Corrosion, Lubrication and Paint Technology	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓					
5.	CH411	Pharmaceutical Chemistry	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓			
6.	CH412	Industrial Chemistry Practical-2	Core	00	00	08	40	20	60	40	100	0:0:4	4	✓	✓	✓		✓		✓	
Total				15	05	08	240	120	360	240	600	24	24								

L= Lecture, T= Tutorial, P = Practical, CA= Continuous Assessment, UE= Unit Exam. TA= Teacher's Assessment, ESE= End Semester Examination;

Sessional=CT+TA; Subject Total= Sessional+ESE;



Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: M.Sc. Industrial Chemistry

Semester: Third

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub Tot.	Credit	Total Credits	Attributes							
				L	T	P	CA		Total	ESE				Employ ability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
							UE	TA													
THEORIES																					
1.	CH501	Polymer Chemistry	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓				✓	
2.	CH502	Petroleum Chemistry	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓		✓		✓			
3.	CH503	Agro-Chemistry	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓			
4.	CH504	Cosmetics & Perfumery	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓			
5.	CH505	Food Chemistry	Elective	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓				✓	
	CH506	Bioinorganic & Supramolecular Chemistry												✓	✓	✓					
6.	CH507	Industrial Chemistry Practical-3	Core	00	00	08	40	20	60	40	100	0:0:4	4	✓	✓	✓		✓	✓		
Total				15	05	08	240	120	360	240	600	24	24								

Semester: Fourth

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub Tot.	Credit	Total Credits	Attributes							
				L	T	P	CA		Total	ESE				Employ ability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
							UE	TA													
THEORIES																					
1.	CH508	Intellectual Property Rights	Core	03	01	00	40	20	60	40	100	3:1:0	4	✓					✓	✓	
2.	CH509	Green Chemistry	Elective	03	01	00	40	20	60	40	100	3:1:0	4	✓	✓	✓		✓			
3.	CH510	Industrial Hygiene and Chemical Safety												✓	✓	✓		✓	✓	✓	
4.	CH511	Seminar Presentation	Core	00	00	04	00	00	00	100	100	0:0:2	2			✓				✓	
5.	CH512	*Industrial Training & Project Evaluation	Core	00	00	00	00	00	00	300	300	10	10	✓	✓	✓		✓	✓	✓	
Total				06	02	04	80	40	120	480	600	20	20								

L= Lecture, T= Tutorial, P = Practical, CA= Continuous Assessment, UE= Unit Exam. TA= Teacher's Assessment, ESE= End Semester Examination;

Sessional=CT+TA; Subject Total= Sessional+ESE;

*The Evaluation scheme for the Industrial Training:

Course Title	Course Code	Dissertation	Presentation	Viva/Discussion	Total
Industrial Training & Project Evaluation	CH512	200	50	50	300

SYLLABI
SEMESTER – I

1. Name of the Department: Chemistry												
2. Course Name	PHYSICAL CHEMISTRY				L	T	P					
3. Course Code	CH401				3	1	0					
4. Type of Course (use tick mark)					Core ()	DE ()	FC (√)					
5. Pre-requisite (if any)	BSc. with Chemistry	6. Frequency (use tickmarks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()						
7. Total Number of Lectures, Tutorials, Practicals												
Lectures = 30			Tutorials = 10			Practical = Nil						
8. COURSE OBJECTIVES: The purpose of this postgraduate course is to impart basic and fundamental knowledge of physical chemistry. It is applied in almost all the field starting from Chemistry to biology, information technology as well as the engineering. After the successfully completion of the course, the students are provided sound foundation to take up Ph.D. course in the future.												
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>												
COURSE OUTCOME (CO)		ATTRIBUTES										
CO1	Students would analyze the idealized version of a gas, a perfect gas and shows how its equation of states may be assembled experimentally.											
CO2	Students would able to develop the concept of conservation of energy; assess the energy changes during physical and chemical process.											
CO3	Students would differentiate between spontaneous and non-spontaneous process and understand how Gibbs free energy is related to maximum non-expansion work.											
CO4	Students would explore the rate of chemical reactions and analyzed how rate of a chemical reaction is varying with change of concentration, pressure and temperature.											
CO5	Students would develop the concept of photochemistry and get inside of Lambert-Beer Law, Grothus – Drapper law, Stark – Einstein law, quantum Efficiency and its determination.											
10. Unit wise detailed content												
Unit-1	Number of lectures = 08	Title of the unit: Properties of Gases										
The states of gases, gases laws and deviation from ideal behavior, Vander Waals equation of state; Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and vander Waals constants, the law of corresponding states, reduced equation of state. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter.												
Unit-2	Number of lectures = 08	Title of the unit: Classical Thermodynamics										
System & surroundings, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work. First Law of Thermodynamics; Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure, Joule's law – Joule Thomson coefficient and inversion temperature. Second Law of Thermodynamics: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium, Equilibrium change in ideal gases and mixing of gases, Maxwell's relations.												
Unit-3	Number of lectures = 08	Title of the unit: Entropy and Free energy										
Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. Nernst heat theorem, statement and concept of residual entropy. Chemical Potential and partial molar properties: Gibbs-Duhem equation, concept of fugacity and its determination.												
Unit-4	Number of lectures = 08	Title of the unit: Chemical Kinetics										
Rate of a reaction, factors influencing the rate of a reaction; mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life, Determination of the order of reaction – differential method, method of integration, method of half life period and isolation method. Radioactive decay as a first order phenomenon, Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.												
Unit-5	Number of lectures = 08	Title of the unit: Photochemistry										
Interaction of radiation with matter, difference between thermal and photochemical processes, Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law Jablonski diagram depicting various processes occurring in the excited state, Lambert-Beer Law: quantum Efficiency and its determination, Qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions – energy transfer processes (simple examples), Kinetics of Photo chemical reaction. (Hydrogen-Bromine, Hydrogen-Chlorine, Decomposition of Hydrogen Iodide and kinetics of Dimerization of Anthracene).												
11. CO-PO mapping												
COs	Attributes				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Students would analyze the idealized version of a gas, a perfect gas and shows how its equation of states may be assembled experimentally.				3	2	2	2	1	3	3	3
CO2	Students would able to develop the concept of conservation of energy; assess the energy changes during physical and chemical process.				3	2	2	1	1	2	2	2
CO3	Students would differentiate between spontaneous and non-spontaneous process and understand how Gibbs free energy is related to maximum non-expansion work.				3	2	3	1	1	3	2	3
CO4	Students would explore the rate of chemical reactions and analyzed how rate of a chemical reaction is varying with change of concentration, pressure and temperature.				3	2	3	1	1	3	3	2
CO5	Students would develop the concept of photochemistry and get inside of Lambert-Beer Law, Grothus – Drapper law, Stark – Einstein law, quantum Efficiency and its determination.				3	2	1	1	1	3	2	1
3 Strong contribution, 2 Average contribution, 1 Low contribution												
12. Brief description of self-learning / E-learning component												
1. http://home.iitk.ac.in/~gtm/thermodynamics/ui/TOC.htm 2. https://nptel.ac.in/courses/115103113/ 3. https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-27.pdf 4. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Engineering%20Chemistry%201/TOC-mainM6.htm 5. https://www.youtube.com/watch?v=SgTuWj9Tj80												
13. Books recommended:												
1. Physical Chemistry, P.W. Atkins, ELBS 2. Thermodynamics – J. Rajaram and J.C. Kuriacose – Educational Publishers. 3. Quantum Chemistry – Eyring, Walter, Kinball 4. Statistical Physics (Part I) (Course of Theoretical Physics Vol. 5) – L.D. London. & E.M. Lefshitz Pergamon Press, London. 5. Principles of Physical Chemistry by Puri, Sharma and Pathan.												

1. Name of the Department: Chemistry											
2. Course Name	INORGANIC CHEMISTRY			L	T	P					
3. Course Code	CH402			3	1	0					
4. Type of Course (use tick mark)				Core ()	DE ()	FC (√)					
5. Pre-requisite (if any)	BSc. with Chemistry	6. Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()					
7. Total Number of Lectures, Tutorials, Practicals											
Lectures = 30		Tutorials = 10		Practical = Nil							
8. COURSE OBJECTIVES: The purpose of this course is to develop the deep understanding of general characteristic properties of transition elements, nomenclature and isomerism in coordination compounds, organometallic chemistry of transition elements, bioinorganic chemistry and process in human and to gain the knowledge of basics of instrumental spectroscopic techniques.											
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>											
COURSE OUTCOME (CO)			ATTRIBUTES								
CO1	Students will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.										
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and understand technical literature related to the discipline.										
CO3	Students will be able to know about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.										
CO4	Students will be able to understand the metal component in protein structure and molecular modeling, including the use of the computer program. Transport mechanisms across cell membranes.										
CO5	Students will be able to understand the basic and advanced instrumental techniques used in inorganic synthesis including spectroscopic and analytical techniques for identification and characterization of complex molecules.										
10. Unit wise detailed content											
Unit-1	Number of lectures = 08	Title of the unit: Coordination Compounds									
General characteristic properties of transition elements, Werner's theory, Effective atomic number, Shapes of d orbitals. Bonding in transition metal complexes; Valence bond theory, Crystal field theory; Octahedral complexes, effects of crystal field splitting, tetrahedral distortion of octahedral complexes (Jahn-Teller Distortion), Square planar arrangements, tetrahedral complexes, chelates, magnetism, Molecular orbital theory.											
Unit-2	Number of lectures = 08	Title of the unit: Nomenclature And Isomerism In Coordination Compounds									
Nomenclature of co-ordination compounds, isomerism in coordination compounds; Polymerization, Ionization, Hydrate, Linkage, Coordination, Coordination position isomerism. Stereoisomerism; Geometrical and optical isomerism. Metal carbonyls, metal clusters and sandwich compounds.											
Unit-3	Number of lectures = 08	Title of the unit: Organometallic Chemistry Of Transition Elements									
Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (Hydrogenation, hydroformylation, isomerisation and polymerisation).											
Unit-4	Number of lectures = 08	Title of the unit: Bioinorganic Chemistry									
Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.											
Unit-5	Number of lectures = 08	Title of the unit: Characterization Of Inorganic Compounds									
Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer, UV-Vis, NQR, MS, electron spectroscopy and microscopic techniques..											
11. CO-PO mapping											
COs	Attributes			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Students will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.			3	1	1	1	2	1	1	1
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and understand technical literature related to the discipline.			3	2	1	2	2	2	2	2
CO3	Students will be able to know about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.			3	2	2	2	2	2	2	2
CO4	Students will be able to understand the metal component in protein structure and molecular modeling, including the use of the computer program and transport mechanisms across cell membranes.			3	2	2	2	2	2	2	2
CO5	Students will be able to understand the basic and advanced instrumental techniques used in inorganic synthesis including spectroscopic and analytical techniques for identification and characterization of complex molecules.			3	2	1	2	2	2	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution											
12. Brief description of self-learning / E-learning component											
1. https://freevidelectures.com/course/3412/co-ordination-chemistry 2. http://wwwchem.uwimona.edu.jm/courses/IC10Kiso.pdf 3. https://nptel.ac.in/courses/104101091/ 4. https://nptel.ac.in/courses/104104109/ 5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106074/lec24.pdf											
13. Books recommended:											
1. F. Albert Cotton, Geoffrey Wilkinson, Carlos A. Murillo and Manfred Bochmann. Advanced Inorganic chemistry, Sixth edition, Wiley India Pvt.Ltd. 2. J. D. Lee, Concise Inorganic Chemistry, Fifth edition, Wiley India Pvt.Ltd. 3. J H Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York(1972).											

