

**Evaluation/Scheme of Examination**  
**M.Sc. (Industrial Chemistry)**  
**1<sup>st</sup>Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credit
				L	T	P	CT	TA	Total	ESE			
<b>THEORIES</b>													
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
<b>PRACTICAL</b>													
6.	CH406	Industrial Chemistry Practical-1	Core	00	00	08	40	20	60	40	100	0:0:4	4
<b>Total</b>				<b>15</b>	<b>05</b>	<b>08</b>	<b>240</b>	<b>120</b>	<b>360</b>	<b>240</b>	<b>600</b>	<b>24</b>	<b>24</b>

**2<sup>nd</sup>Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credit
				L	T	P	CT	TA	Total	ESE			
<b>THEORIES</b>													
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
<b>PRACTICAL</b>													
6.	CH412	Industrial Chemistry Practical-2	Core	00	00	08	40	20	60	40	100	0:0:4	4
<b>Total</b>				<b>15</b>	<b>05</b>	<b>08</b>	<b>240</b>	<b>120</b>	<b>360</b>	<b>240</b>	<b>600</b>	<b>24</b>	<b>24</b>

**3<sup>rd</sup>Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credit
				L	T	P	CT	TA	Total	ESE			
<b>THEORIES</b>													
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
6.	CH506	Bioinorganic & Supra molecular Chemistry	Elective										
<b>PRACTICAL</b>													
6.	CH507	Industrial Chemistry Practical-3	Core	00	00	08	40	20	60	40	100	0:0:4	4
<b>Total</b>				<b>15</b>	<b>05</b>	<b>08</b>	<b>240</b>	<b>120</b>	<b>360</b>	<b>240</b>	<b>600</b>	<b>24</b>	<b>24</b>

**4<sup>th</sup>Semester**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credit
				L	T	P	CT	TA	Total	ESE			
<b>THEORIES</b>													
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	Elective										
<b>PRACTICAL</b>													
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
<b>Total</b>				<b>06</b>	<b>02</b>	<b>04</b>	<b>80</b>	<b>40</b>	<b>120</b>	<b>480</b>	<b>600</b>	<b>20</b>	<b>20</b>

CT= Class Test, TA= Teacher's Assessment, ESE= End Semester Examination; Sessional=CT+TA; Subject Total=Sessional+ESE;

**Total Credit=24+24+24+20=92**

\*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**

<b>1. Name of the Department: Chemistry</b>												
<b>2. Course Name</b>	<b>PHYSICAL CHEMISTRY</b>				<b>L</b>	<b>T</b>	<b>P</b>					
<b>3. Course Code</b>	<b>CH401</b>				<b>3</b>	<b>1</b>	<b>0</b>					
<b>4. Type of Course (use tick mark)</b>					<b>Core ( )</b>	<b>DE ( )</b>	<b>FC ( √ )</b>					
<b>5. Pre-requisite (if any)</b>	BSc. with Chemistry		<b>6. Frequency (use tickmarks)</b>	Even ( )	Odd ( √ )	Either Sem ( )		Every Sem ( )				
<b>7. Total Number of Lectures, Tutorials, Practicals</b>												
<b>Lectures = 30</b>			<b>Tutorials = 10</b>			<b>Practical = Nil</b>						
<b>8. COURSE OBJECTIVES:</b> The purpose of this postgraduate course is to impart basic and fundamental knowledge of physical chemistry. It is applied in almost all the fields starting from Chemistry to biology, information technology as well as the engineering. After the successful completion of the course, the students are provided a sound foundation to take up Ph.D. course in the future.												
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>												
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>											
<b>CO1</b>	Students would analyze the idealized version of a gas, a perfect gas and shows how its equation of states may be assembled experimentally.											
<b>CO2</b>	Students would able to develop the concept of conservation of energy; assess the energy changes during physical and chemical process.											
<b>CO3</b>	Students would differentiate between spontaneous and non-spontaneous process and understand how Gibbs free energy is related to maximum non-expansion work.											
<b>CO4</b>	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.											
<b>CO5</b>	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.											
<b>10. Unit wise detailed content</b>												
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Properties of Gases</b>										
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.												
<b>Unit-2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Classical Thermodynamics</b>										
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.												
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Entropy and Free energy</b>										
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.												
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Chemical Kinetics</b>										
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.												
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Photochemistry</b>										
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 Photochemical reaction. (Hydrogen-Bromine, Hydrogen-Chlorine, Decomposition of Hydrogen Iodide and kinetics of Dimerization of Anthracene).												
<b>11. CO-PO mapping</b>												
<b>COs</b>	<b>Attributes</b>				<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Students would analyze the idealized version of a gas, a perfect gas and shows how its equation of states may be assembled experimentally.				<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO2</b>	Students would able to develop the concept of conservation of energy; assess the energy changes during physical and chemical process.				<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO3</b>	Students would differentiate between spontaneous and non-spontaneous process and understand how Gibbs free energy is related to maximum non-expansion work.				<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>CO4</b>	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.				<b>3</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CO5</b>	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.				<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>												
<b>12. Brief description of self-learning / E-learning component</b>												
1. <a href="http://home.iitk.ac.in/~gtm/thermodynamics/ui/TOC.htm">http://home.iitk.ac.in/~gtm/thermodynamics/ui/TOC.htm</a> 2. <a href="https://nptel.ac.in/courses/115103113/">https://nptel.ac.in/courses/115103113/</a> 3. <a href="https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-27.pdf">https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-27.pdf</a> 4. <a href="http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Engineering%20Chemistry%201/TOC-mainM6.htm">http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Engineering%20Chemistry%201/TOC-mainM6.htm</a> 5. <a href="https://www.youtube.com/watch?v=SgTuWj9Tj80">https://www.youtube.com/watch?v=SgTuWj9Tj80</a>												
<b>13. Books recommended:</b>												
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.												

<b>1. Name of the Department: Chemistry</b>											
<b>2. Course Name</b>	<b>INORGANIC CHEMISTRY</b>			<b>L</b>	<b>T</b>	<b>P</b>					
<b>3. Course Code</b>	<b>CH402</b>			<b>3</b>	<b>1</b>	<b>0</b>					
<b>4. Type of Course (use tick mark)</b>				<b>Core ( )</b>	<b>DE ( )</b>	<b>FC (√ )</b>					
<b>5. Pre-requisite (if any)</b>	BSc. with Chemistry	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd ( √ )	Either Sem ( )	Every Sem ( )					
<b>7. Total Number of Lectures, Tutorials, Practicals</b>											
<b>Lectures = 30</b>		<b>Tutorials = 10</b>		<b>Practical = Nil</b>							
<b>8. COURSE OBJECTIVES:</b> 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.											
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>											
<b>COURSE OUTCOME (CO)</b>			<b>ATTRIBUTES</b>								
<b>CO1</b>	Students will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.										
<b>CO2</b>	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and understand technical literature related to the discipline.										
<b>CO3</b>	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.										
<b>CO4</b>	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.										
<b>CO5</b>	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.										
<b>10. Unit wise detailed content</b>											
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Coordination Compounds</b>									
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.											
<b>Unit-2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Nomenclature And Isomerism In Coordination Compounds</b>									
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.											
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Organometallic Chemistry Of Transition Elements</b>									
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).											
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Bioinorganic Chemistry</b>									
Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.											
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Characterization Of Inorganic Compounds</b>									
Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer, UV-Vis, NQR, MS, electron spectroscopy and microscopic techniques..											
<b>11. CO-PO mapping</b>											
<b>COs</b>	<b>Attributes</b>			<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Students will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.			<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>CO2</b>	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and understand technical literature related to the discipline.			<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO3</b>	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.			<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO4</b>	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.			<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO5</b>	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.			<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>											
<b>12. Brief description of self-learning / E-learning component</b>											
1. <a href="https://freevidelectures.com/course/3412/co-ordination-chemistry">https://freevidelectures.com/course/3412/co-ordination-chemistry</a> 2. <a href="http://wwwchem.uwimona.edu.jm/courses/IC10Kiso.pdf">http://wwwchem.uwimona.edu.jm/courses/IC10Kiso.pdf</a> 3. <a href="https://nptel.ac.in/courses/104101091/">https://nptel.ac.in/courses/104101091/</a> 4. <a href="https://nptel.ac.in/courses/104104109/">https://nptel.ac.in/courses/104104109/</a> 5. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106074/lec24.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106074/lec24.pdf</a>											
<b>13. Books recommended:</b>											
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).											