1. Name of the Department: Chemistry												
2. Course Name	ORGANIC CHEMISTRY				L	T	P					
3. Course Code	CH403				3	1	0					
4. Type of Course (use tick mark)					Core ()	DE ()	FC (√)					
5. Pre-requisite (if any)	BSc. with Chemistry		6. Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()					
7. Total Number of Lectures, Tutorials, Practicals												
Lectures = 30			Tutorials = 10			Practical = Nil						
8. COURSE OBJECTIVES: Students will be able to gain knowledge of Generation, stability and reactivity of intermediates, Name reactions. pericyclic reactions, concerted pi electron shift and minimize environmental pollution through without use of solvents concepts of stereochemistry of acyclic & cyclic compounds, stereo chemi properties and their applications.												
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>												
COURSE OUTCOME (CO)												
ATTRIBUTES												
CO1	Analyze and compare reactivity and stability of carbocations, carbanions, free radicals, carbenes, nitrenes and benzyne and addition reactions with electrophilic, nucleophilic or radical species											
CO2	Comprehension of types of Organic reaction mechanisms involving elimination and substitution reactions with electrophilic, nucleophilic or radical species.											
CO3	Able to evaluate different types of Name reactions and its mechanism.											
CO4	Know about Pericyclic reactions, types of Pericyclic reactions, stereochemistry, thermal and photochemical cyclisation, Cope and Claisen rearrangement.											
CO5	Understand the Principles of stereochemistry, Configurational and conformational isomerism in acyclic and cyclic compounds, stereogenicity, stereoselectivity, enantioselectivity and diastereoselectivity.											
10. Unit wise detailed content												
Unit-1	Number of lectures = 08	Title of the unit: Reactive intermediates										
Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and benzyne. Organic reaction mechanisms involving addition reactions with electrophilic, nucleophilic or radical species.												
Unit-2	Number of lectures =08	Title of the unit: Reaction mechanisms and Name reactions										
Organic reaction mechanisms; involving, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Neighbouring group participation, elimination: E2 vs E1, elimination vs substitution. Aldol condensation, Cannizzaro reaction, Hofmann, Beckmann and Fries rearrangements, Reimer-Tiemann reaction.												
Unit-3	Number of lectures = 08	Title of the unit: Name reactions										
Reformatsky and Grignard reactions, Michael addition, Friedel-Crafts reaction, Wittig reaction, Oppenaur oxidation, Clemmensen reduction, Wolff-Kishner reduction, Meerwein-Ponndorf Verley reduction and birch reduction, hydroboration-oxidation, oxymercuration and deoxymercuration.												
Unit-4	Number of lectures = 08	Title of the unit: Pericyclic, Electrocyclic, Cycloaddition reactions and Sigmatropic rearrangements										
Pericyclic reactions: Introduction, π molecular orbital of ethylene and 1,3-butadiene. Electrocyclic reactions: Introduction, stereochemistry for the ring opening and ring closing electrocyclic reactions, thermal and photochemical cyclisation of (4n) and (4n+2) system. Cycloaddition reactions: Introduction, Thermal and photochemical induced (2+2) and (4+2) cycloaddition reactions. Sigmatropic rearrangements: Introduction, classification, Cope and Claisen rearrangement..												
Unit-5	Number of lectures = 08	Title of the unit: Principles of stereochemistry										
Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity and diastereoselectivity.												
11. CO-PO mapping												
COs	Attributes				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Analyze and compare reactivity and stability of carbocations, carbanions, free radicals, carbenes, nitrenes and benzyne and addition reactions with electrophilic, nucleophilic or radical species.				3	1	2	1	1	2	2	2
CO2	Comprehension of types of Organic reaction mechanisms involving elimination and substitution reactions with electrophilic, nucleophilic or radical species.				3	1	2	1	2	2	2	2
CO3	Able to evaluate different types of Name reactions and its mechanism.				3	1	2	1	2	2	2	2
CO4	Know about Pericyclic reactions, types of Pericyclic reactions, stereochemistry, thermal and photochemical cyclisation, Cope and Claisen rearrangement.				3	1	2	1	2	3	3	2
CO5	Understand the Principles of stereochemistry, Configurational and conformational isomerism in acyclic and cyclic compounds, stereogenicity stereoselectivity, enantioselectivity and diastereoselectivity.				3	1	2	1	2	2	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution												
12. Brief description of self-learning / E-learning component												
1. https://nptel.ac.in/courses/104105104/ 2. https://nptel.ac.in/courses/104101005/ 3. https://nptel.ac.in/courses/104103023/ 4. https://nptel.ac.in/courses/104106077/ 5. https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod8.pdf												
13. Books recommended:												
1. Advanced Organic Chemistry (Reactions, Mechanisms and Structure): Michel B. Smith and Jerry March, 4th Edition, Wiley Interscience Publication. 2. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Six edition, Pearson publication. 3. Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition, Pearson publication. 4. Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, Second edition, Oxford Publication. 5. Organic Chemistry by T.W. Graham Solomons, and Craig B. Fryhle, Ninth edition, Wiley Publication. 6. Organic Chemistry by I.L. Finar, Volume 1 & 2, Sixth edition, Pearson Publication.												

1. Name of the Department: Chemistry									
2. Course Name	ENVIRONMENTAL CHEMISTRY		L	T	P				
3. Course Code	CH404		3	1	0				
4. Type of Course (use tick mark)			Core (√)	DE ()	FC ()				
5. Pre-requisite (if any)	BSc. with Chemistry	6. Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals									
Lectures = 30		Tutorials = 10		Practical = Nil					
8. COURSE OBJECTIVES: The main objectives of this course is to study various types of pollutants, their sources, effects on living and non living species and related controlmeasures.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)		ATTRIBUTES							
CO1	Evaluate different types of air pollutants, their harmful effects on living and non living species, their control measures; Study of Global Warming, Green House Effect and Ozone Layer Depletion.								
CO2	Analyze the various factors of water quality assessment parameters, water pollutants and their sources and different types of waste water treatment processes.								
CO3	Understand the importance of soil composition; Analyze various types of soil pollutants, their control and related standards.								
CO4	Evaluate the various types of waste and their toxicity aspects and management.								
CO5	Understand the sources of heavy metals and their health hazards								
10. Unit wise detailed content									
Unit-1	Number of lectures = 08	Title of the unit: Air pollutants							
CO, CO2, ozone, CFC, & NOx, ozone depletion, global warming, Harmful effects of pollutants on living and non-living species, Analytical methods for monitoring air pollutants, international and national standards.									
Unit-2	Number of lectures =08	Title of the unit: Physical, chemical and biological water quality parameters							
Physical, chemical and biological water quality parameters; their assessment; Water pollution; water pollutants; toxicity aspects; international and national standards; control; Water sampling techniques; Water treatment processes: aeration, solid purification, nanofiltration, chemical treatments, reverses osmosis, desalination. Waste water treatment processes. Water table maintenance & harvesting methods.									
Unit-3	Number of lectures = 08	Title of the unit: Composition of soil							
Inorganic and organic components, micro and macronutrients; Soil pollution; Fertilizers, insecticides, pesticides, plastics, toxic metals, dyes, surfactants; toxicity aspects; international and national standards; control.									
Unit-4	Number of lectures = 08	Title of the unit: Industrial waste							
Toxic aspects, management and disposal; Radioactive, municipal, agricultural and biomedical waste – toxicity hazards. Bhopal gas tragedy, Chernobyl disaster.									
Unit-5	Number of lectures = 08	Title of the unit: Heavy metal in the environment							
Sources of heavy metals; Poisoning of heavy metals in every bite; Mercury, Copper, Chromium, Cadmium, Cobalt, Lead, Arsenic.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Evaluate different types of air pollutants, their harmful effects on living and non livin species, their control measures; Study of Global Warming, Green House Effect and Ozon Layer Depletion.	3	2	3	3	3	3	3	2
CO2	Analyze the various factors of water quality assessment parameters, water pollutants and their sources and different types of waste water treatment processes.	3	2	3	3	3	3	3	2
CO3	Understand the importance of soil composition; Analyze various types of soil pollutants their control and related standards.	3	1	3	3	3	3	3	3
CO4	Evaluate the various types of waste and their toxicity aspects and management.	3	2	3	3	2	3	3	2
CO5	Understand the sources of heavy metals and their health hazards.	3	2	3	3	3	3	3	2
3 Strong contribution, 2 Average contribution , 1 Low contribution									
12. Brief description of self-learning / E-learning component									
1. https://nptel.ac.in/content/storage2/courses/105102089/air%20pollution%20(Civil)/Module-1/2.htm									
2. https://www.youtube.com/watch?v=xw9FP1q0sJ8									
3. https://www.youtube.com/watch?v=7kizaNBowrw									
4. https://www.youtube.com/watch?v=dnQjYXX17A									
5. https://www.ukessays.com/essays/environmental-sciences/the-issue-of-heavy-metals-contamination-environmental-sciences-essay.php									
13. Books recommended:									
1. Environmental Chemistry Manahan, Stanley E, 2004, Taylor & FrancisLtd.									
2. Basic Concepts of Environmental Chemistry, Desley W. Connell, 1 edition,CRC-Press									
3. Environmental Chemistry: A Global Perspective, Gary W. Vanloon Stephen J. Duffy , Oxford Univ Pr(Sd).									
4. Introduction to Environmental Chemistry, Reid, Brian J. Blackwell ScienceLtd.									
5. Chemistry of the Environment, Thomas G. Spiro, William M. Stigliani, 2nd Edition, Prentice Hallpublication.									

1.NameoftheDepartment:Chemistry													
2.CourseName	MODERN ANALYTICAL TECHNIQUES		L	T	P								
3.CourseCode	CH405		3	1	0								
4.TypeofCourse(usetickmark)			Core(√)	DE()	FC()								
5.Pre-requisite(ifany)	B.Sc. with Chemistry	6.Frequency(usetickmarks)	Even ()	Odd (√)	Either Sem () EverySem ()								
7.TotalNumberofLectures,Tutorials,Practicals													
Lectures=30		Tutorials=10		Practical=Nil									
8. COURSE OBJECTIVES: The course aims at providing knowledge of principles and instrumentations of UV, IR, NMR, Atomic absorption spectroscopy and Mass spectrometry. Make the students able to interpret and assign spectroscopic data as a tool for structural elucidation.													
9. COURSE OUTCOMES (CO):													
<i>After the successful course completion, learners will develop following attributes:</i>													
COURSE OUTCOME (CO)	ATTRIBUTES												
CO1	Explain the effect of conjugation, solvent polarity and non-bonding electrons on a UV/Vis absorption spectrum. Evaluate the utility of UV/Vis spectroscopy as a qualitative and quantitative method. Application of correct Woodward-Fieser rules to calculate wavelength of maximum absorption of organic compounds.												
CO2	Comprehension of factors affecting vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides, interpret and assign IR spectroscopic data as a tool for structural elucidation.												
CO3	Argue how nuclear spins are affected by a magnetic field, and be able to explain what happens when radiofrequency radiation is absorbed. Identify the number of proton and carbon NMR signals expected from a compound given its structure, splitting pattern in the proton NMR spectrum of a compound given its structure, to assign peaks with the aid of a chart of chemical shifts from ¹ H and ¹³ C NMR in an NMR spectrum to specific protons and carbons in a compound.												
CO4	Become familiar with the mass spectrometric technique, different types of ionization techniques and sketch components of a mass spectrometer and functions of each. Application of a mass spectrometric technique, distinguish fragmentation methods. Interpretation of mass spectra												
CO5	Comprehension of principle, instrumentation, interferences and Sample preparation, Applications of AAS												
10.Unitwisedetailedcontent													
Unit-1	Number of lectures=08	Title of the unit: UV Spectroscopy											
Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, effect of solvents on electronic transitions, formation and designation of absorption bands, conjugated systems and transition energies, unsaturated carbonyl compounds, dienes and conjugated polyenes, Woodward – Fieser rules													
Unit-2	Number of lectures= 08	Title of the unit: IR Spectroscopy											
Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, calculation of vibrational frequencies, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, fingerprint region, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides), applications of infrared spectroscopy.													
Unit-3	Number of lectures=08	Title of the unit: NMR Spectroscopy											
Introduction, theory of NMR spectroscopy, Instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling and stereostructure, proton exchange reactions, nuclear overhauser effect (NOE), shift reagents, principle of C-13 NMR spectroscopy, Relaxation and dynamic processes - Spin lattice relaxation (T ₁) and Spin - spin relaxation (T ₂) measurements. Interpretation of NMR spectra of some representative compounds.													
Unit-4	Number of lectures=08	Title of the unit: Mass Spectrometry											
Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, various modes of ionization (EI, CI, FD and FAB) and their applications, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols, amines, ketones, aldehydes, esters, acids and anhydrides), molecular ion peak, metastable peak, McLafferty rearrangements, Nitrogen rule.													
Unit-5	Number of lectures=08	Title of the unit: Atomic Absorption											
Spectrophotometry: Introduction, Principle, Instrumentation, Interferences- Spectral, Ionization, Physical and Refractory compound formation, Sample preparation, Internal standard and standard addition calibration and applications of AAS.													
11. CO-PO mapping													
COs	Attributes					PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Explain the effect of conjugation, solvent polarity and non-bonding electrons on a UV/Vis absorption spectrum. Evaluate the utility of UV/Vis spectroscopy as a qualitative and quantitative method. Application of correct Woodward-Fieser rules to calculate wavelength of maximum absorption of organic compounds.					3	2	1	1	1	3	2	2
CO2	Comprehension of factors affecting vibrational, frequencies, vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides, interpret and assign IR spectroscopic data as a tool for structural elucidation.					3	2	1	1	2	3	2	2
CO3	Argue how nuclear spins are affected by a magnetic field, and be able to explain what happens when radiofrequency radiation is absorbed. Identify the number of proton and carbon NMR signals expected from a compound given its structure, splitting pattern in the proton NMR spectrum of a compound given its structure, to assign peaks with the aid of a chart of chemical shifts from ¹ H and ¹³ C NMR in an NMR spectrum to specific protons and carbons in a compound.					3	2	1	1	2	3	2	2
CO4	Become familiar with the mass spectrometric technique, different types of ionization techniques and sketch components of a mass spectrometer and functions of each. Application of a mass spectrometric technique, distinguish fragmentation methods. Interpretation of mass spectra					3	2	1	1	2	3	2	2
CO5	Comprehension of principle, instrumentation, interferences and Sample preparation, Applications of AAS					3	2	2	2	2	3	2	2
3 Strong contribution, 2 Average contribution , 1 Low contribution													
12.Briefdescriptionofself-learning /E-learningcomponent													
1. https://www.youtube.com/watch?v=tbUx-RaZS7M 2. https://nptel.ac.in/courses/103108139/ 3. https://nptel.ac.in/courses/104108078/ 4. https://nptel.ac.in/courses/102101050/ 5. https://www.youtube.com/watch?v=xOKoVOMKHn8													
13. Books recommended:													
1. Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole. 2. Spectroscopic methods in organic chemistry: H. Williams and Ian Fleming, V Edition Tata Mc Grawhills 3. Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications. 4. Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.													

1. Name of the Department: Chemistry												
2. Course Name	INDUSTRIAL CHEMISTRY PRACTICAL-1				L	T	P					
3. Course Code	CH406				0	0	8					
4. Type of Course (use tick mark)					Core (√)	DE ()	FC ()					
5. Pre-requisite (if any)		B.Sc. with Chemistry	6. Frequency (use tick marks)		Even ()	Odd (√)	Either Sem ()		Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals												
Lectures = 00			Tutorials = 00			Practical = 08						
8. COURSE OBJECTIVES: To develop practical and technical skills for better understanding of theory. To develop transferrable skills and enhancing communication skills of students.												
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>												
COURSE OUTCOME (CO)		ATTRIBUTES										
CO1	Perform accurate and precise analysis in the field of industrial chemistry.											
CO2	Able to examine water quality parameters (DO, COD, BOD and TDS) and argue about water quality.											
CO3	Explain the principles of chromatographic techniques, UV spectroscopy and viscosity measurements.											
CO4	Organize the records of all performed experiments in the manner which is required in laboratory.											
CO5	Analyze the importance of personal safety and care of equipments and chemicals.											
10. List of experiments												
1. To determine the percentage composition of the given mixture consisting of two liquids A and B by viscosity method.												
2. To determine the relative surface tension of a liquid by Stalagmometer.												
3. To determine the molecular weight of non-volatile solute cryscopically using water assolvent.												
4. Selective extraction of iron metal cation from mixture of iron and magnesium for determination of their respective concentration.												
5. Paper chromatography separation of metalion.												
6. Determination of copper and nickel in the givensample.												
7. Separation of amino acid by thin layer chromatography.												
8. Separation of mixture of carbohydrate by thin layer chromatography.												
9. Separation of plant pigment from green leaves by column chromatography.												
10. Separation of mixture of dyes by column chromatography.												
11. Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone.												
12. Determination of Dissolved Oxygen (D.O.) in the given water sample.												
13. Determination of Biological Oxygen Demand (B.O.D.) in the given water sample.												
14. Determination of Chemical Oxygen Demand (C.O.D.) in the given water sample.												
15. Determination of Conductivity of the water sample.												
16. Determination of Total Dissolved Solid (T.D.S.) in the given water sample.												
17. Determination of concentration of KMnO4 by UV-Visible Spectrophotometer.												
18. Determination of iron content in the given water sample by UV-Visible Spectrophotometer.												
11. CO-PO mapping												
COs	Attributes				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Perform accurate and precise analysis in the field of industrial chemistry.				3	2	2	1	3	3	3	2
CO2	Able to examine water quality parameters (DO, COD, BOD and TDS) and argue about water quality				3	2	3	3	3	3	3	2
CO3	Explain the principles of chromatographic techniques, UV spectroscopy and viscosity measurements.				3	2	2	2	3	3	3	2
CO4	Organize the records of all performed experiments in the manner which is required in laboratory.				3	3	2	2	3	1	3	2
CO5	Analyze the importance of personal safety and care of equipments and chemicals.				3	1	2	2	3	3	3	2
3 Strong contribution, 2 Average contribution, 1 Low contribution												
12. Brief description of self- learning / E-learning component												
1. https://www.fondriest.com/environmental-measurements/measurements/measuring-water-quality/dissolved-oxygen-sensors-and-methods/												
2. http://www.nsec.ac.in/images/bes_Viscosity%20of%20Sugar%20Solution.pdf												
3. https://www.youtube.com/watch?v=8wrmQ_xWqZbo												
4. https://www.youtube.com/watch?v=kXI_Om-2XYk												
5. https://www.youtube.com/watch?v=YBeZZwNSeb8												
6. https://www.youtube.com/watch?v=WBYP48A4gM												
7. https://www.youtube.com/watch?v=V16USbjKZXw												
13. Books recommended:												
1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition.												
2. Practical Organic Chemistry, A.I.Vogel.												
3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.												
4. Experimental Inorganic Chemistry –W.G.Palmer.												

SEMESTER-II

1.Name of the Department: Chemistry									
2.Course Name	HEAVY AND FINE CHEMICALS			L	T	P			
3.CourseCode	CH407			3	1	0			
4.Type of Course(use tick mark)				Core(√)	DE()	FC()			
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(use tick marks)	Even (√)	Odd ()	Either Sem ()	EverySem()			
7.Total Number of Lectures,Tutorials,Practicals									
Lectures=30			Tutorials=10		Practical=Nil				
8. COURSE OBJECTIVES: There are a very large number of Heavy and fine chemicals that are produced. The chemistry of producing these products requires a high degree of flexibility. Heavy and fine chemicals production is more expensive, generates more waste, and requires a higher research investment per kilogram than the manufacturing of other chemical products. Heavy and fine chemicals are pure, single chemical substances commercially produced with chemical reactions for highly specialized applications. Students will have a firm foundation on biocides, and specialty in chemicals, characterized for technical applications likes performance-enhancing additives, ceramics, refractories, cement, sugar, fertilizers, adhesives, special coatings, and photographic chemicals are common examples of specialty chemicals.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Students will have a firm foundation in the approaches to the development ceramics and refractories with commercial applications.								
CO2	Students will have a firm foundation in have a basic understanding of how physical models explain chemical properties of glass and cements chemistry with commercial applications.								
CO3	Students will have a firm foundation in have a basic understanding of sugar, pulps and paper with flow sheet industrial manufacturing scheme.								
CO4	Students have gained specialist knowledge in one or more of the following fields leather and fertilizers synthetic manufacturing schemes in industrial aspects.								
CO5	Students will be able to understand the basic and advanced instrumental techniques used in adhesion.								
10.Unitwisedetailedcontent									
Unit-1	Number of lectures=08	Title of the unit: Industrial Carbon							
Lamp Black, Manufacture of Carbon, Manufacture of Graphite Carbon, Manufacture of Activated Carbon, Application of Industrial Carbon.									
Unit-2	Number of lectures= 08	Title of the unit: Industrial Catalysts							
Raney Nickel, Other Forms of Nickel, Palladium, Chromate, Vanadium and Platinum base catalyst, Aluminum Alkoxide, Titanium tetra chloride and Titanium dioxide.									
Unit-3	Number of lectures=08	Title of the unit: Soap & Detergent Industry							
Soaps- Raw material, Manufacture of Soap, Toilet and Transparent soaps; Detergent-Classification of detergent, Anionic detergent, Cationic detergent, non-ionic detergents, Eco-friendly detergents, Manufacture of Shampoos.									
Unit-4	Number of lectures=08	Title of the unit: Adhesives							
Introduction, Process of bonding, Classification of adhesives, Preparation of adhesives like Animal glue, Starch adhesives, Synthetic resin adhesives, Cellulose and silicate adhesives, Applications of various adhesives.									
Unit-5	Number of lectures=08	Title of the unit: Chemical Explosives & Rocket Propellants							
Types of industrial explosives; propellants, Rockets and missiles, Propellants for rockets, Toxic chemical weapons.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Students will have a firm foundation in the approaches to the development ceramics and refractories with commercial applications.	3	1	2	1	2	1	3	1
CO2	Students will have a firm foundation in have a basic understanding of how physical models explain chemical properties of glass and cements chemistry with commercial applications.	3	1	2	2	2	1	3	1
CO3	Students will have a firm foundation in have a basic understanding of sugar, pulps and paper with flow sheet industrial manufacturing scheme.	3	1	2	2	2	3	3	1
CO4	Students have gained specialist knowledge in one or more of the following fields leather and fertilizers synthetic manufacturing schemes in industrial aspects.	3	1	2	2	2	1	3	1
CO5	Students will be able to understand the basic and advanced instrumental techniques used in adhesion.	3	1	2	2	2	3	3	1
3 Strong contribution, 2 Average contribution , 1 Low contribution									
12.Briefdescriptionofself-learning /E-learning component									
1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104105103/lec57 2. https://nptel.ac.in/content/storage2/courses/103103026/pdf/mod1.pdf 3. https://ch402npc.wordpress.com/2018/03/30/nptel-lecture-introduction-to-soap-and-detergent-soap-making-and-recovery-of-glycerine/ 4. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113106087/lec58.pdf 5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/101104019/lec37.pdf									
13. Books recommended:									
1. Chemical process industries N.R Nerris shreve 2. Chemical process principales: part 1 & II – O.A / Hougen, K.M Watson RA Ragatz (CBS) 3. Shrev's Chemical process Industries: 5th edition – George T. Austin, Mc Graw Hill Book Co. 4. Handbook of industrial chemistry: Volume I & II , KH Davis , FS Berner, CBS Publication. 5. Plastic Additives Technology Hand Book: Himadri Panda, Engineers India Research Institute.									

1.Name of the Department: Chemistry											
2.Course Name	MODERN INSTRUMENTAL METHODS OF ANALYSIS AND COMPUTATIONAL TECHNIQUES			L	T	P					
3.Course Code	CH408			3	1	0					
4.Type of Course (use tick mark)				Core(√)	DE()	FC()					
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(usetickmarks)	Even (√)	Odd ()	Either Sem ()	EverySem()					
7.TotalNumberofLectures,Tutorials,Practicals											
Lectures=30		Tutorials=10		Practical=Nil							
8. COURSE OBJECTIVES: This course is designed for postgraduate students of chemistry and industrial chemistry as a broad base introduction to analytical instrumentation techniques for the measurement of different chemical and physical properties of compounds and materials (composition, structure, etc.). After successfully completion of course, the student will be able to understand the working principle and applications of various modern analytical techniques as well as their operation.											
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>											
COURSE OUTCOME (CO)	ATTRIBUTES										
CO1	Students would be able to analyze the data by applying different type of statistical methods and would also understand the difference between systematic and random errors.										
CO2	Students evaluate fundamentals of electrochemistry and recognize the electrochemical processes. They got sound inside of different type of polarographic and voltammetric methods and their applications.										
CO3	Students would develop the concept of thermogravimetric analysis, differential analysis and differential scanning calorimetry methods and their applications.										
CO4	Students would restate difference between different modes of chromatographic separation; apply knowledge of qualitative and quantitative analysis in various fields of chemical, pharmaceutical industry etc.										
CO5	Students would be able to illustrate how the computer and software are used in analytical laboratory and got springboard for further study.										
10.Unitwisedetailedcontent											
Unit-1	Number of lectures=08		Title of the unit: Errors and Evaluation								
Definition of terms mean and median, precision, standard deviation, relative standard deviation, accuracy, absolute error, relative error, types of error in experimental data, determinate (systematic), indeterminate (random) and gross, sources of errors and their effects upon the analytical results, statistical evaluation of data-normal distribution, interval estimation, methods of least squares.											
Unit-2	Number of lectures= 08		Title of the unit: Polarographic Techniques and Voltammetry								
Polarography; Theory, Instrumentation and its working; Advantages of using dropping mercury electrode, Derivation of Ilkovic equation, Factors affecting the limiting current, The half wave potential, Criterion of reversibility, Applications of polarography, Square-wave polarography, Differential pulse polarography and cyclic voltammetry showing cyclic voltammetric excitation.											
Unit-3	Number of lectures=08		Title of the unit: Thermal Methods								
Thermogravimetric analysis, Instrumentation and Applications, Differential thermal analysis, General principles and applications with special reference to polymers; Differential scanning calorimetry, Theory and different types of thermal scanning calorimetry, Instruments, Power compensated DSC instrument, Heat flux DSC instrument and modulated DSC instrument, DSC data analysis and applications.											
Unit-4	Number of lectures=08		Title of the unit: Chromatography								
Chromatographic mechanism, Classification of chromatography, principles, types, techniques of column chromatography and techniques of elution, thin layer chromatography, Gas chromatography, Applications of gel permeation and ion exchange chromatography. Introduction of HPLC, instrumentation, reverse phase HPLC, industrial applications of HPLC.											
Unit-5	Number of lectures=08		Title of the unit: Computer application								
Elements of computer system set-up, components of computer system, generation of computer and computer languages, personal computers, PC-software packages, an introduction, disk operating system and windows, text processing software, introduction to a spreadsheet software, creation of spreadsheet software, creation of spreadsheet applications, range, formulas, function, data base functions in spreadsheets, graphics on spreadsheet, presentation graphics, creating a presentation on a PC, data communications, networking: Lan & Wans, software system, software development process, file design & report design, Data files: types/organization, master & transaction file, relevance of database management systems and integration of applications, basic of data processing, flow charting, input-process- output analysis, report generation and label generation.											
11. CO-PO mapping											
COs	Attributes			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Students would be able to analyze the data by applying different type of statistical methods and would also understand the difference between systematic and random errors.			3	1	1	1	2	3	2	3
CO2	Students evaluate fundamentals of electrochemistry and recognize the electrochemical processes. They got sound inside of different type of polarographic and voltammetric methods and their applications.			3	1	1	2	1	3	2	3
CO3	Students would develop the concept of thermogravimetric analysis, differential analysis and differential scanning calorimetry methods and their applications.			3	1	1	2	1	3	2	2
CO4	Students would restate difference between different modes of chromatographic separation; apply knowledge of qualitative and quantitative analysis in various fields of chemical, pharmaceutical industry etc.			3	2	1	2	2	3	1	2
CO5	Students would be able to illustrate how the computer and software are used in analytical laboratory and got springboard for further study.			3	2	1	2	3	3	1	2
3 Strong contribution, 2 Average contribution, 1 Low contribution											
12.Brief description of self-learning /E-learning component											
1. https://www.youtube.com/watch?v=HEgl0JyX80U 2. https://www.youtube.com/watch?v=d1vv7ww8xtA 3. https://www.youtube.com/watch?v=NzbDEjI8IKE 4. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod5.pdf 5. https://www.youtube.com/watch?v=Cu_WeVyOaHI											
13. Books recommended:											
1. Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications. 2. Principles and practice of analytical chemistry, F. W. Fifield, D. Kealey, 5th edition, Blackwell publication. 3. Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication. 4. Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers.											