<b>1. Name of the Department: Chemistry</b>									
<b>2. Course Name</b>	ORGANIC CHEMISTRY			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3. Course Code</b>	CH403			3	1	0			
<b>4. Type of Course (use tick mark)</b>				<b>Core ( )</b>	<b>DE ( )</b>	<b>FC (√ )</b>			
<b>5. Pre-requisite (if any)</b>	BSc. with Chemistry	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )			
<b>7. Total Number of Lectures, Tutorials, Practicals</b>									
Lectures = 30		Tutorials = 10		Practical = Nil					
<b>8. COURSE OBJECTIVES:</b> 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 chemical properties and their applications.									
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
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.								
<b>10. Unit wise detailed content</b>									
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Reactive intermediates</b>							
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.									
<b>Unit-2</b>	<b>Number of lectures =08</b>	<b>Title of the unit: Reaction mechanisms and Name reactions</b>							
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.									
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Name reactions</b>							
Reformatsky and Grignard reactions, Michael addition, Friedel-Crafts reaction, Wittig reaction, Oppenauer oxidation, Clemmensen reduction, Wolff-Kishner reduction, Meerwein-Ponndorf Verley reduction and birch reduction, hydroboration-oxidation, oxymercuration and deoxymercuration.									
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Pericyclic, Electrocyclic, Cycloaddition reactions and Sigmatropic rearrangements</b>							
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..									
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Principles of stereochemistry</b>							
Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity and diastereoselectivity.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
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
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12. Brief description of self-learning / E-learning component</b>									
1. <a href="https://nptel.ac.in/courses/104105104/">https://nptel.ac.in/courses/104105104/</a> 2. <a href="https://nptel.ac.in/courses/104101005/">https://nptel.ac.in/courses/104101005/</a> 3. <a href="https://nptel.ac.in/courses/104103023/">https://nptel.ac.in/courses/104103023/</a> 4. <a href="https://nptel.ac.in/courses/104106077/">https://nptel.ac.in/courses/104106077/</a> 5. <a href="https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod8.pdf">https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod8.pdf</a>									
<b>13. Books recommended:</b>									
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.									



<b>1.NameoftheDepartment:Chemistry</b>											
<b>2.CourseName</b>	MODERN ANALYTICAL TECHNIQUES			<b>L</b>	<b>T</b>	<b>P</b>					
<b>3.CourseCode</b>	CH405			3	1	0					
<b>4.TypeofCourse(usetickmark)</b>				<b>Core(√)</b>	<b>DE( )</b>	<b>FC( )</b>					
<b>5.Pre-requisite(ifany)</b>	B.Sc. with Chemistry	<b>6.Frequency(usetickmarks)</b>	Even ( )	Odd (√)	Either Sem ( )	EverySem( )					
<b>7.TotalNumberofLectures,Tutorials,Practicals</b>											
<b>Lectures=30</b>		<b>Tutorials=10</b>		<b>Practical=Nil</b>							
<b>8. COURSE OBJECTIVES:</b> The course aims at providing knowledge of principles and instrumentations of UV, IR, NMR, Atomic absorption spectroscopy and Mass spectrometry. Make the studentsable to interpret and assign spectroscopic data as a tool for structural elucidation.											
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>											
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>										
<b>CO1</b>	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.										
<b>CO2</b>	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.										
<b>CO3</b>	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 <sup>1</sup> H and <sup>13</sup> C NMR in an NMR spectrum to specific protons and carbons in a compound.										
<b>CO4</b>	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										
<b>CO5</b>	Comprehension of principle, instrumentation, interferences and Sample preparation, Applications of AAS										
<b>10.Unitwisedetailedcontent</b>											
<b>Unit-1</b>	<b>Number of lectures=08</b>	<b>Title of the unit: UV Spectroscopy</b>									
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											
<b>Unit-2</b>	<b>Number of lectures= 08</b>	<b>Title of the unit: IR Spectroscopy</b>									
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.											
<b>Unit-3</b>	<b>Number of lectures=08</b>	<b>Title of the unit: NMR Spectroscopy</b>									
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 (T1) and Spin - spin relaxation (T2) measurements. Interpretation of NMR spectra of some representative compounds.											
<b>Unit-4</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Mass Spectrometry</b>									
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.											
<b>Unit-5</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Atomic Absorption</b>									
Spectrophotometry: Introduction, Principle, Instrumentation, Interferences- Spectral, Ionization, Physical and Refractory compound formation, Sample preparation, Internal standard and standard addition calibration and applications of AAS.											
<b>11. CO-PO mapping</b>											
<b>COs</b>	<b>Attributes</b>			<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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
<b>CO2</b>	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
<b>CO3</b>	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 <sup>1</sup> H and <sup>13</sup> C NMR in an NMR spectrum to specific protons and carbons in a compound.			3	2	1	1	2	3	2	2
<b>CO4</b>	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
<b>CO5</b>	Comprehension of principle, instrumentation, interferences and Sample preparation, Applications of AAS			3	2	2	2	2	3	2	2
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>											
<b>12.Briefdescriptionofself-learning /E-learningcomponent</b>											
1. <a href="https://www.youtube.com/watch?v=tbUx-RaZS7M">https://www.youtube.com/watch?v=tbUx-RaZS7M</a> 2. <a href="https://nptel.ac.in/courses/103108139/">https://nptel.ac.in/courses/103108139/</a> 3. <a href="https://nptel.ac.in/courses/104108078/">https://nptel.ac.in/courses/104108078/</a> 4. <a href="https://nptel.ac.in/courses/102101050/">https://nptel.ac.in/courses/102101050/</a> 5. <a href="https://www.youtube.com/watch?v=xK0vOMKHn8">https://www.youtube.com/watch?v=xK0vOMKHn8</a>											
<b>13. Books recommended:</b>											
1. Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole. 2. Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V EditionTata 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.											