1. Name of the Department: Chemistry									
2. Course Name	CHEMISTRY OF NATURAL PRODUCTS			L	T	P			
3. Course Code	CH409			3	1	0			
4. Type of Course (use tick mark)				Core (√)	DE ()	FC ()			
5. Pre-requisite (if any)	BSc. with Chemistry	6. Frequency (use tick marks)	Even (√)	Odd ()	Either Sem ()	Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals									
Lectures = 30		Tutorials = 10		Practical = Nil					
8. COURSE OBJECTIVES: Students gain the knowledge of secondary plant metabolites such as terpenoids, alkaloids, carbohydrates, Amino Acid, Peptides & Proteins, steroids, Synthesis and medicinal uses of; caffeine, theophylline, theobromine and Phytopharmaceuticals.									
9. COURSE OUTCOMES (CO):									
<i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Create the concept of secondary plant metabolites; terpenoids and its general methods of structure determination, isoprene rule; Stereochemistry, constitution and synthesis of Citral and Menthol.								
CO2	Evaluate the general method of isolation, structure elucidation of alkaloid, specially based on nitrogen heterocyclic ring (Hofmann's exhaustive methylation, Emde's degradation and Von Braun's method).								
CO3	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids.								
CO4	Know about, classification, general method of preparation, properties and reactions of amino acids, general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins.								
CO5	Understand the Synthesis and medicinal uses of; caffeine, theophylline, theobromine. Phytopharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of novel therapeutic leads from natural products.								
10. Unit wise detailed content									
Unit-1	Number of lectures = 08	Title of the unit: Terpenoids							
Introduction, nomenclature, occurrence, general properties, classification, isolation and general methods of structure determination of terpenoids, isoprene rule; Stereochemistry, constitution and synthesis of Citral and Menthol. Carotenoids; Introduction, classification, isolation and general method of structure determination of carotenoids.									
Unit-2	Number of lectures = 08	Title of the unit: Alkaloids							
Introduction, nomenclature, classification, isolation, physiological action, occurrence and general method of structure elucidation of alkaloid, specially based on nitrogen heterocyclic ring (Hofmann's exhaustive methylation, Emde's degradation and Von Braun's method).									
Unit-3	Number of lectures = 08	Title of the unit: Carbohydrates & Steroids							
Introduction, classification, general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Steroids; Introduction, Diehl's hydrocarbon, nomenclature, stereochemistry and configuration of the nucleus of steroids.									
Unit-4	Number of lectures = 08	Title of the unit: Amino Acid, Peptides & Proteins							
Introduction, nomenclature, classification, general method of preparation, properties and reactions of amino acids. Introduction, occurrence, nomenclature, general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins.									
Unit-5	Number of lectures = 08	Title of the unit: Phytopharmaceuticals							
Synthesis and medicinal uses of; caffeine, theophylline, theobromine. Phytopharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of novel therapeutic leads from natural products.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Create the concept of secondary plant metabolites; terpenoids and its general methods of structure determination, isoprene rule; Stereochemistry, constitution and synthesis of Citral and Menthol.	3	1	2	1	1	2	2	2
CO2	Evaluate the general method of isolation, structure elucidation of alkaloid, specially based on nitrogen heterocyclic ring (Hofmann's exhaustive methylation, Emde's degradation and Von Braun's method).	3	1	2	1	2	2	2	2
CO3	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids.	3	1	2	1	2	2	2	2
CO4	Know about, classification, general method of preparation, properties and reactions of amino acids. general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins.	3	1	2	1	2	2	1	2
CO5	Understand the Synthesis and medicinal uses of; caffeine, theophylline, theobromine. Phytopharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of novel therapeutic leads from natural products.	3	1	2	1	2	2	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12. Brief description of self-learning / E-learning component									
1. https://www.intechopen.com/books/terpenes-and-terpenoids/introductory-chapter-terpenes-and-terpenoids									
2. https://www.intechopen.com/books/alkaloids-their-importance-in-nature-and-human-life/introductory-chapter-alkaloids									
3. https://study.com/academy/lesson/steroids-structure-function.html									
4. http://chemistry.creighton.edu/~jksoukup/lec5-aminoacidsSTUD.pdf									
5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/127106009/lec4.pdf									
13. Books recommended:									
1. Natural products: Chemistry and Biological Significance, J.Mann, R.S.Davidson, J.B.Hobbs, d.V.Banthrope and B.Harborne, Longman, Essex.									
2. Organic Chemistry, Vol 2, I. L. Finar, ELBS.									
3. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta And. Marston, Harwood Academic Publishers.									
4. Chemistry of natural products, S.V.Bhat, B.A.Nagasampagi, M. Sivakumar.									
5. Natural products from plants, Peter B. Kaufman, Leland J. Creke, Sara Warber, James A. Dupe, Harry L. Brielmann, CRC publication									
6. Organic chemistry of natural products, Vol. I and II, Gurdeep Chatwal, Himalya Publishing house.									

1. Name of the Department: Chemistry												
2. Course Name	CORROSION, LUBRICATION AND PAINT TECHNOLOGY				L	T	P					
3. Course Code	CH410				3	1	0					
4. Type of Course (use tick mark)					Core(√)	DE()	FC()					
5. Pre-requisite (if any)	B.Sc. with Chemistry	6. Frequency (use tick marks)		Even (√)	Odd ()	Either Sem ()		EverySem()				
7. Total Number of Lectures, Tutorials, Practicals												
Lectures=30				Tutorials=10			Practical=Nil					
8. COURSE OBJECTIVES: Main objective includes deep understanding of mechanism of corrosion, lubrication and action of lubricants, properties, constituents and formulation of industrial paints, dyes and varnishes.												
9. COURSE OUTCOMES (CO): After the successful course completion, learners will develop following attributes:												
COURSE OUTCOME (CO) ATTRIBUTES												
CO1	Explain the theories and mechanisms of corrosion. Describe, identify, analyze, and compare different corrosion types. Formulate industry relevant surface treatment methods for metals and alloys and corrosion protection strategies.											
CO2	Comprehension of the fundamentals of lubricants, lubrication and the lubricants operating requirements, relationship with the lubrication requirements, as well as on the lubricants properties. Know how to recommend a lubricant and how to identify the causes of in-service issues and their solutions, defend the selection of an appropriate lubricant for perfect lubrication.											
CO3	Describe the ingredients and characteristics of paint. Evaluate the properties (adhesion, hardness, thickness, extent of cure, etc.) of the cured film. Will be familiar with the composition of paints and coatings and modern technologies used in the preparation of paint/coatings formulations.											
CO4	Comprehension of properties, constituents and formulations of pigments and dyes, differentiate dyes and pigments, their mechanisms of action and applications.											
CO5	Comprehensive understanding of properties, constituents, formulations and uses of varnishes. Develop an appropriate choice of coating material (paint, pigment, dye or varnish) based on the nature of the substrate.											
10. Unit wise detailed content												
Unit-1	Number of lectures=08			Title of the unit: Corrosion								
Introduction to corrosion, cause of corrosion, Theories of Corrosion, Mechanism of Electrochemical or Wet corrosion, dry corrosion, Factors influencing corrosion; Types of corrosion- Galvanic corrosion, Erosion Corrosion, Crevice corrosion, Pitting corrosion, Intergranular corrosion, Waterline Corrosion, Stress corrosion, Microbiological corrosion, Fatigue Corrosion, Fretting Corrosion; Protection from corrosion: Design and Material selection, Cathodic & Anodic protection, Corrosion inhibitors, Passivity, Galvanizing, Tinning and Electroplating, Pourbiax (P ^H potential) diagram												
Unit-2	Number of lectures=08			Title of the unit: Lubrication								
Introduction, Friction and wear, Lubricants, Theories of Friction, Lubrication and wear, Mechanism of lubrication- Fluid or Hydrodynamic; lubrication, Boundary and extreme pressure lubrication; Classification of lubricants: Solid, Semisolid, Synthetic lubricants, lubricating oils - vegetable oils, animal oils, mineral oils, blended oils, lubricating emulsion, greases; Properties of lubricating oils, cutting fluids, selection of lubricants.												
Unit-3	Number of lectures=08			Title of the unit: Paint Technology								
Introduction to paint, ingredient and classification; Essential concepts of paint formulation, formulation of coating for masonry, steel work, aircrafts, automobile, distempers, etc., Failure of paint film; Testing and evaluation tests of liquids films, dry films, performance and weathering test, world standard specification for paints and materials.												
Unit-4	Number of lectures=08			Title of the unit: Pigments and Dyes								
Introduction to pigments, general and physical properties; Preparation, properties and uses of Black pigment (Carbon black), Yellow pigment (chrome yellow), Red pigment (Red lead), Green pigment (Chrome green), White pigment (ZnO), Blue pigment (Ultramarine blue); Properties of Coating, solvent plasticizers Dyes: Introduction, Classification, Methods of dyeing, Basic operations in dyeing, Study of Phenolphthalein, Methyl orange and Crystal violet. Difference between pigment and dye.												
Unit-5	Number of lectures=08			Title of the unit: Varnishes								
Introduction to varnishes, physical properties of varnishes; Constituents of varnishes, classification and formulation of industrial varnishes; Characteristics of good varnish; Applications of varnish.												
11. CO-PO mapping												
COs	Attributes				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Explain the theories and mechanisms of corrosion. Describe, identify, analyze, and compare different corrosion types. Formulate industry relevant surface treatment methods for metals and alloys and corrosion protection strategies.				3	2	2	2	1	2	2	2
CO2	Comprehension of the fundamentals of lubricants, lubrication and the lubricants operating requirements, relationship with the lubrication requirements, as well as on the lubricants properties. Know how to recommend a lubricant and how to identify the causes of in-service issues and their solutions, defend the selection of an appropriate lubricant for perfect lubrication.				3	2	2	2	2	2	1	2
CO3	Describe the ingredients and characteristics of paint. Evaluate the properties (adhesion, hardness, thickness, extent of cure, etc.) of the cured film. Will be familiar with the composition of paints and coatings and modern technologies used in the preparation of paint/coatings formulations.				3	2	2	1	2	2	1	2
CO4	Comprehension of properties, constituents and formulations of pigments and dyes, differentiate dyes and pigments, their mechanisms of action and applications.				3	2	1	2	2	1	2	2
CO5	Comprehensive understanding of properties, constituents, formulations and uses of varnishes. Develop an appropriate choice of coating material (paint, pigment, dye or varnish) based on the nature of the substrate.				3	2	1	2	2	1	1	2
3 Strong contribution, 2 Average contribution, 1 Low contribution												
12. Brief description of self-learning /E-learning component												
<ol style="list-style-type: none"> https://www.youtube.com/watch?v=5OxdXq91TV0 https://www.youtube.com/watch?v=WQ8v-UcACTE https://www.youtube.com/watch?v=Keff0zA7Zq8 https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/116102052/lec3.pdf https://www.oreilly.com/library/view/basic-civil-engineering/9788131729885/xhtml/chapter010.xhtml 												
13. Books recommended:												

1. Friction and Lubrication of Solids - Bowden, F.P. and D. Tabor Part I & II Clarendon Press, Oxford (1954)
2. An Introduction to Metallic Corrosion – 3rd Ed., Ulick R. Evans, Edward Arnold Ltd. And ASM (1981)
3. Corrosion and Corrosion Control 3rd Ed., H.H. Uhling & R.Winston Revie, Wiley- Inter Sciences, New York (1985)
4. Corrosion Engineering, 3rd, Ed., M.G. Fontana, McGraw Hill, New York (1986).

1. Name of the Department: Chemistry									
2. Course Name	PHARMACEUTICAL CHEMISTRY			L	T	P			
3. Course Code	CH411			3	1	0			
4. Type of Course (use tick mark)				Core (✓)	DE ()	FC ()			
5. Pre-requisite (if any)	B.Sc. with Chemistry	6. Frequency (use tick marks)	Even (✓)	Odd ()	Either Sem ()	Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals									
Lectures = 30		Tutorials = 10		Practical = Nil					
8. COURSE OBJECTIVES: Student should understand the Synthesis, uses and mode of action of Antibiotics and Sulpha Drugs, Antipyretics, analgesics, Anesthetic drugs, cardiovascular drugs, Drug Design.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Evaluate the concept of antibiotics. Classification, synthesis, mode of action and uses of different types of antibiotics.								
CO2	Analyze classification, structure, synthesis and uses of analogues of p-aminophenol, Salicylic acid, Pyrazolones and Pyrazolodiones.								
CO3	Create the basic knowledge, Classification, Synthesis and mode of action of Inhalation, Intravenous anesthetics and Basal anesthetics.								
CO4	Analyze classes, structure, synthesis and mode of action of cardiac glycosides Digoxin, and Digitoxin; Anti-hypertensive and hypotensive drugs, Antiarrhythmic agents.								
CO5	Comprehension of analogues and prodrugs; concept of lead; factors governing drug design; rational approach to drug design; revolutions in drug discovery, research and development strategies.								
10. Unit wise detailed content									
Unit-1	Number of lectures = 08	Title of the unit: Antibiotics and Sulpha Drugs							
Introduction and classification of antibiotics; beta lactam antibiotics: penicillins, its structure and mode of action, synthesis of Penicillin-v. Cephalosporins: classification, structure and mode of action of first, second, third and fourth generation cephalosporins. Aminoglycoside antibiotics: structure and mode of action of Streptomycin, Neomycin and Kenamycin. Chloramphenicol: its structure, synthesis and mode of action. Synthesis and uses of sulphathiazole, sulphaguanidine, sulphadiazine, sulphamethazine and sulphaacetamide.									
Unit-2	Number of lectures = 08	Title of the unit: Antipyretics analgesics							
Introduction, classification, structure, synthesis and uses of analogues of p-aminophenol: Paracetamol, Phenacetin and antifebrin; Salicylic acid analogues: Aspirin, Salol, Salsalate and benorilate; Pyrazolones and Pyrazolodiones analogues: Antipyrine, Aminopyrin, Dipyrone, Phenylbutazone, Oxyphenbutazone and Sulphinpyrazone									
Unit-3	Number of lectures = 08	Title of the unit: Anesthetic drugs							
Introduction, Classification, Synthesis and mode of action of; Inhalation anesthetics: Vinyl ether, Cyclopropane and Fluoroxene; Intravenous anesthetics: Thiopental Sodium & Methohexital Sodium; Basal anesthetics: Procaine hydrochloride, Tetracaine hydrochloride, Butacaine hydrochloride, Benzamine hydrochloride and Pyrocaine hydrochloride.									
Unit-4	Number of lectures = 08	Title of the unit: Cardiovascular drugs							
Introduction, classification, structure and mode of action of cardiac glycosides Digoxin, and Digitoxin; Anti-hypertensive and hypotensive drugs: structure, synthesis and mode of action of Losartan, Clonidine, Hydralazine, Methyl dopa and Diazoxide; Antiarrhythmic agents: structure, synthesis and mode of action of Diisopyramide, Procainamide, Propranolol, Berilyium Tosilate; Vasopressor drugs: structure, synthesis and mode of action of Isoxsuprine, Prenyl amine.									
Unit-5	Number of lectures = 08	Title of the unit: Drug Design							
Introduction; analogues and prodrugs; concept of lead; factors governing drug design; rational approach to drug design; Drug design: the method of variation; Drug design and development: preamble, revolutions in drug discovery, research and development strategies.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Evaluate the concept of antibiotics. Classification, synthesis, mode of action and uses of different types of antibiotics.	3	1	2	2	2	3	2	2
CO2	Analyze classification, structure, synthesis and uses of analogues of p-aminophenol, Salicylic acid, Pyrazolones and Pyrazolodiones.	3	1	2	2	2	3	2	2
CO3	Create the basic knowledge, Classification, Synthesis and mode of action of Inhalation, Intravenous anesthetics and Basal anesthetics.	3	1	2	2	2	3	2	2
CO4	Analyze classes, structure, synthesis and mode of action of cardiac glycosides Digoxin, and Digitoxin; Anti-hypertensive and hypotensive drugs, Antiarrhythmic agents.	3	1	2	2	2	3	3	2
CO5	Comprehension of analogues and prodrugs; concept of lead; factors governing drug design; rational approach to drug design; revolutions in drug discovery, research and development strategies.	3	1	2	2	2	3	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12. Brief description of self-learning / E-learning component									
1. https://www.youtube.com/watch?v=NGwP471sehl									
2. https://www.youtube.com/watch?v=Ac6yMWno6yk									
3. https://www.youtube.com/watch?v=-UD0y4jdKuc									
4. http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf									
5. https://www.youtube.com/watch?v=2vLDzMSo2Tc&list=PLg8Xhs-vwgXLSkf7XRqynlrY6aGHseZry&index=43									
13. Books recommended:									
1. Burger's Medicinal Chemistry: Mangrove E. Wolff, 4th Edition, John Wiley and Sons									
2. Medicinal Chemistry by Asutosh Kar, New Age International publication									
3. Principles of Medicinal Chemistry: W.O.Foye.									
4. The Pharmacological Basis of Therapeutics: L.S. Goodman and A.Gilman									
5. Wilson's Medicinal Chemistry The Organic Chemistry of Drug Synthesis: D. Lednicer and L.A.Mitscher									

1. Name of the Department: Chemistry									
2. Course Name	INDUSTRIAL CHEMISTRY PRACTICAL-2			L	T	P			
3. Course Code	CH412			0	0	8			
4. Type of Course (use tick mark)				Core (√)	DE ()	FC ()			
5. Pre-requisite (if any)	B.Sc. with Chemistry	6. Frequency (use tick marks)	Even (v)	Odd ()	Either Sem ()	Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals									
Lectures = 00		Tutorials = 00		Practical = 08					
8. COURSE OBJECTIVES: Imparting of scientific methodology, Development of practical/technical skills, The ability to work effectively and safely in a laboratory environment, Developing transferable skills (team work, time management), Enhancing communication skill.									
9. COURSE OUTCOMES (CO):									
<i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry								
CO2	Able to detect adulterants in the given food sample.								
CO3	Know the determination of strength of acid, optical rotation of cane sugar. Saponification value of oil, acid value of oil. Isolation of lycopene, nicotine, lactose and casein, lecithin Caffeine from tea. Preparation of Acetanilide, Aspirin, Paracetamol.								
CO4	Remember to keep records of all performed experiments in the manner, which is required in laboratory.								
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.								
10. List of experiments									
<ol style="list-style-type: none"> Determination of strength of acid against strong base by pH meter. Determination of optical rotation of cane sugar. Determination of saponification value in the given oil. Determination of acid value in the given oil. Detection of adulterants in the given food sample. Estimation of amino acid. Estimation of Glucose. Estimation of aspirin present in the given drug. Separation of essential oils by soxhlet extractor. Isolation of Lycopene from tomato. Isolation of Nicotine from tobacco. Isolation of Lactose and caesin from milk. Isolation of lecithin from egg yolk. Isolation of Caffeine from tea. Preparation of Acetanilide. Preparation of Aspirin. Preparation of Magnesium bisilicate (antacid). Preparation of Paracetamol. 									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry	3	1	1	1	1	2	1	2
CO2	Able to detect adulterants in the given food sample.	3	1	3	1	2	3	3	2
CO3	Know the determination of strength of acid, optical rotation of cane sugar. Saponification value of oil, acid value of oil. Isolation of lycopene, nicotine, lactose and casein, lecithin Caffeine from tea. Preparation of Acetanilide, Aspirin, Paracetamol.	3	1	1	1	2	2	1	2
CO4	Remember to keep records of all performed experiments in the manner, which is required in laboratory.	3	1	1	1	2	2		
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	3	1	1	1	2	2	1	3
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12. Brief description of self- learning / E-learning component									
<ol style="list-style-type: none"> https://www.youtube.com/watch?v=MTsn1-ToKqQ 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 https://www.youtube.com/watch?v=249FNCSR-Cw https://www.youtube.com/watch?v=2O8h9utwKA4 									
13. Books recommended:									
<ol style="list-style-type: none"> 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. 									

Semester– III

Name of the Department		CHEMISTRY										
2. Course Name		POLYMER CHEMISTRY			L	T	P					
3. Course Code		CH501			3	1	0					
4. Type of Course (use tick mark)					Core (<input checked="" type="checkbox"/>)	DE (<input type="checkbox"/>)	FC (<input type="checkbox"/>)					
5. Pre-requisite (if any)		B.Sc. with Chemistry	6. Frequency (use tick marks)		Even (<input type="checkbox"/>)	Odd (<input checked="" type="checkbox"/>)	Either Sem (<input type="checkbox"/>)	Every Sem (<input type="checkbox"/>)				
7. Total Number of Lectures, Tutorials, Practicals												
Lectures = 30			Tutorials = 10			Practical = Nil						
8. COURSE OBJECTIVES: The main objective of this course is to study the mechanism of polymer preparation, their processing techniques, commercial uses, identification techniques and preparation process of vinyl polymers, polyamides, polyesters, synthetic rubbers, cellulose and copolymer resins												
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>												
COURSE OUTCOME (CO)		ATTRIBUTES										
CO1		Evaluate the different mechanisms of polymer preparation and their classification.										
CO2		Understand the colligative properties of Polymers and evaluate the identification techniques such as IR, NMR of Polymers.										
CO3		Analyze various processing techniques of Polymer.										
CO4		Understand the preparation process of vinyl polymers, polyamide, polyesters and rubber.										
CO5		Understand the Vulcanization of Rubber and synthesis of Synthetic Rubber and various other copolymer resins.										
10. Unit wise detailed content												
Unit-1		Number of lectures = 08			Title of the unit: Polymer & Polymerization							
Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; their kinetics, metallocene polymers and other newer techniques of polymerization, copolymerization, monomer reactivity ratios and its significance, kinetics, different copolymers, random, alternating, azeotropic												
Unit-2		Number of lectures = 08			Title of the unit: End group analysis							
Solubility and swelling, Concept of molecular weight distribution and its significance, concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, analysis of polymers using IR, XRD, microscopic (optical and electronic) techniques.												
Unit-3		Number of lectures = 08			Title of the unit: Polymer processing Techniques							
Commodity and general-purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, PBT, PSU, PPO, ABS, Fluoropolymers Thermosetting polymers: Polyurethane, PF, MF, UF, Epoxy, Unsaturated polyester, Alkyds. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex; SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE, Specialty plastics: PEK, PEEK, PPS, PSU, PES etc. Biopolymers such as PLA, PHA/PHB.												
Unit-4		Number of lectures = 08			Title of the unit: Some Commercially important Polymers							
Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, thermodynamics, phase morphology, polymer alloys, polymer eutectics, plastic-plastic, rubber-plastic and rubber-rubber blends, FRP, particulate, long and short fibre reinforced composites. Polymer reinforcement, reinforcing fibers – natural and synthetic, base polymer for reinforcement (unsaturated polyester), ingredients / recipes for reinforced polymer composite.												
Unit-5		Number of lectures = 08			Title of the unit: Vulcanization of rubber							
Polymer compounding-need and significance, different compounding ingredients for rubber and plastics (Antioxidants, Light stabilizers, UV stabilizers, Lubricants, Processing aids, Impact modifiers, Flame retardant, antistatic agents. PVC stabilizers and Plasticizers) and their function, use of carbon black, polymer mixing equipment, cross-linking and vulcanization, vulcanization kinetics												
11. CO-PO mapping												
COs		Attributes			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		Evaluate the different mechanisms of polymer preparation and their classification.			3	2	1	1	1	2	2	2
CO2		Understand the colligative properties of Polymers and evaluate the identification techniques such as IR, NMR of Polymers.			3	1	1	1	1	2	1	2
CO3		Analyze various processing techniques of Polymer.			3	1	2	2	1	3	2	3
CO4		Understand the preparation process of vinyl polymers, polyamide, polyesters and rubber.			3	2	3	2	1	3	2	3
CO5		Understand the Vulcanization of Rubber and synthesis of Synthetic Rubber and various other copolymer resins.			3	2	2	2	1	3	2	3
3 Strong contribution, 2 Average contribution, 1 Low contribution												
12. Brief description of self-learning / E-learning component												
1. https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod7.pdf												
2. https://www.e-education.psu.edu/matse202/node/712												
3. http://eacharya.inflibnet.ac.in/data-server/eacharya_documents/55daa452e41301c73a2cb5ac_INFIEP_208/806/ET/lec%20-3.pdf												
4. https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod7.pdf												
5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113105028/lec20.pdf												
13. Books recommended:												
1. Principles of polymer chemistry: A Ravve, 2nd Edition, Kluwer Academic publications												
2. Polymer Science and technology: Joll. R. Fried, Prentice – Hall.												
3. Principles of polymer systems: F. Rodriguez, Claude Cohen, C.K. Ober, L.A. Archer, Vth Edition, Taylor & Francis												
4. Introduction to polymers: R.J. Young and P.A. Lovell, 2nd Edition, Netron Thornes publications												
5. Polymer chemistry – an introduction, Malcolm D. Stevens, Oxford University press.												

1.Name of the Department: Chemistry												
2.Course Name	PETROLEUM CHEMISTRY				L	T	P					
3.Course Code	CH502				3	1	0					
4.Type of Course (use tick mark)					Core(√)	DE()	FC()					
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency (use tick marks)		Even ()	Odd (√)	Either Sem ()		EverySem()				
7.Total Number of Lectures,Tutorials,Practicals												
Lectures=30				Tutorials=10			Practical=Nil					
8. COURSE OBJECTIVES: To introduce the basic fundamental knowledge of petrochemicals: origin, composition, exploration and desalting of petrochemicals along with essentials, profile and methods of distillation accompanied by processing and treatments of petroleum. Also, introduce refining and cracking processes of petroleum, lubricating oils, additives and naphtha cracking with the introduction of quality procedures like ASTM/BIS/IP/DIN.												
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>												
COURSE OUTCOME (CO)		ATTRIBUTES										
CO1		Introduction of origin, composition, exploration and desalting of petrochemicals create a better understanding of petroleum.										
CO2		Knowledge of the fundamentals, profile and methods of distillation along with processing and treatments of petroleum provide the extra strength to analyzed crude oil.										
CO3		Overview, classification, stabilization, absorption and adsorption purification of hydrocarbons and fuels another significant parameter to evaluate the quality of petroleum.										
CO4		Outline of refining and cracking processes of petroleum are the valuable methods that can provide the fundamentals of handling are well as an understanding of chemical changes in the petroleum.										
CO5		Teach to remember lubricating oils, additives and naphtha cracking along with the introduction of quality procedures like ASTM/BIS/IP/DIN.										
10.Unitwisedetailedcontent												
Unit-1		Number of lectures=08			Title of the unit: Introduction to Petroleum							
Introduction, origin of petroleum in nature, carbide theory, anglers theory, modern views; Petroleum exploration in India and their resources; crude oil, natural gas; composition of petroleum; preparation of crude for processing; destruction of natural emulsion of petroleum crude, desalting.												
Unit-2		Number of lectures=08			Title of the unit: Methods of Petroleum distillation							
Fundamentals of preliminary distillation; Methods of petroleum distillation; Distillation of crude petroleum; Treatment of the residual liquid; Processing of liquid fuels such as petroleum and petroleum products; Product profile of refinery distillations and their specification.												
Unit-3		Number of lectures=08			Title of the unit: Classification of Liquefied hydrocarbon gases and fuels							
Introduction and classification of Liquefied hydrocarbon gases and fuels; Fuels for jet engines and gas turbine engines; Dye intermediates, Lacquers, Solvent and thinnerAbsorptive and adsorptive purification, Sulphuric acid purification, alkaline purification, Hydrofining, New method of purification, demercaptanisation, Stabilization.												
Unit-4		Number of lectures=08			Title of the unit: Petroleum Refining and Cracking							
Introduction of petroleum refining, cracking, application of cracking, synthetic petrol, Bergius process, Fischer-Tropsh process, octane number, flash point, determination of flash point, synthesis of pure chemicals from petrochemicals.												
Unit-5		Number of lectures=08			Title of the unit: Lubricating oils and additives							
Lubricating oils and additives, fuel quality aspects and environment aspects, Case study of Naphtha crackers and their product profile, introduction to quality procedures like ASTM/BIS/IP/DIN.												
11. CO-PO mapping												
COs	Attributes				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Introduction of origin, composition, exploration and desalting of petrochemicals create a better understanding of petroleum.				1	1	1	2	3	3		2
CO2	Knowledge of the fundamentals, profile and methods of distillation along with processing and treatments of petroleum provide the extra strength to analyzed crude oil.				2	-	-	-	3	2	-	-
CO3	Overview, classification, stabilization, absorption and adsorption purification of hydrocarbons and fuels another significant parameter to evaluate the quality of petroleum.				2	-	-	-	3	2	-	-
CO4	Outline of refining and cracking processes of petroleum are the valuable methods that can provide the fundamentals of handling are well as an understanding of chemical changes in the petroleum.				2	-	2	-	3	2	-	2
CO5	Teach to remember lubricating oils, additives and naphtha cracking along with the introduction of quality procedures like ASTM/BIS/IP/DIN.				1	-	2	2	3	2	-	2
3 Strong contribution, 2 Average contribution , 1 Low contribution												
12.Brief description of self-learning /E-learning component												
1. https://byjus.com/chemistry/petroleum/ 2. https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf 3. https://www.shell.com/energy-and-innovation/natural-gas/liquefied-natural-gas-Ing.html 4. https://www.e-education.psu.edu/fsc432/content/lesson-7-overview 5. https://www.stle.org/images/pdf/STLE_ORG/BOK/LS/Additives/The%20Chemistry%20and%20Function%20of%20Lubricant%20Additives.pdf												
13. Books recommended:												
1. Fuel technology by Wilfrid Francis and M.C.Peters. Plenum press (1981). 2. Fuel Science and Technology Handbook, James G. Speight. Marcel Dekker (1990) 3. Fuels and Combustion, Samir Sarkar, 2nd.Edition, Orient Longmans (1990) Mumbai. 4. Modern Petroleum refining process, B.K. Bharbana Rao, Oxford and IBH publication 5. Petroleum chemistry and refining , James g. Speight, Taylor and francis publishers 6. Fuel technology by Wilfrid Francis and M.C.Peters. Plenum press (1981). 7. Fuel Science and Technology Handbook, James G. Speight. Marcel Dekker (1990) 8. Fuels and Combustion, Samir Sarkar, 2nd.Edition,Orient Longmans (1990) Mumbai. 9. Petroleum refining, William L. Leffler, Pennwell publication												