<b>1. Name of the Department: Chemistry</b>												
<b>2. Course Name</b>	<b>INDUSTRIAL CHEMISTRY PRACTICAL-1</b>				<b>L</b>	<b>T</b>	<b>P</b>					
<b>3. Course Code</b>	<b>CH406</b>				<b>0</b>	<b>0</b>	<b>8</b>					
<b>4. Type of Course (use tick mark)</b>					<b>Core (√)</b>	<b>DE ( )</b>	<b>FC ( )</b>					
<b>5. Pre-requisite (if any)</b>		B.Sc. with Chemistry	<b>6. Frequency (use tick marks)</b>		Even ( )	Odd (√)	Either Sem ( )		Every Sem ( )			
<b>7. Total Number of Lectures, Tutorials, Practicals</b>												
<b>Lectures = 00</b>			<b>Tutorials = 00</b>			<b>Practical = 08</b>						
<b>8. COURSE OBJECTIVES:</b> To develop practical and technical skills for better understanding of theory. To develop transferrable skills and enhancing communication skills of students.												
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>												
<b>COURSE OUTCOME (CO)</b>		<b>ATTRIBUTES</b>										
<b>CO1</b>		Perform accurate and precise analysis in the field of industrial chemistry.										
<b>CO2</b>		Able to examine water quality parameters (DO, COD, BOD and TDS) and argue about water quality.										
<b>CO3</b>		Explain the principles of chromatographic techniques, UV spectroscopy and viscosity measurements.										
<b>CO4</b>		Organize the records of all performed experiments in the manner which is required in laboratory.										
<b>CO5</b>		Analyze the importance of personal safety and care of equipments and chemicals.										
<b>10. List of experiments</b>												
<ol style="list-style-type: none"> <li>To determine the percentage composition of the given mixture consisting of two liquids A and B by viscosity method.</li> <li>To determine the relative surface tension of a liquid by Stalagmometer.</li> <li>To determine the molecular weight of non-volatile solute cryscopically using water assolvent.</li> <li>Selective extraction of iron metal cation from mixture of iron and magnesium for determination of their respective concentration.</li> <li>Paper chromatography separation of metalion.</li> <li>Determination of copper and nickel in the givensample.</li> <li>Separation of amino acid by thin layer chromatography.</li> <li>Separation of mixture of carbohydrate by thin layer chromatography.</li> <li>Separation of plant pigment from green leaves by column chromatography.</li> <li>Separation of mixture of dyes by column chromatography.</li> <li>Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone.</li> <li>Determination of Dissolved Oxygen (D.O.) in the given water sample.</li> <li>Determination of Biological Oxygen Demand (B.O.D.) in the given water sample.</li> <li>Determination of Chemical Oxygen Demand (C.O.D.) in the given water sample.</li> <li>Determination of Conductivity of the water sample.</li> <li>Determination of Total Dissolved Solid (T.D.S.) in the given water sample.</li> <li>Determination of concentration of KMnO4 by UV-Visible Spectrophotometer.</li> <li>Determination of iron content in the given water sample by UV-Visible Spectrophotometer.</li> </ol>												
<b>11. CO-PO mapping</b>												
<b>COs</b>	<b>Attributes</b>				<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Perform accurate and precise analysis in the field of industrial chemistry.				<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CO2</b>	Able to examine water quality parameters (DO, COD, BOD and TDS) and argue about water quality				<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CO3</b>	Explain the principles of chromatographic techniques, UV spectroscopy and viscosity measurements.				<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CO4</b>	Organize the records of all performed experiments in the manner which is required in laboratory.				<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>2</b>
<b>CO5</b>	Analyze the importance of personal safety and care of equipments and chemicals.				<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>												
<b>12. Brief description of self- learning / E-learning component</b>												
<ol style="list-style-type: none"> <li><a href="https://www.fondriest.com/environmental-measurements/measurements/measuring-water-quality/dissolved-oxygen-sensors-and-methods/">https://www.fondriest.com/environmental-measurements/measurements/measuring-water-quality/dissolved-oxygen-sensors-and-methods/</a></li> <li><a href="http://www.nsec.ac.in/images/bes_Viscosity%20of%20Sugar%20Solution.pdf">http://www.nsec.ac.in/images/bes_Viscosity%20of%20Sugar%20Solution.pdf</a></li> <li><a href="https://www.youtube.com/watch?v=8wmQ_xWqZbo">https://www.youtube.com/watch?v=8wmQ_xWqZbo</a></li> <li><a href="https://www.youtube.com/watch?v=kXI_Om-2XYk">https://www.youtube.com/watch?v=kXI_Om-2XYk</a></li> <li><a href="https://www.youtube.com/watch?v=YBeZZwNSeb8">https://www.youtube.com/watch?v=YBeZZwNSeb8</a></li> <li><a href="https://www.youtube.com/watch?v=WBYP48A4gM">https://www.youtube.com/watch?v=WBYP48A4gM</a></li> <li><a href="https://www.youtube.com/watch?v=V16USbjKZXw">https://www.youtube.com/watch?v=V16USbjKZXw</a></li> </ol>												
<b>13. Books recommended:</b>												
<ol style="list-style-type: none"> <li>Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition.</li> <li>Practical Organic Chemistry, A.I.Vogel.</li> <li>Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.</li> <li>Experimental Inorganic Chemistry –W.G.Palmer.</li> </ol>												

## SEMESTER-II

<b>1.Name of the Department: Chemistry</b>									
<b>2.Course Name</b>	<b>HEAVY AND FINE CHEMICALS</b>			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3.CourseCode</b>	<b>CH407</b>			3	1	0			
<b>4.Type of Course(use tick mark)</b>				<b>Core(√)</b>	<b>DE( )</b>	<b>FC( )</b>			
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency(use tick marks)</b>	Even (√)	Odd ( )	Either Sem ( )	EverySem( )			
<b>7.Total Number of Lectures,Tutorials,Practicals</b>									
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>				
<b>8. COURSE OBJECTIVES:</b> 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.									
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
<b>CO1</b>	Students will have a firm foundation in the approaches to the development ceramics and refractories with commercial applications.								
<b>CO2</b>	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.								
<b>CO3</b>	Students will have a firm foundation in have a basic understanding of sugar, pulps and paper with flow sheet industrial manufacturing scheme.								
<b>CO4</b>	Students have gained specialist knowledge in one or more of the following fields leather and fertilizers synthetic manufacturing schemes in industrial aspects.								
<b>CO5</b>	Students will be able to understand the basic and advanced instrumental techniques used in adhesion.								
<b>10.Unitwisedetailedcontent</b>									
<b>Unit-1</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Industrial Carbon</b>						
Lamp Black, Manufacture of Carbon, Manufacture of Graphite Carbon, Manufacture of Activated Carbon, Application of Industrial Carbon.									
<b>Unit-2</b>	<b>Number of lectures= 08</b>		<b>Title of the unit: Industrial Catalysts</b>						
Raney Nickel, Other Forms of Nickel, Palladium, Chromate, Vanadium and Platinum base catalyst, Aluminum Alkoxide, Titanium tetra chloride and Titanium dioxide.									
<b>Unit-3</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Soap &amp; Detergent Industry</b>						
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.									
<b>Unit-4</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Adhesives</b>						
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.									
<b>Unit-5</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Chemical Explosives &amp; Rocket Propellants</b>						
Types of industrial explosives; propellants, Rockets and missiles, Propellants for rockets, Toxic chemical weapons.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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
<b>CO2</b>	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
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	Students will be able to understand the basic and advanced instrumental techniques used in adhesion.	3	1	2	2	2	3	3	1
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>									
<b>12.Briefdescriptionofself-learning /E-learning component</b>									
1. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104105103/lec57">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104105103/lec57</a> 2. <a href="https://nptel.ac.in/content/storage2/courses/103103026/pdf/mod1.pdf">https://nptel.ac.in/content/storage2/courses/103103026/pdf/mod1.pdf</a> 3. <a href="https://ch402npc.wordpress.com/2018/03/30/nptel-lecture-introduction-to-soap-and-detergent-soap-making-and-recovery-of-glycerine/">https://ch402npc.wordpress.com/2018/03/30/nptel-lecture-introduction-to-soap-and-detergent-soap-making-and-recovery-of-glycerine/</a> 4. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113106087/lec58.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113106087/lec58.pdf</a> 5. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/101104019/lec37.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/101104019/lec37.pdf</a>									
<b>13. Books recommended:</b>									
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.									