1.Name of the Department: Chemistry												
2.Course Name	AGRO CHEMISTRY				L	T	P					
3.Course Code	CH503				3	1	0					
4.Type of Course (use tick mark)					Core(√)	DE()	FC()					
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency (use tick marks)			Even ()	Odd (√)	Either Sem ()	Every Sem()				
7.Total Number of Lectures,Tutorials,Practicals												
Lectures=30				Tutorials=10			Practical=Nil					
8. COURSE OBJECTIVES: Students will be able to understand of Synthesis, structure activity relationship, formulation of Organophosphates,Organochlorines and Carbamates Insecticides and their mode of actions, Classification and chemistry of Fungicides Synthesis and uses of some aromatic acid derivatives as herbicide concepts of QSAR and CMM in pesticide design												
9. COURSE OUTCOMES (CO): After the successful course completion, learners will develop following attributes:												
COURSE OUTCOME (CO)		ATTRIBUTES										
CO1	Remember the concept of pesticides, Classification of Insecticides, synthesis, structure activity relationship, mode of action, uses and formulation of Organochlorines and Carbamates Insecticides.											
CO2	Analyze and compare Organophosphate over Organochlorines Insecticides, Synthesis, and structure activity relationship, mode of action, uses and formulation of Organophosphate.											
CO3	Create the basic knowledge of chemistry of fungicides and also able to evaluate different classes like Inorganic sulfur, dithiocarbamates, antibiotics, quinones, benzimidazole.											
CO4	Analyze and compare the applications and commercial synthetic methodologies of Aromatic Acid compounds, N, N-dimethylureas, anilides and new highly potent sulphonyl urea derivatives as herbicides.											
CO5	Comprehension of Quantitative structure–activity relationship (QSAR), Computer-Assisted Molecular Modeling (CMM) in pesticide design, rodenticides and Molluscicides.											
10.Unit wise detailed content												
Unit-1	Number of lectures=08	Title of the unit: Organochlorines and Carbamates Insecticides										
General Introduction and concept of pesticides, Classification of Insecticides, synthesis, structure activity relationship, mode of action, uses and formulation of following insecticides: Organochlorines: DDT, HCH (Lindane), Heptachlor and endosulfan; Carbamates: Phenyl carbamates (carbaryl and carbofuran), N-Methylcarbamates (Zectran, Isolan), Oxime carbamates (Oxamil, Methyomyl).												
Unit-2	Number of lectures=08	Title of the unit: Organophosphorous Insecticides										
Synthesis, structure activity relationship, mode of action, uses and formulation of following insecticides: Organophosphorous: methyparathion, malathion, phosphamidon, dichlorvos, phosdrin, monocrotophos, dicrotophos, fenitrothion, fenthion, chlorpyrifos & phosalone.												
Unit-3	Number of lectures=08	Title of the unit: Fungicides										
Classification and chemistry of following fungicides: Inorganic; sulfur, copper-oxchloride and organomercurials. Dithiocarbamates; ziram, thirum and zineb. Quinones; chloranil. Antibiotics; kasugamycin and griseofulvin. Benzimidazole; carbendazim, thiabendazole.												
Unit-4	Number of lectures=08	Title of the unit :Herbicides										
Synthesis and uses of following herbicides:Aromatic Acid compounds; 2, 4-D, 2, 4, 5-T. N, N-dimethylureas; monuron and diuron Anilides; alachlor and butachlor , New high potency herbicides like sulfonylureas												
Unit-5	Number of lectures=08	Title of the unit: Rodenticides, Molluscicides, QSAR and CMM										
Synthesis and uses of following miscellaneous chemicals; Rodenticides: Hydroxycoumarin: Dicoumarin, Warfarin Zinc-phosphide and bromodiolone; Molluscicides: metaldehyde and carbamates; Quantitative Structure Activity Relationship (QSAR) & Computer Assisted Molecular Modelling (CMM) in Pesticide Design												
11. CO-PO mapping												
COs	Attributes				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Remember the concept of pesticides, Classification of Insecticides, synthesis, structure activity relationship, mode of action, uses and formulation of Organochlorines and Carbamates Insecticides.				3	1	2	2	2	3	2	2
CO2	Analyze and compare Organophosphate over Organochlorines Insecticides, Synthesis, and structure activity relationship, mode of action, uses and formulation of Organophosphate.				3	1	2	2	2	3	2	2
CO3	Create the basic knowledge of chemistry of fungicides and also able to evaluate different classes like Inorganic sulfur, dithiocarbamates, antibiotics, quinones, benzimidazole.				3	1	2	2	2	3	2	2
CO4	Analyze and compare the applications and commercial synthetic methodologies of Aromatic Acid compounds, N, N-dimethylureas, anilides and new highly potent sulphonyl urea derivatives as herbicides.				3	1	2	2	2	3	3	2
CO5	Comprehension of Quantitative structure–activity relationship (QSAR), Computer-Assisted Molecular Modeling (CMM) in pesticide design, rodenticides and Molluscicides.				3	1	2	2	2	3	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution												
12.Brief description of self-learning /E-learning component												
1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107081/lec39.pdf												
2. https://www.cdc.gov/biomonitoring/pdf/OP-DPM_FactSheet.pdf												
3. https://nptel.ac.in/content/storage2/courses/126104003/LectureNotes/Week-5_Chemicals_IPM_history_classification_lect3.pdf												
4. https://nptel.ac.in/content/storage2/courses/104108056/module9/PNR%20lecture%2036.pdf												
5. https://www.ncbi.nlm.nih.gov/pubmed/8941939												
13. Books recommended:												
1. Fuel technology by Wilfrid Francis and M.C.Peters. Plenum press (1981).												
2. Fuel Science and Technology Handbook, James G. Speight. Marcel Dekker (1990)												
3. Fuels and Combustion, Samir Sarkar, 2nd.Edition, Orient Longmans (1990) Mumbai.												
4. Modern Petroleum refining process, B.K. Bharbana Rao, Oxford and IBH publication												
5. Petroleum chemistry and refining, James g. Speight, Taylor and francis publishers												
6. Fuel technology by Wilfrid Francis and M.C.Peters. Plenum press (1981).												
7. Fuel Science and Technology Handbook, James G. Speight. Marcel Dekker (1990)												
8. Fuels and Combustion, Samir Sarkar, 2nd.Edition, Orient Longmans (1990) Mumbai.												
9. Petroleum refining, William L. Leffler, Pennwell publication												

1.Name of the Department: Chemistry											
2.Course Name	COSMETICS AND PERFUMERY			L	T	P					
3.Course Code	CH504			3	1	0					
4.Type of Course (use tick mark)				Core (√)	DE ()	FC ()					
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem()					
7.Total Number of Lectures,Tutorials,Practicals											
Lectures=30			Tutorials=10		Practical=Nil						
8. COURSE OBJECTIVES: Students to understand the Chemical Nature and Utility of Emulsifiers, lipid components, humectants, and fragrances. Cosmetic Raw Materials, Face powder and lipstick, Cosmetic for Skin, Hair products, Herbal Cosmetics.											
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>											
COURSE OUTCOME (CO)	ATTRIBUTES										
CO1	Evaluate the concept of Chemical Nature and Utility of Emulsifiers, lipid components, humectants, and fragrances.										
CO2	Analyze Chemical Nature and Utility of colours (dyes and pigments), preservatives and antioxidants in cosmetics. Technical requirements, basic components and formulation of face powders and lipstick.										
CO3	Create the basic knowledge of general skin problems, purpose, types and key ingredients of skin cleansing, skin toners, moisturizers, nourishing, protective, sunscreen and bleaching products. Antiperspirants and deodorants.										
CO4	Analyze general hair problems and scalp disorders. Shampoos (requirements, classification, ingredients and special additives for hair condition and scalp health). Hair colourants and Chemical depilatories.										
CO5	Comprehension of the plant materials used in cosmetics. Use of herbs in different forms. Herbal cosmetics for skin and Herbal Cosmetics for hair.										
10.Unitwisedetailedcontent											
Unit-1	Number of lectures=08		Title of the unit: Cosmetic Raw Materials								
Study of Chemical Nature and Utility of Emulsifiers (natural, synthetic and finely dispersed solid), lipid components (oils, fats, waxes), humectants (inorganic, organic and organo-metallic) and perfumes / fragrances (plant oils, animal secretions, chemical substances).											
Unit-2	Number of lectures=08		Title of the unit: Cosmetic Raw Materials, Face powder and lipstick								
Study of Chemical Nature and Utility of colours (dyes and pigments), preservatives and antioxidants in cosmetics. Technical requirements, basic components and formulation of face powders and lipstick.											
Unit-3	Number of lectures=08		Title of the unit: Cosmetic for Skin								
Introduction to general skin problems, purpose, types and key ingredients of skin cleansing, skin toners, moisturizers, nourishing, protective (barrier), sunscreen and bleaching products. Antiperspirants and deodorants (mechanism, ingredients and formulation).											
Unit-4	Number of lectures=08		Title of the unit: Hair products								
Introduction to general hair problems and scalp disorders. Shampoos (requirements, classification, ingredients and special additives for hair condition and scalp health). Hair colourants (temporary, semi-permanent and gradual colourants and their dyeing system). Chemical depilatories.											
Unit-5	Number of lectures=08		Title of the unit: Herbal Cosmetics								
A comprehensive study of the plant materials used in cosmetics. Use of herbs in different forms. Herbal cosmetics for skin (cleaning creams, moisturizing creams, masks, body lotions, massage preparations, nourishing creams). Herbal Cosmetics for hair (conditioners, oils, shampoo, dyes).											
11. CO-PO mapping											
COs	Attributes			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Evaluate the concept of Chemical Nature and Utility of Emulsifiers, lipid components, humectants, and fragrances.			3	1	2	2	2	3	2	2
CO2	Analyze Chemical Nature and Utility of colours (dyes and pigments), preservatives and antioxidants in cosmetics. Technical requirements, basic components and formulation of face powders and lipstick.			3	1	2	2	2	3	2	2
CO3	Create the basic knowledge of general skin problems, purpose, types and key ingredients of skin cleansing, skin toners, moisturizers, nourishing, protective, sunscreen and bleaching products. Antiperspirants and deodorants.			3	1	2	2	2	3	2	2
CO4	Analyze general hair problems and scalp disorders. Shampoos (requirements, classification, ingredients and special additives for hair condition and scalp health). Hair colourants and Chemical depilatories.			3	1	2	2	2	3	3	2
CO5	Comprehension of the plant materials used in cosmetics. Use of herbs in different forms. Herbal cosmetics for skin and Herbal Cosmetics for hair.			3	1	2	2	2	3	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution											
12.Brief description of self-learning /E-learning component											
<ol style="list-style-type: none"> https://www.youtube.com/watch?v=z1SPZHKaQRg https://www.science.org.au/curious/people-medicine/chemistry-cosmetics https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mm13/ https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112107217/lec3.pdf http://priede.bf.lu.lv/groz/AuguFiziologijas/Augu_resursu_biologija/gramatas/Herbal%20Principles%20in%20Cosmetics.pdf 											
13. Books recommended:											
<ol style="list-style-type: none"> Perfumes, soaps, detergents and cosmetics-Bhatia, Volume I & II Poucher's Perfumes, Cosmetics and Soaps (Vol. III), Cosmetics (Vol. I & II) - Hilda Butler 											