<b>1.Name of the Department: Chemistry</b>											
<b>2.Course Name</b>	<b>MODERN INSTRUMENTAL METHODS OF ANALYSIS AND COMPUTATIONAL TECHNIQUES</b>			<b>L</b>	<b>T</b>	<b>P</b>					
<b>3.Course Code</b>	<b>CH408</b>			3	1	0					
<b>4.Type of Course (use tick mark)</b>				<b>Core ( ✓ )</b>	<b>DE ( )</b>	<b>FC ( )</b>					
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency(usetickmarks)</b>	Even ( ✓ )	Odd ( )	Either Sem ( )	EverySem ( )					
<b>7.TotalNumberofLectures,Tutorials,Practicals</b>											
<b>Lectures=30</b>		<b>Tutorials=10</b>		<b>Practical=Nil</b>							
<b>8. COURSE OBJECTIVES:</b> 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.											
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>											
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>										
<b>CO1</b>	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.										
<b>CO2</b>	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.										
<b>CO3</b>	Students would develop the concept of thermogravimetric analysis, differential analysis and differential scanning calorimetry methods and their applications.										
<b>CO4</b>	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.										
<b>CO5</b>	Students would be able to illustrate how the computer and software are used in analytical laboratory and got springboard for further study.										
<b>10.Unitwisetailedcontent</b>											
<b>Unit-1</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Errors and Evaluation</b>								
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.											
<b>Unit-2</b>	<b>Number of lectures= 08</b>		<b>Title of the unit: Polarographic Techniques and Voltammetry</b>								
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.											
<b>Unit-3</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Thermal Methods</b>								
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.											
<b>Unit-4</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Chromatography</b>								
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.											
<b>Unit-5</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Computer application</b>								
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.											
<b>11. CO-PO mapping</b>											
<b>COs</b>	<b>Attributes</b>			<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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
<b>CO2</b>	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
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	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
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>											
<b>12.Brief description of self-learning /E-learning component</b>											
1. <a href="https://www.youtube.com/watch?v=HEgl0JyX80U">https://www.youtube.com/watch?v=HEgl0JyX80U</a> 2. <a href="https://www.youtube.com/watch?v=d1vv7ww8xtA">https://www.youtube.com/watch?v=d1vv7ww8xtA</a> 3. <a href="https://www.youtube.com/watch?v=NzbDEjI8IKE">https://www.youtube.com/watch?v=NzbDEjI8IKE</a> 4. <a href="https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod5.pdf">https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod5.pdf</a> 5. <a href="https://www.youtube.com/watch?v=Cu_WeVyOaHI">https://www.youtube.com/watch?v=Cu_WeVyOaHI</a>											
<b>13. Books recommended:</b>											
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.											

<b>1. Name of the Department: Chemistry</b>									
<b>2. Course Name</b>	CHEMISTRY OF NATURAL PRODUCTS			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3. Course Code</b>	CH409			3	1	0			
<b>4. Type of Course (use tick mark)</b>				<b>Core (√)</b>	<b>DE ( )</b>	<b>FC ( )</b>			
<b>5. Pre-requisite (if any)</b>	BSc. with Chemistry	<b>6. Frequency (use tick marks)</b>	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )			
<b>7. Total Number of Lectures, Tutorials, Practicals</b>									
Lectures = 30		Tutorials = 10		Practical = Nil					
<b>8. COURSE OBJECTIVES:</b> 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.									
<b>9. COURSE OUTCOMES (CO):</b>									
<i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
<b>CO1</b>	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.								
<b>CO2</b>	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).								
<b>CO3</b>	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids.								
<b>CO4</b>	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.								
<b>CO5</b>	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.								
<b>10. Unit wise detailed content</b>									
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Terpenoids</b>							
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.									
<b>Unit-2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Alkaloids</b>							
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).									
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Carbohydrates &amp; Steroids</b>							
Introduction, classification, general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Steroids; Introduction, Diei's hydrocarbon, nomenclature, stereochemistry and configuration of the nucleus of steroids.									
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Amino Acid, Peptides &amp; Proteins</b>							
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.									
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Phytopharmaceuticals</b>							
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.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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
<b>CO2</b>	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
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	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
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12. Brief description of self-learning / E-learning component</b>									
1. <a href="https://www.intechopen.com/books/terpenes-and-terpenoids/introductory-chapter-terpenes-and-terpenoids">https://www.intechopen.com/books/terpenes-and-terpenoids/introductory-chapter-terpenes-and-terpenoids</a>									
2. <a href="https://www.intechopen.com/books/alkaloids-their-importance-in-nature-and-human-life/introductory-chapter-alkaloids">https://www.intechopen.com/books/alkaloids-their-importance-in-nature-and-human-life/introductory-chapter-alkaloids</a>									
3. <a href="https://study.com/academy/lesson/steroids-structure-function.html">https://study.com/academy/lesson/steroids-structure-function.html</a>									
4. <a href="http://chemistry.creighton.edu/~jksoukup/lec5-aminoacidsSTUD.pdf">http://chemistry.creighton.edu/~jksoukup/lec5-aminoacidsSTUD.pdf</a>									
5. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/127106009/lec4.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/127106009/lec4.pdf</a>									
<b>13. Books recommended:</b>									
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.									

<b>1. Name of the Department: Chemistry</b>												
<b>2.Course Name</b>	<b>CORROSION, LUBRICATION AND PAINT TECHNOLOGY</b>			<b>L</b>	<b>T</b>	<b>P</b>						
<b>3.Course Code</b>	<b>CH410</b>			<b>3</b>	<b>1</b>	<b>0</b>						
<b>4.Type of Course (use tick mark)</b>				<b>Core(√)</b>	<b>DE( )</b>	<b>FC( )</b>						
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency (use tick marks)</b>	Even (√)	Odd ( )	Either Sem ( )	EverySem( )						
<b>7.Total Number of Lectures,Tutorials,Practicals</b>												
<b>Lectures=30</b>		<b>Tutorials=10</b>		<b>Practical=Nil</b>								
<b>8. COURSE OBJECTIVES:</b> Main objective includes deep understanding of mechanism of corrosion, lubrication and action of lubricants, properties, constituents and formulation of industrial paints, dyes and varnishes.												
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>												
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>											
<b>CO1</b>	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.											
<b>CO2</b>	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.											
<b>CO3</b>	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.											
<b>CO4</b>	Comprehension of properties, constituents and formulations of pigments and dyes, differentiate dyes and pigments, their mechanisms of action and applications.											
<b>CO5</b>	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.											
<b>10.Unit wise detailed content</b>												
<b>Unit-1</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Corrosion</b>										
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 <sup>H</sup> potential) diagram												
<b>Unit-2</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Lubrication</b>										
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.												
<b>Unit-3</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Paint Technology</b>										
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.												
<b>Unit-4</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Pigments and Dyes</b>										
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.												
<b>Unit-5</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Varnishes</b>										
Introduction to varnishes, physical properties of varnishes; Constituents of varnishes, classification and formulation of industrial varnishes; Characteristics of good varnish; Applications of varnish.												
<b>11. CO-PO mapping</b>												
<b>COs</b>	<b>Attributes</b>				<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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.				<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO2</b>	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.				<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>
<b>CO3</b>	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.				<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>
<b>CO4</b>	Comprehension of properties, constituents and formulations of pigments and dyes, differentiate dyes and pigments, their mechanisms of action and applications.				<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>
<b>CO5</b>	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.				<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>												
<b>12. Brief description of self-learning /E-learning component</b>												
<ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=5OxdXq91TV0">https://www.youtube.com/watch?v=5OxdXq91TV0</a></li> <li><a href="https://www.youtube.com/watch?v=WQ8v-UcACTE">https://www.youtube.com/watch?v=WQ8v-UcACTE</a></li> <li><a href="https://www.youtube.com/watch?v=Keff0zA7Zq8">https://www.youtube.com/watch?v=Keff0zA7Zq8</a></li> <li><a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/116102052/lec3.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/116102052/lec3.pdf</a></li> <li><a href="https://www.oreilly.com/library/view/basic-civil-engineering/9788131729885/xhtml/chapter010.xhtml">https://www.oreilly.com/library/view/basic-civil-engineering/9788131729885/xhtml/chapter010.xhtml</a></li> </ol>												
<b>13. Books recommended:</b>												

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).

<b>1. Name of the Department: Chemistry</b>									
<b>2. Course Name</b>	PHARMACEUTICAL CHEMISTRY			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3. Course Code</b>	CH411			3	1	0			
<b>4. Type of Course (use tick mark)</b>				<b>Core (√)</b>	<b>DE ( )</b>	<b>FC ( )</b>			
<b>5. Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6. Frequency (use tick marks)</b>	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )			
<b>7. Total Number of Lectures, Tutorials, Practicals</b>									
<b>Lectures = 30</b>		<b>Tutorials = 10</b>		<b>Practical = Nil</b>					
<b>8. COURSE OBJECTIVES:</b> Student should understand the Synthesis, uses and mode of action of Antibiotics and Sulpha Drugs, Antipyretics, analgesics, Anesthetic drugs, cardiovascular drugs, Drug Design.									
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
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.								
<b>10. Unit wise detailed content</b>									
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Antibiotics and Sulpha Drugs</b>							
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.									
<b>Unit-2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Antipyretics analgesics</b>							
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									
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Anesthetic drugs</b>							
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.									
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Cardiovascular drugs</b>							
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 Disopyramide, Procainamide, Propranolol, Berilyium Tosilate; Vasopressor drugs: structure, synthesis and mode of action of Isoxsuprine, Prenyl amine.									
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Drug Design</b>							
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.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
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
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12. Brief description of self-learning / E-learning component</b>									
1. <a href="https://www.youtube.com/watch?v=NGwP471sehl">https://www.youtube.com/watch?v=NGwP471sehl</a>									
2. <a href="https://www.youtube.com/watch?v=Ac6yMWno6yk">https://www.youtube.com/watch?v=Ac6yMWno6yk</a>									
3. <a href="https://www.youtube.com/watch?v=-UD0y4jdKuc">https://www.youtube.com/watch?v=-UD0y4jdKuc</a>									
4. <a href="http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf">http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf</a>									
5. <a href="https://www.youtube.com/watch?v=2vLDzMSo2Tc&amp;list=PLg8Xhs-vwgXLSKf7XRqynlrY6aGHseZry&amp;index=43">https://www.youtube.com/watch?v=2vLDzMSo2Tc&amp;list=PLg8Xhs-vwgXLSKf7XRqynlrY6aGHseZry&amp;index=43</a>									
<b>13. Books recommended:</b>									
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									

<b>1. Name of the Department: Chemistry</b>									
<b>2. Course Name</b>	<b>INDUSTRIAL CHEMISTRY PRACTICAL-2</b>				<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	<b>CH412</b>				<b>0</b>	<b>0</b>	<b>8</b>		
<b>4. Type of Course (use tick mark)</b>					<b>Core (√)</b>	<b>DE ( )</b>	<b>FC ( )</b>		
<b>5. Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6. Frequency (use tick marks)</b>			Even (√)	Odd ( )	Either Sem ( )		Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practicals</b>									
<b>Lectures = 00</b>			<b>Tutorials = 00</b>			<b>Practical = 08</b>			
<b>8. COURSE OBJECTIVES:</b> 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.									
<b>9. COURSE OUTCOMES (CO):</b>									
<i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>									
<b>ATTRIBUTES</b>									
<b>CO1</b>	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry								
<b>CO2</b>	Able to detect adulterants in the given food sample.								
<b>CO3</b>	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.								
<b>CO4</b>	Remember to keep records of all performed experiments in the manner, which is required in laboratory.								
<b>CO5</b>	Analyze the importance of personal safety and care of equipment's and chemicals.								
<b>10. List of experiments</b>									
<ol style="list-style-type: none"> <li>Determination of strength of acid against strong base by pH meter.</li> <li>Determination of optical rotation of cane sugar.</li> <li>Determination of saponification value in the given oil.</li> <li>Determination of acid value in the given oil.</li> <li>Detection of adulterants in the given food sample.</li> <li>Estimation of amino acid.</li> <li>Estimation of Glucose.</li> <li>Estimation of aspirin present in the given drug.</li> <li>Separation of essential oils by soxhlet extractor.</li> <li>Isolation of Lycopene from tomato.</li> <li>Isolation of Nicotine from tobacco.</li> <li>Isolation of Lactose and caesin from milk.</li> <li>Isolation of lecithin from egg yolk.</li> <li>Isolation of Caffeine from tea.</li> <li>Preparation of Acetanilide.</li> <li>Preparation of Aspirin.</li> <li>Preparation of Magnesium bisilicate (antacid).</li> <li>Preparation of Paracetamol.</li> </ol>									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>2</b>
<b>CO2</b>	Able to detect adulterants in the given food sample.	<b>3</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CO3</b>	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.	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>
<b>CO4</b>	Remember to keep records of all performed experiments in the manner, which is required in laboratory.	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>		
<b>CO5</b>	Analyze the importance of personal safety and care of equipment's and chemicals.	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>									
<b>12. Brief description of self- learning / E-learning component</b>									
<ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=MTsn1-ToKqQ">https://www.youtube.com/watch?v=MTsn1-ToKqQ</a></li> <li><a href="http://www.bellevuecollege.edu/wp-content/uploads/sites/140/2014/06/aspirin_tablets_titration.pdf">http://www.bellevuecollege.edu/wp-content/uploads/sites/140/2014/06/aspirin_tablets_titration.pdf</a></li> <li><a href="https://www.frontiersin.org/articles/10.3389/fonc.2015.00196/full">https://www.frontiersin.org/articles/10.3389/fonc.2015.00196/full</a></li> <li><a href="https://www.youtube.com/watch?v=1tmqUVSVp04">https://www.youtube.com/watch?v=1tmqUVSVp04</a></li> <li><a href="https://www.youtube.com/watch?v=KZ35K05SA7g">https://www.youtube.com/watch?v=KZ35K05SA7g</a></li> <li><a href="https://www.youtube.com/watch?v=249FNCSR-Cw">https://www.youtube.com/watch?v=249FNCSR-Cw</a></li> <li><a href="https://www.youtube.com/watch?v=2O8h9utwKA4">https://www.youtube.com/watch?v=2O8h9utwKA4</a></li> </ol>									
<b>13. Books recommended:</b>									
<ol style="list-style-type: none"> <li>Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.</li> <li>Practical Organic Chemistry A.I.Vogel.</li> <li>Practical Physical Chemistry : B. Viswanathan and P.S.Raghavan.</li> <li>Experimental Inorganic Chemistry –W.G.Palmer.</li> </ol>									