1. Name of the Department: Chemistry									
2. Course Name	FOOD CHEMISTRY			L	T	P			
3. Course Code	CH505			3	1	0			
4. Type of Course (use tick mark)				Core ()	DE (v)	FC ()			
5. Pre-requisite (if any)	B.Sc. with Chemistry	6. Frequency (use tick marks)	Even ()	Odd (v)	Either Sem ()	Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals									
Lectures = 30		Tutorials = 10		Practical = Nil					
8. COURSE OBJECTIVES: Students gain the knowledge of secondary plant metabolites such as terpenoids, alkaloids, carbohydrates, Amino Acid, Peptides & Proteins, steroids, Synthesis and medicinal uses of; caffeine, theophylline, theobromine and Phytopharmaceuticals.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)		ATTRIBUTES							
CO1	Create the concept of secondary plant metabolites; terpenoids and its general methods of structure determination, isoprene rule; Stereochemistry, constitution and synthesis of Citral and Menthol.								
CO2	Evaluate the general method of isolation, structure elucidation of alkaloid, specially based on nitrogen heterocyclic ring (Hofmann's exhaustive methylation, Emde's degradation and Von Braun's method).								
CO3	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids.								
CO4	Know about, classification, general method of preparation, properties and reactions of amino acids, general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins.								
CO5	Understand the Synthesis and medicinal uses of; caffeine, theophylline, theobromine. Phytopharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of novel therapeutic leads from natural products.								
10. Unit wise detailed content									
Unit-1	Number of lectures = 08	Title of the unit: Governmental regulation							
Introduction, Food laws and standards: Indian and international food safety laws and standards; Quality and safety assurance in food industry; BIS Laboratory Services and Certification by BIS, Food labeling.									
Unit-2	Number of lectures =08	Title of the unit: Constituents of foods & their nutritive aspects							
Carbohydrates, Proteins, Fats and oils, Vitamins and Minerals. Food additives: Preservatives, Antioxidants, Chelating agents, Surface active agents, Stabilizing and Thickening agents, Bleaching and Maturing agents, Buffering agents, Colouring agents, Sweetening agents & Flavoring agents.									
Unit-3	Number of lectures = 08	Title of the unit: 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.									
Unit-4	Number of lectures = 08	Title of the unit: 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: HACCP method.									
Unit-5	Number of lectures = 08	Title of the unit: Fermentation and other uses of Microorganisms							
Industrial uses of bacteria, and yeast lactic acid fermentation, vinegar production, amino acid production, alcoholic fermentation, Bakers yeast, food yeast industrial uses of molds, Microbial Transformation: Type of bioconversion reaction, procedures of biotransformation.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Create the concept of secondary plant metabolites; terpenoids and its general methods of structure determination, isoprene rule; Stereochemistry, constitution and synthesis of Citral and Menthol.	3	1	2	1	1	2	2	2
CO2	Evaluate the general method of isolation, structure elucidation of alkaloid, specially based on nitrogen heterocyclic ring (Hofmann's exhaustive methylation, Emde's degradation and Von Braun's method).	3	1	2	1	2	2	2	2
CO3	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids.	3	1	2	1	2	2	2	2
CO4	Know about, classification, general method of preparation, properties and reactions of amino acids, general method of synthesis & determination of structure of polypeptides. Primary, secondary, tertiary & quaternary structure of proteins.	3	1	2	1	2	2	1	2
CO5	Understand the Synthesis and medicinal uses of; caffeine, theophylline, theobromine Phytopharmaceuticals: Recent development and commercialization of plant derived natural products. Strategies for rapid identification of novel therapeutic leads from natural products.	3	1	2	1	2	2	2	2
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12. Brief description of self-learning / E-learning component									
1. https://nptel.ac.in/content/storage2/courses/110108056/module5/Lecture32.pdf									
2. https://nptel.ac.in/content/syllabus_pdf/126104004.pdf									
3. http://ncert.nic.in/textbook/pdf/lehe105.pdf									
4. https://swayam.gov.in/nd1_noc20_ce07/preview									
5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/102105058/lec36.pdf									
13. Books recommended:									
1. Food Chemistry, Belitz and Gosch, Springer – Verlag Bertin Heiderberg, 2nd Edition, 1999									
2. Principles of Human Nutrition, Martin Eastwood, Chapman and Hall, London, 1st Edition, 1997.									
3. Food – The Chemistry of its Components, T.P. Coultate, Royal Soc. Chemistry, 4th Edition, 2002.									
4. Food additives, Branan, Alfred Larry, Davidson P. Michae, Food Science and Technology series (35), Morcel Dekker, Inc, 1990.									
5. Introduction to food science, Rick Parker, Delmar Learning, U.S.A, 1st Edition, 2003.									
6. Nutrition Science and application, Lori Smolin L.A., Saunders College Publishing, 3rd Edition.									

1.Name of the Department: Chemistry									
2.Course Name	BIOINORGANIC AND SUPRAMOLECULAR CHEMISTRY			L	T	P			
3.Course Code	CH506			3	1	0			
4.Type of Course (use tick mark)				Core()	DE(v)	FC()			
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency (use tick marks)	Even ()	Odd (v)	Either Sem ()	EverySem()			
7.Total Number of Lectures,Tutorials,Practicals									
Lectures=30			Tutorials=10		Practical=Nil				
8. COURSE OBJECTIVES: This course is designed for postgraduate students of chemistry and industrial chemistry as a broad base introduction to analytical instrumentation techniques for the measurement of different chemical and physical properties of compounds and materials (composition, structure, etc.). After successful completion of course, the student will be able to understand the working principle and applications of various modern analytical techniques as well as their operation.									
9. COURSE OUTCOMES (CO):									
<i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Student would be able to understand the role of ions in biological system.								
CO2	Students evaluate fundamentals of enzyme reactions and metalloenzymes.								
CO3	Students would develop the concept of metal acid reactions, and administration of drugs.								
CO4	Students would restate difference between different modes of molecular reactions.								
CO5	Students would be able to apply the concepts of supramolecular chemistry.								
10.Unitwise detailed content									
Unit-1	Number of lectures=08	Title of the unit: Metal ions in Biological functions							
A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na ⁺ , K ⁺ and Mg ²⁺ ions: Na/K pump; Role of Mg ²⁺ ions in energy production and chlorophyll. Role of Ca ²⁺ in blood clotting, stabilization of protein structures and structural role (bones).									
Unit-2	Number of lectures= 08	Title of the unit: Metalloenzymes							
Enzyme, coenzyme, apoenzyme and holoenzyme, Zinc enzymes: carboxypeptidase, carbonic anhydrase and alcohol dehydrogenase. Iron enzymes-catalase and peroxidase. Copper enzymes -superoxide dismutase. Molybdenum enzymes –xanthine oxidase.									
Unit-3	Number of lectures=08	Title of the unit: Metal-Nucleic Acid Interactions							
Metals used for diagnosis and chemotherapy with particular reference to anticancer drugs. cis-platin-indication and contra indications. Administration of drug and its antidote. Reaction, use of antihistamine, mannitol, epinephrine and steroid preparation of drug administration.									
Unit-4	Number of lectures=08	Title of the unit: Supramolecular Chemistry							
Concepts and language. Molecular recognition: Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition.									
Unit-5	Number of lectures=08	Title of the unit: Applications of Supramolecular Species/Compounds							
(A) Supramolecular reactivity and catalysis. (B) Transport processes and carrier design. (C) Supramolecular devices. Supramolecular photochemistry, supramolecular electronic, ionic and switching devices. (D) Some example of self-assembly in supramolecular chemistry.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Student would be able to understand the role of ions in biological system.	3	1	1	3	2	3	3	3
CO2	Students evaluate fundamentals of enzyme reactions and metalloenzymes.	3	1	1	3	1	3	3	3
CO3	Students would develop the concept of metal acid reactions, and administration of drugs.	3	1	1	3	1	3	3	2
CO4	Students would restate difference between different modes of molecular reactions.	3	2	1	3	2	3	3	2
CO5	Students would be able to apply the concepts of supramolecular chemistry.	3	2	1	3	3	3	3	2
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12.Brief description of self-learning /E-learning component									
1. https://nptel.ac.in/courses/104101116/									
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101093/lec8.pdf									
3. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod4.pdf									
4. https://www.ias.ac.in/article/fulltext/reso/023/03/0277-0290									
5. https://shodhganga.inflibnet.ac.in/bitstream/10603/35062/2/c1.pdf									
13. Books recommended:									
1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.									
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.									
3. Inorganic Biochemistry vols I and II. ed. G.L. Eichhorn, Elsevier.									
4. Progress in Inorganic Chemistry, Vols 18 and 38 eds. J.J. Lippard, Wiley.									
5. Supramolecular Chemistry, J.M. Lehn, VCH.									
6. Bioinorganic Chemistry, M.N. Hughes, Wiley.									

1. Name of the Department: Chemistry									
2. Course Name	INDUSTRIAL CHEMISTRY PRACTICAL-3			L	T	P			
3. Course Code	CH507			0	0	8			
4. Type of Course (use tick mark)				Core (√)	DE ()	FC ()			
5. Pre-requisite (if any)	B.Sc. with Chemistry	6. Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()			
7. Total Number of Lectures, Tutorials, Practicals									
Lectures = 00		Tutorials = 00		Practical = 08					
8. COURSE OBJECTIVES: Imparting of scientific methodology, Development of practical/technical skills, The ability to work effectively and safely in a laboratory environment, Developing transferable skills (team work, time management), Enhancing communication skill.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)		ATTRIBUTES							
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry								
CO2	Able to prepare Phenol formaldehyde resin, Urea formaldehyde resin, Nylon 66, soap, shampoo, vanishing cream, hand lotion, lather shaving cream								
CO3	Know about the Estimation of ascorbic acid, calcium thioglycolate, lakes and fillers, zinc-pyrithione, acetic acid, protein content, fat content, salt content, moisture content								
CO4	Remember to keep records of all performed experiments in the manner which is required in laboratory.								
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.								
10. List of experiments									
<ol style="list-style-type: none"> Preparation of Phenol formaldehyde resin. Preparation of Urea formaldehyde resin. Preparation of Nylon 66. Preparation of soap. Preparation of shampoo. Preparation of vanishing cream. Preparation of hand lotion. Preparation of lather shaving cream. Determination of calcium thioglycolate / thioglycolic acid in the depilatories. Determination of lakes and fillers in the given lipstick. Determination of zinc-pyrithione/pH in the given shampoo. Determination of acetic acid content in the given sample of food. Determination of protein content in the given sample of food. Determination of fat content in the given sample of food. Determination of salt content in the given sample of butter. Determination of moisture content in the given sample by K. F. titre. Determination of sugar /glucose content in the given sample.\ Estimation of ascorbic acid in the given fruit juices. 									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry	3	1	1	1	1	2	1	2
CO2	Able to prepare Phenol formaldehyde resin, Urea formaldehyde resin, Nylon 66, soap, shampoo, vanishing cream, hand lotion, lather shaving cream	3	1	3	1	2	3	3	2
CO3	Know about the Estimation of ascorbic acid, calcium thioglycolate, lakes and fillers, zinc-pyrithione, acetic acid, protein content, fat content, salt content, moisture content	3	1	1	1	2	2	1	2
CO4	Remember to keep records of all performed experiments in the manner which is required in laboratory.	3	1	1	1	2	2		
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	3	1	1	1	2	2	1	3
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12. Brief description of self- learning / E-learning component									
<ol style="list-style-type: none"> http://www.khalidshadid.com/uploads/3/9/2/0/3920808/phenol_formaldehyde_resin.pdf http://www.inference.org.uk/sustainable/LCA/elcd/external_docs/n66_311147f8-fabd-11da-974d-0800200c9a66.pdf https://www.youtube.com/watch?v=eA9I2MkWMW0 https://www.youtube.com/watch?v=Tu_sWoHULtY https://pubs.acs.org/doi/abs/10.1021/ac60157a011 https://nptel.ac.in/content/storage2/courses/102103047/PDF/mod1.pdf http://www.denverinstrument.com/denverusa/media/pdf/titration_notes/food_beverage/Determination_of_Salt_in_Butter.pdf http://dmsc2.dmsc.moph.go.th/webroot/drug/km/lab_analysis/Karl%20Fischer%20Titration.pdf 									
13. Books recommended:									
<ol style="list-style-type: none"> Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition. Practical Organic ChemistryA.I.Vogel. Practical Physical Chemistry : B. Viswanathan and P.S.Raghavan. Experimental Inorganic Chemistry –W.G.Palmer. 									