## Semester– III

<b>1.Name of the Department: Chemistry</b>									
<b>2.Course Name</b>	POLYMER CHEMISTRY			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3.Course Code</b>	CH501			3	1	0			
<b>4.Type of Course (use tick mark)</b>				<b>Core (√)</b>	<b>DE ( )</b>	<b>FC ( )</b>			
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )			
<b>7.Total Number of Lectures,Tutorials,Practicals</b>									
Lectures=30			Tutorials=10		Practical=Nil				
<b>8. COURSE OBJECTIVES:</b> 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									
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
<b>CO1</b>	Evaluate the different mechanisms of polymer preparation and their classification.								
<b>CO2</b>	Understand the colligative properties of Polymers and evaluate the identification techniques such as IR, NMR of Polymers.								
<b>CO3</b>	Analyze various processing techniques of Polymer.								
<b>CO4</b>	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubber.								
<b>CO5</b>	Understand the Vulcanization of Rubber and synthesis of Synthetic Rubber and various other copolymer resins.								
<b>10.Unitwisedetailedcontent</b>									
<b>Unit-1</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Polymer &amp; Polymerization</b>							
General introduction of polymers; Classification of polymers; Addition polymerization, Condensation polymerization, Co polymerization, Ring opening polymerization their mechanism and kinetics; Kinetic length.									
<b>Unit-2</b>	<b>Number of lectures=08</b>	<b>Title of the unit: End group analysis</b>							
Colligative property measurement, Solution viscosity & molecular size, IR, and NMR of polymers; Viscous flow; Kinetic theory of rubber elasticity; Visco elasticity, Mechanical properties of polymers.									
<b>Unit-3</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Polymer processing Techniques</b>							
Polymer processing & its classification, extrusion, calendering, film blowing, injection moulding, blow moulding, vacuum forming and compression moulding, fibre spinning, films and laminates.									
<b>Unit-4</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Some Commercially important Polymers</b>							
Nylons, polyester fibers (Terylene, Dacron), vinyl fibers, rubber, copolymers of butadiene and acrylonitrile, polyethylene; Plastics, resins and lacquers, cellulose acetate, cellulose nitrate, cellulose mixed esters and cellulose ethers, polytetrafluoroethylene (Teflon).									
<b>Unit-5</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Vulcanization of rubber</b>							
Synthetic rubber; buna rubber; phenol-formaldehyde resins, ion exchange resins, urea-formaldehyde resins, melamine formaldehyde resins and epoxy resins.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Evaluate the different mechanisms of polymer preparation and their classification.	3	2	1	1	2	2	2	2
<b>CO2</b>	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
<b>CO3</b>	Analyze various processing techniques of Polymer.	3	1	2	2	1	3	2	3
<b>CO4</b>	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubber.	3	2	3	2	1	3	2	3
<b>CO5</b>	Understand the Vulcanization of Rubber and synthesis of Synthetic Rubber and various other copolymer resins.	3	2	2	2	1	3	2	3
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12.Brief description of self-learning /E-learning component</b>									
1. <a href="https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod7.pdf">https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod7.pdf</a>									
2. <a href="https://www.e-education.psu.edu/matse202/node/712">https://www.e-education.psu.edu/matse202/node/712</a>									
3. <a href="http://eacharya.inflibnet.ac.in/data-server/eacharya%20documents/55daa452e41301c73a2cb5ac_INFIEP_208/806/ET/lec%20-3.pdf">http://eacharya.inflibnet.ac.in/data-server/eacharya documents/55daa452e41301c73a2cb5ac_INFIEP_208/806/ET/lec%20-3.pdf</a>									
4. <a href="https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod7.pdf">https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod7.pdf</a>									
5. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113105028/lec20.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113105028/lec20.pdf</a>									
<b>13. Books recommended:</b>									
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.									

<b>1.Name of the Department: Chemistry</b>												
<b>2.Course Name</b>	PETROLEUM CHEMISTRY				<b>L</b>	<b>T</b>	<b>P</b>					
<b>3.Course Code</b>	CH502				3	1	0					
<b>4.Type of Course (use tick mark)</b>					<b>Core(√)</b>	<b>DE( )</b>	<b>FC( )</b>					
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency (use tick marks)</b>			Even ( )	Odd (√)	Either Sem ( )	EverySem( )				
<b>7.Total Number of Lectures,Tutorials,Practicals</b>												
Lectures=30				Tutorials=10			Practical=Nil					
<b>8. COURSE OBJECTIVES:</b> 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.												
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>												
<b>COURSE OUTCOME (CO)</b>		<b>ATTRIBUTES</b>										
<b>CO1</b>		Introduction of origin, composition, exploration and desalting of petrochemicals create a better understanding of petroleum.										
<b>CO2</b>		Knowledge of the fundamentals, profile and methods of distillation along with processing and treatments of petroleum provide the extra strength to analyzed crude oil.										
<b>CO3</b>		Overview, classification, stabilization, absorption and adsorption purification of hydrocarbons and fuels another significant parameter to evaluate the quality of petroleum.										
<b>CO4</b>		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.										
<b>CO5</b>		Teach to remember lubricating oils, additives and naphtha cracking along with the introduction of quality procedures like ASTM/BIS/IP/DIN.										
<b>10.Unitwisedetailedcontent</b>												
<b>Unit-1</b>	<b>Number of lectures=08</b>			<b>Title of the unit: Introduction to Petroleum</b>								
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.												
<b>Unit-2</b>	<b>Number of lectures=08</b>			<b>Title of the unit: Methods of Petroleum distillation</b>								
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.												
<b>Unit-3</b>	<b>Number of lectures=08</b>			<b>Title of the unit: Classification of Liquefied hydrocarbon gases and fuels</b>								
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.												
<b>Unit-4</b>	<b>Number of lectures=08</b>			<b>Title of the unit: Petroleum Refining and Cracking</b>								
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.												
<b>Unit-5</b>	<b>Number of lectures=08</b>			<b>Title of the unit: Lubricating oils and additives</b>								
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.												
<b>11. CO-PO mapping</b>												
<b>COs</b>	<b>Attributes</b>				<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Introduction of origin, composition, exploration and desalting of petrochemicals create a better understanding of petroleum.				1	1	1	2	3	3		2
<b>CO2</b>	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	-	-
<b>CO3</b>	Overview, classification, stabilization, absorption and adsorption purification of hydrocarbons and fuels another significant parameter to evaluate the quality of petroleum.				2	-	-	-	3	2	-	-
<b>CO4</b>	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
<b>CO5</b>	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
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>												
<b>12.Brief description of self-learning /E-learning component</b>												
1. <a href="https://byjus.com/chemistry/petroleum/">https://byjus.com/chemistry/petroleum/</a> 2. <a href="https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf">https://nptel.ac.in/content/storage2/courses/103103029/pdf/mod2.pdf</a> 3. <a href="https://www.shell.com/energy-and-innovation/natural-gas/liquefied-natural-gas-Ing.html">https://www.shell.com/energy-and-innovation/natural-gas/liquefied-natural-gas-Ing.html</a> 4. <a href="https://www.e-education.psu.edu/fsc432/content/lesson-7-overview">https://www.e-education.psu.edu/fsc432/content/lesson-7-overview</a> 5. <a href="https://www.stle.org/images/pdf/STLE_ORG/BOK/LS/Additives/The%20Chemistry%20and%20Function%20of%20Lubricant%20Additives.pdf">https://www.stle.org/images/pdf/STLE_ORG/BOK/LS/Additives/The%20Chemistry%20and%20Function%20of%20Lubricant%20Additives.pdf</a>												
<b>13. Books recommended:</b>												
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												