Semester– IV

1.Name of the Department: Chemistry									
2.Course Name	INTELLECTUAL PROPERT RIGHTS (IPR)			L	T	P			
3.Course Code	CH508			3	1	0			
4.Type of Course(use tick mark)				Core(√)	DE()	FC()			
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(usetickmarks)	Even (√)	Odd ()	Either Sem ()	Every Sem()			
7.Total Number of Lectures,Tutorials,Practicals									
Lectures=30			Tutorials=10		Practical=Nil				
8. COURSE OBJECTIVES: Professional ethics will be inculcated in students in context to Intellectual Property Rights in India and abroad. Various IPR laws, procedures governing the filing of patents in India and abroad and various treaties and conventions governing IPR will be introduced.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Awareness is created among students regarding the importance of ethics, IPR and laws for protection.								
CO2	An analysis of the genesis and development of IPR in India is done in the form of various laws and acts.								
CO3	An understanding of different branches of IPR including copyrights and patents etc. is inculcated.								
CO4	How various conventions and treaties can be applied to protect intellectual rights would be taught for the creation of innovations.								
CO5	Evaluation of malpractice and infringements and penalties would be analysed.								
10.Unitwisedetailedcontent									
Unit-1	Number of lectures=08	Title of the unit: Overview of Intellectual Property							
Introduction and the need for intellectual property right (IPR). IPR in India – Genesis and Development IPR in abroad. Some important examples of IPR.									
Unit-2	Number of lectures= 08	Title of the unit: Patents							
Macro economic impact of the patent system. Patent and kind of inventions protected by a patent. Patent document. Protection of inventions. Granting of patent. Rights of a patent. Patent protection. Protection of inventions by patents. Searching, Drafting and Filing of a patent. The different layers of the international patent system (national, regional and international options).									
Unit-3	Number of lectures=08	Title of the unit: Patents & Copyright							
Utility models. Differences between a utility model and a patent. Trade secrets and know-how agreements. Copyright: Introduction, How to obtain, Differences from Patents. Related rights. Distinction between related rights and copyright. Rights covered by copyright.									
Unit-4	Number of lectures=08	Title of the unit: Trademarks							
Trademark, Rights of trademark. Kind of signs used as trademarks. Types of trademark. Function does a trademark perform. Protection and registration of trademark. Duration of trademark protection. Well-known marks and their protection. Domain name and it relate to trademarks.									
Unit-5	Number of lectures=08	Title of the unit: Industrial Designs							
Industrial design. Protection of industrial designs. Kind of protection is provided by industrial designs. Duration of protection. IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Awareness is created among students regarding the importance of ethics, IPR and laws for protection.	1	1	1	2	3	3		2
CO2	An analysis of the genesis and development of IPR in India is done in the form of various laws and acts.	2				3	2		
CO3	An understanding of different branches of IPR including copyrights and patents etc. is inculcated.	2				3	2		
CO4	How various conventions and treaties can be applied to protect intellectual rights would be taught for the creation of innovations.	2		2		3	2		2
CO5	Evaluation of malpractice and infringements and penalties would be analysed.	1		2	2	3	2		2
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12.Brief description of self-learning /E-learning component									
<ol style="list-style-type: none"> https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627956/IP-Rights-in-India.pdf https://nptel.ac.in/courses/109106128/ https://nptel.ac.in/content/storage2/courses/downloads/121106007/Assignment-6_noc18_ge12_108.pdf https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109105112/lec25.pdf https://www.shiksha.com/careers/industrial-designer-63 									
13. Books recommended:									
<ol style="list-style-type: none"> Ajit Parulekar and Sarita D’ Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd, 2006 B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India2000 P. Narayanan; Law of Copyright and Industrial Designs;Eastern law House, Delhi, 2010 N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001). Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003). P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001). 									

1.Name of the Department: Chemistry									
2.Course Name	GREEN CHEMISTRY			L	T	P			
3.Course Code	CH509			3	1	0			
4.Type of Course (use tick mark)				Core()	DE(√)	FC()			
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(use tick marks)	Even (√)	Odd ()	Either Sem ()	Every Sem ()			
7.Total Number of Lectures,Tutorials,Practicals									
Lectures=30		Tutorials=10		Practical=Nil					
8. COURSE OBJECTIVES: This course is designed for postgraduate students of chemistry and industrial chemistry as a broad base introduction to analytical instrumentation techniques for the measurement of different chemical and physical properties of compounds and materials (composition, structure, etc.). After successful completion of course, the student will be able to understand the working principle and applications of various modern analytical techniques as well as their operation.									
9. COURSE OUTCOMES (CO):									
<i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Students would be able to create new routes for the synthesis of useful compounds without consuming harmful solvents.								
CO2	Students would be able to understand the principles of green chemistry								
CO3	Students would be able to apply the important tools for the synthesis of useful compounds without harming of environment.								
CO4	Students would restate difference between different modes of chromatographic separation; apply knowledge of qualitative and quantitative analysis in various fields of chemical, pharmaceutical industry etc.								
CO5	Students would be able to illustrate the future of green chemistry								
10.Unit wise detailed content									
Unit-1	Number of lectures=08	Title of the unit: Introduction							
Definition and concept of Green Chemistry, Need for Green Chemistry, Goals of Green Chemistry, Emergence of green Chemistry, Limitations/Obstacles in the pursuit of the goals of Green Chemistry.									
Unit-2	Number of lectures= 08	Title of the unit: Principles of Green Chemistry and Designing a Chemical synthesis							
Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/minimization of hazardous/toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.									
Unit-3	Number of lectures=08	Title of the unit: Green Synthesis/Reactions-I							
1. Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4- aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to strecker synthesis), citral, ibuprofen, paracetamol, furfural.2. Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzoic acid), Oxidation (of toluene, alcohols). Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels Alder Reaction, Decarboxylation. Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles from aldehydes; anhydrides from dicarboxylic acid; pyrimidine and pyridine derivatives; 1,2-dihydrotriazine derivatives; benzimidazoles.									
Unit-4	Number of lectures=08	Title of the unit: Green Synthesis/Reactions-II							
1. Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizzaro reaction, Strecker synthesis, Reformatsky reaction.2. Selective methylation of active methylene group using dimethylcarbonate: Solid-state polymerization of amorphous polymers using diphenylcarbonate; Use of "Clayon", a nonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in Organic Syntheses; Biocatalysis in Organic Syntheses.									
Unit-5	Number of lectures=08	Title of the unit: Future Trends in Green Chemistry							
Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development.									
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Students would be able to create new routes for the synthesis of useful compounds without consuming harmful solvents.	3	1	1	1	2	3	2	3
CO2	Students would be able to understand the principles of green chemistry	3	1	1	2	1	3	2	3
CO3	Students would be able to apply the important tools for the synthesis of useful compounds without harming of environment.	3	1	1	2	1	3	2	2
CO4	Students would restate difference between different modes of chromatographic separation; apply knowledge of qualitative and quantitative analysis in various fields of chemical, pharmaceutical industry etc.	3	2	1	2	2	3	1	2
CO5	Students would be able to illustrate the future of green chemistry	3	2	1	2	3	3	1	2
3 Strong contribution, 2 Average contribution, 1 Low contribution									
12.Brief description of self-learning /E-learning component									
1. http://www.ch.ic.ac.uk/marshall/4110/41101.pdf									
2. https://oregonstate.edu/instruct/ch390/lessons/media/lesson1.pdf									
3. https://freevideolectures.com/course/2908/green-chemistry-an-interdisciplinary-approach-to-sustainability									
4. http://airconline.com/ijci/V6N2/6217ijci15.pdf									
5. https://www.researchgate.net/publication/228333980_GREEN_CHEMISTRY_POTENTIAL_FOR_PAST_PRESENT_AND_FUTURE_PERSPECTIVES									
13. Books recommended:									
1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).									
2. P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).									
3. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).									
4. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).									

1.Name of the Department: Chemistry											
2.Course Name	INDUSTRIAL HYGIENE AND CHEMICAL SAFETY			L	T	P					
3.Course Code	CH510			3	1	0					
4.Type of Course (use tick mark)				Core()	DE(√)	FC()					
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(use tick marks)	Even (√)	Odd ()	Either Sem ()	EverySem()					
7.Total Number of Lectures,Tutorials,Practicals											
Lectures=30			Tutorials=10		Practical=Nil						
8. COURSE OBJECTIVES: The purpose of the industrial hygiene and chemical safety course provides the prevention and control of hazards arising from work processes is occupational hygiene. The goals of occupational hygiene include the protection and promotion of workers' health, the protection of the environment and contribution to a safe and sustainable development.											
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>											
COURSE OUTCOME (CO)	ATTRIBUTES										
CO1	Students will be able to understand the objectives, principles and practices of industrial hygiene cummings memorial lecture american industrial hygiene association										
CO2	Students will create the science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.										
CO3	Students will be able to understand about the biological hazards can cause serious infections. These can be chronic, meaning they have a rapid onset and last for a short time, or acute, meaning they last for a long time and/or constantly recur. Both acute and chronic infections can be serious and even fatal.										
CO4	Students will be able to understand about the key challenges of Some occupational hygienists working in manufacturing, petrochemical, pharmaceutical, steel, mining and other industries.										
CO5	Students will have a firm foundation on concept of hazardous chemicals through different types of exposures, including: Inhalation (breathing the chemical), Absorption (direct contact with the skin), Ingestion (eating or drinking the chemical).										
10.Unit wise detailed content											
Unit-1	Number of lectures=08		Title of the unit: Industrial hygiene								
Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments											
Unit-2	Number of lectures= 08		Title of the unit: Occupational Safety; Health and Environment Management								
Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards.											
Unit-3	Number of lectures=08		Title of the unit: Safety and Health Management								
Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Importance of Industrial safety, role of safety department, Safety committee and Function.											
Unit-4	Number of lectures=08		Title of the unit: Chemical Hazards								
Classification of hazardous chemicals, storage, transportation, handling, risk assessments, challenges and solutions.											
Unit-5	Number of lectures=08		Title of the unit: Radiation and Industrial Hazards								
Types and effects of radiation on human body, Measurement and detection of radiation intensity, Effects of radiation on human body, Measurement –disposal of radioactive waste, Control of radiation. Different air pollutants in industries, Effect of different gases and particulate matter ,acid fumes, smoke, fog on human health.											
11. CO-PO mapping											
COs	Attributes			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Students will be able to understand the objectives, principles and practices of industrial hygiene cummings memorial lecture american industrial hygiene association			3	1	1	1	2	2	1	1
CO2	Students will create the science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.			3	1	2	2	2	2	2	2
CO3	Students will be able to understand about the biological hazards can cause serious infections. These can be chronic, meaning they have a rapid onset and last for a short time, or acute, meaning they last for a long time and/or constantly recur. Both acute and chronic infections can be serious and even fatal.			3	1	2	2	2	2	2	2
CO4	Students will be able to understand about the key challenges of Some occupational hygienists working in manufacturing, petrochemical, pharmaceutical, steel, mining and other industries.			3	1	2	2	2	3	2	2
CO5	Students will have a firm foundation on concept of hazardous chemicals through different types of exposures, including: Inhalation (breathing the chemical), Absorption (direct contact with the skin), Ingestion (eating or drinking the chemical).			3	1	1	2	2	3	2	2
3 Strong contribution, 2 Average contribution , 1 Low contribution											
12.Brief description of self-learning /E-learning component											
1. https://www.osha.gov/Publications/OSHA3143/OSHA3143.htm											
2. https://nptel.ac.in/courses/114106017/											
3. https://www.academia.edu/38181906/SAFETY_AND_HEALTH_MANAGEMENT_AND_ORGANIZATIONAL_PRODUCTIVITY_edited.pdf											
4. https://nptel.ac.in/content/storage2/courses/108101092/Week-2-RF-Radiation-Hazards-July2016-extra.pdf											
5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107156/lec56.pdf											
13. Books recommended:											
1. The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai											
2. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)											
3. Industrial Safety –National Safety Council of India											
4. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)											
5. Slote.L,Handbook of Occupational Safety and Health, John Willey and Sons, NewYork .											
6. Frank P Lees – Loss of prevention in Process Industries, Vol. 1 and 2, Butterworth- Heinemann Ltd., London (1991).											
7. R. K. Jain and Sunil S. Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)											

1. Name of the Department: Chemistry									
2.CourseName	SEMINAR PRESENTATION			L	T	P			
3.CourseCode	CH511			0	0	0			
4.TypeofCourse(use tick mark)				Core(v)	DE()	FC()			
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency(use tick marks)	Even (v)	Odd ()	Either Sem ()	Every Sem()			
7.TotalNumberofLectures,Tutorials,Practicals									
Lectures=30		Tutorials=10		Practical=Nil					
8. COURSE OBJECTIVES: The primary objectives of this course are to develop students' communication and discussion skills, increase vocabulary knowledge, learn about communication style, develop learner autonomy, & build confidence to use English for oral presentation. Also to develop the ability to seek clarification and defend the ideas of others effectively.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	To develop and improve the communication skills								
CO2	To develop discussion and leadership abilities								
CO3	Skills for the development of demonstration abilities								
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	To develop and improve the communication skills	1	1	2	3	2	2	3	2
CO2	To develop discussion and leadership abilities	1	1	1	2	2	2	2	3
CO3	Skills for the development of demonstration abilities	1	1	3	1	2	2	1	2
3 Strong contribution, 2 Average contribution , 1 Low contribution									

1. Name of the Department: Chemistry									
2.CourseName	INDUSTRIAL TRAINING & PROJECT EVALUATION			L	T	P			
3.CourseCode	CH512			0	0	0			
4.Type of Course(use tick mark)				Core(v)	DE()	FC()			
5.Pre-requisite (if any)	B.Sc. with Chemistry	6.Frequency (use tick marks)	Even (v)	Odd ()	Either Sem ()	EverySem()			
7.Total Number of Lectures,Tutorials,Practicals									
Lectures=30		Tutorials=10		Practical=Nil					
8. COURSE OBJECTIVES: The main objective is to enhance the technical skills and to provide students industrial exposure.									
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>									
COURSE OUTCOME (CO)	ATTRIBUTES								
CO1	Hands on training								
CO2	Integrate class room theory with industrial practice.								
CO3	Understanding professional ethics of industry.								
11. CO-PO mapping									
COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	Hands on training	3	3	3	2	2	3	2	3
CO2	Integrate class room theory with industrial practice.	3	2	3	2	2	2	2	3
CO3	Understanding professional ethics of industry.	3	3	3	2	3	2	1	3
3 Strong contribution, 2 Average contribution , 1 Low contribution									