<b>1.Name of the Department: Chemistry</b>												
<b>2.Course Name</b>	AGRO CHEMISTRY			<b>L</b>	<b>T</b>	<b>P</b>						
<b>3.Course Code</b>	CH503			3	1	0						
<b>4.Type of Course (use tick mark)</b>				<b>Core(√)</b>	<b>DE( )</b>	<b>FC( )</b>						
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( )	Every Sem( )						
<b>7.Total Number of Lectures,Tutorials,Practicals</b>												
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>							
<b>8. COURSE OBJECTIVES:</b> 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 herbicides, concepts of QSAR and CAMM in pesticide design												
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>												
<b>COURSE OUTCOME (CO)</b>			<b>ATTRIBUTES</b>									
<b>CO1</b>	Remember the concept of pesticides, Classification of Insecticides, synthesis, structure activity relationship, mode of action, uses and formulation of Organochlorines and Carbamates Insecticides.											
<b>CO2</b>	Analyze and compare Organophosphate over Organochlorines Insecticides, Synthesis, and structure activity relationship, mode of action, uses and formulation of Organophosphate.											
<b>CO3</b>	Create the basic knowledge of chemistry of fungicides and also able to evaluate different classes like Inorganic sulfur, dithiocarbamates, antibiotics, quinones, benzimidazole.											
<b>CO4</b>	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.											
<b>CO5</b>	Comprehension of Quantitative structure–activity relationship (QSAR), Computer-Assisted Molecular Modeling (CAMM) in pesticide design, rodenticides and Molluscicides.											
<b>10.Unit wise detailed content</b>												
<b>Unit-1</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Organochlorines and Carbamates Insecticides</b>									
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).												
<b>Unit-2</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Organophosphorous Insecticides</b>									
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.												
<b>Unit-3</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Fungicides</b>									
Classification and chemistry of following fungicides: Inorganic; sulfur, copper-oxychloride and organomercurials. Dithiocarbamates; ziram, thirum and zineb. Quinones; chloranil. Antibiotics; kasugamycin and griseofulvin. Benzimidazole; carbendazim, thiabendazole.												
<b>Unit-4</b>	<b>Number of lectures=08</b>		<b>Title of the unit :Herbicides</b>									
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												
<b>Unit-5</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Rodenticides, Molluscicides, QSAR and CAMM</b>									
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 (CAMM) in Pesticide Design												
<b>11. CO-PO mapping</b>												
<b>COs</b>	<b>Attributes</b>				<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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
<b>CO2</b>	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
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	Comprehension of Quantitative structure–activity relationship (QSAR), Computer-Assisted Molecular Modeling (CAMM) in pesticide design, rodenticides and Molluscicides.				3	1	2	2	2	3	2	2
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>												
<b>12.Brief description of self-learning /E-learning component</b>												
1. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107081/lec39.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107081/lec39.pdf</a>												
2. <a href="https://www.cdc.gov/biomonitoring/pdf/OP-DPM_FactSheet.pdf">https://www.cdc.gov/biomonitoring/pdf/OP-DPM_FactSheet.pdf</a>												
3. <a href="https://nptel.ac.in/content/storage2/courses/126104003/LectureNotes/Week-5_Chemicals_IPM_history_classification_lect3.pdf">https://nptel.ac.in/content/storage2/courses/126104003/LectureNotes/Week-5_Chemicals_IPM_history_classification_lect3.pdf</a>												
4. <a href="https://nptel.ac.in/content/storage2/courses/104108056/module9/PNR%20lecture%2036.pdf">https://nptel.ac.in/content/storage2/courses/104108056/module9/PNR%20lecture%2036.pdf</a>												
5. <a href="https://www.ncbi.nlm.nih.gov/pubmed/8941939">https://www.ncbi.nlm.nih.gov/pubmed/8941939</a>												
<b>13. Books recommended:</b>												
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. Bhabana 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												

<b>1.Name of the Department: Chemistry</b>											
<b>2.Course Name</b>	<b>COSMETICS AND PERFUMERY</b>			<b>L</b>	<b>T</b>	<b>P</b>					
<b>3.Course Code</b>	<b>CH504</b>			3	1	0					
<b>4.Type of Course (use tick mark)</b>				<b>Core ( √ )</b>	<b>DE ( )</b>	<b>FC ( )</b>					
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency(use tick marks)</b>	Even ( )	Odd ( √ )	Either Sem ( )	Every Sem ( )					
<b>7.Total Number of Lectures,Tutorials,Practicals</b>											
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>						
<b>8. COURSE OBJECTIVES:</b> Students to understand the Chemical Nature and Utility of Emulsifiers, lipid components, humectants, and fragrances. Cosmetic Raw Materials, Face power and lipstick, Cosmetic for Skin, Hair products, Herbal Cosmetics.											
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>											
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>										
<b>CO1</b>	Evaluate the concept of Chemical Nature and Utility of Emulsifiers, lipid components, humectants, and fragrances.										
<b>CO2</b>	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.										
<b>CO3</b>	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.										
<b>CO4</b>	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.										
<b>CO5</b>	Comprehension of the plant materials used in cosmetics. Use of herbs in different forms. Herbal cosmetics for skin and Herbal Cosmetics for hair.										
<b>10.Unitwisedetailedcontent</b>											
<b>Unit-1</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Cosmetic Raw Materials</b>								
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).											
<b>Unit-2</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Cosmetic Raw Materials, Face power and lipstick</b>								
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.											
<b>Unit-3</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Cosmetic for Skin</b>								
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).											
<b>Unit-4</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Hair products</b>								
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.											
<b>Unit-5</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Herbal Cosmetics</b>								
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).											
<b>11. CO-PO mapping</b>											
<b>COs</b>	<b>Attributes</b>			<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Evaluate the concept of Chemical Nature and Utility of Emulsifiers, lipid components, humectants, and fragrances.			3	1	2	2	2	3	2	2
<b>CO2</b>	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
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	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
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>											
<b>12.Brief description of self-learning /E-learning component</b>											
<ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=z15PZHkaQRg">https://www.youtube.com/watch?v=z15PZHkaQRg</a></li> <li><a href="https://www.science.org.au/curious/people-medicine/chemistry-cosmetics">https://www.science.org.au/curious/people-medicine/chemistry-cosmetics</a></li> <li><a href="https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mm13/">https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mm13/</a></li> <li><a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112107217/lec3.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112107217/lec3.pdf</a></li> <li><a href="http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_resursu_biologija/gramatas/Herbal%20Principles%20in%20Cosmetics.pdf">http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_resursu_biologija/gramatas/Herbal%20Principles%20in%20Cosmetics.pdf</a></li> </ol>											
<b>13. Books recommended:</b>											
<ol style="list-style-type: none"> <li>Perfumes, soaps, detergents and cosmetics-Bhatia, Volume I &amp; II</li> <li>Poucher's Perfumes, Cosmetics and Soaps (Vol. III), Cosmetics (Vol. I &amp; II) - Hilda Butler</li> </ol>											

<b>1. Name of the Department: Chemistry</b>									
<b>2. Course Name</b>	FOOD CHEMISTRY			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3. Course Code</b>	CH505			3	1	0			
<b>4. Type of Course (use tick mark)</b>				<b>Core ( )</b>	<b>DE (√)</b>	<b>FC ( )</b>			
<b>5. Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )			
<b>7. Total Number of Lectures, Tutorials, Practicals</b>									
<b>Lectures = 30</b>		<b>Tutorials = 10</b>		<b>Practical = Nil</b>					
<b>8. COURSE OBJECTIVES:</b> 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.									
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
<b>CO1</b>	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.								
<b>CO2</b>	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).								
<b>CO3</b>	Analyze general reactions, constitution of glucose & fructose; Conformations of monosaccharide's. Stereochemistry and configuration of the nucleus of steroids.								
<b>CO4</b>	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.								
<b>CO5</b>	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.								
<b>10. Unit wise detailed content</b>									
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Governmental regulation</b>							
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.									
<b>Unit-2</b>	<b>Number of lectures =08</b>	<b>Title of the unit: Constituents of foods &amp; their nutritive aspects</b>							
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.									
<b>Unit-3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Food processing techniques</b>							
Common unit operations, Food deterioration and their control: Heat preservation and processing, Cold preservation and processing Food dehydration, Food concentration & food packaging.									
<b>Unit-4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Food Safety, Risks and Hazards</b>							
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.									
<b>Unit-5</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Fermentation and other uses of Microorganisms</b>							
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.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Create the concept of secondary plant metabolites; terpenoids and its general methods of structure determination, isoprene rule; Stereochemistry, constitution and synthesis of Citra and Menthol.	3	1	2	1	1	2	2	2
<b>CO2</b>	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
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	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
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12. Brief description of self-learning / E-learning component</b>									
1. <a href="https://nptel.ac.in/content/storage2/courses/110108056/module5/Lecture32.pdf">https://nptel.ac.in/content/storage2/courses/110108056/module5/Lecture32.pdf</a>									
2. <a href="https://nptel.ac.in/content/syllabus_pdf/126104004.pdf">https://nptel.ac.in/content/syllabus_pdf/126104004.pdf</a>									
3. <a href="http://ncert.nic.in/textbook/pdf/lehe105.pdf">http://ncert.nic.in/textbook/pdf/lehe105.pdf</a>									
4. <a href="https://swayam.gov.in/nd1_noc20_ce07/preview">https://swayam.gov.in/nd1_noc20_ce07/preview</a>									
5. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/102105058/lec36.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/102105058/lec36.pdf</a>									
<b>13. Books recommended:</b>									
1. Food Chemistry, Belitz and Gosch, Springer – Verlag Bertin Heiderberg, 2nd Edition, 1999									
2. Principles of Human Nutrition, Martin Eastwood, Chapman and Hall, London, I Edition, 1997.									
3. Food – The Chemistry of its Components, T.P. Coultate, Royal Soc. Chemistry, 4th Edition, 2002.									
4. Food additives, Branam, 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, I Edition, 2003.									
6. Nutrition Science and application, Lori Smolin L.A., Saunders College Publishing, 3rd Edition.									

<b>1.Name of the Department: Chemistry</b>									
<b>2.Course Name</b>	<b>BIOINORGANIC AND SUPRAMOLECULAR CHEMISTRY</b>			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3.Course Code</b>	<b>CH506</b>			3	1	0			
<b>4.Type of Course (use tick mark)</b>				<b>Core()</b>	<b>DE(√)</b>	<b>FC( )</b>			
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( )	EverySem( )			
<b>7.Total Number of Lectures,Tutorials,Practicals</b>									
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>				
<b>8. COURSE OBJECTIVES:</b> 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.									
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
<b>CO1</b>	Student would be able to understand the role of ions in biological system.								
<b>CO2</b>	Students evaluate fundamentals of enzyme reactions and metalloenzymes.								
<b>CO3</b>	Students would develop the concept of metal acid reactions, and administration of drugs.								
<b>CO4</b>	Students would restate difference between different modes of molecular reactions.								
<b>CO5</b>	Students would be able to apply the concepts of supramolecular chemistry.								
<b>10.Unitwise detailed content</b>									
<b>Unit-1</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Metal ions in Biological functions</b>							
A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na <sup>+</sup> , K <sup>+</sup> and Mg <sup>2+</sup> ions: Na/K pump; Role of Mg <sup>2+</sup> ions in energy production and chlorophyll. Role of Ca <sup>2+</sup> in blood clotting, stabilization of protein structures and structural role (bones).									
<b>Unit-2</b>	<b>Number of lectures= 08</b>	<b>Title of the unit: Metalloenzymes</b>							
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.									
<b>Unit-3</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Metal-Nucleic Acid Interactions</b>							
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.									
<b>Unit-4</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Supramolecular Chemistry</b>							
Concepts and language. Molecular recognition: Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition.									
<b>Unit-5</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Applications of Supramolecular Species/Compounds</b>							
(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.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Student would be able to understand the role of ions in biological system.	3	1	1	3	2	3	3	3
<b>CO2</b>	Students evaluate fundamentals of enzyme reactions and metalloenzymes.	3	1	1	3	1	3	3	3
<b>CO3</b>	Students would develop the concept of metal acid reactions, and administration of drugs.	3	1	1	3	1	3	3	2
<b>CO4</b>	Students would restate difference between different modes of molecular reactions.	3	2	1	3	2	3	3	2
<b>CO5</b>	Students would be able to apply the concepts of supramolecular chemistry.	3	2	1	3	3	3	3	2
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12.Brief description of self-learning /E-learning component</b>									
1. <a href="https://nptel.ac.in/courses/104101116/">https://nptel.ac.in/courses/104101116/</a> 2. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101093/lec8.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101093/lec8.pdf</a> 3. <a href="https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod4.pdf">https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod4.pdf</a> 4. <a href="https://www.ias.ac.in/article/fulltext/reso/023/03/0277-0290">https://www.ias.ac.in/article/fulltext/reso/023/03/0277-0290</a> 5. <a href="https://shodhganga.inflibnet.ac.in/bitstream/10603/35062/2/c1.pdf">https://shodhganga.inflibnet.ac.in/bitstream/10603/35062/2/c1.pdf</a>									
<b>13. Books recommended:</b>									
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 3. Science Books. 4. Inorganic Biochemistry vols I and II. ed. G.L. Eichhorn, Elsevier. 5. Progress in Inorganic Chemistry, Vols 18 and 38 eds. J.J. Lippard, Wiley. 6. Supramolecular Chemistry, J.M. Lehn, VCH. 7. Bioinorganic Chemistry, M.N. Hughes,Wiley.									

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

## Semester– IV

<b>1.Name of the Department: Chemistry</b>									
<b>2.Course Name</b>	<b>INTELLECTUAL PROPERT RIGHTS (IPR)</b>			<b>L</b>	<b>T</b>	<b>P</b>			
<b>3.Course Code</b>	<b>CH508</b>			<b>3</b>	<b>1</b>	<b>0</b>			
<b>4.Type of Course(use tick mark)</b>				<b>Core( √ )</b>	<b>DE( )</b>	<b>FC( )</b>			
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency(usetickmarks)</b>	Even ( √ )	Odd ( )	Either Sem ( )	Every Sem( )			
<b>7.Total Number of Lectures,Tutorials,Practicals</b>									
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>				
<b>8. COURSE OBJECTIVES:</b> 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.									
<b>9. COURSE OUTCOMES (CO):</b>									
<i>After the successful course completion, learners will develop following attributes:</i>									
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>								
<b>CO1</b>	Awareness is created among students regarding the importance of ethics, IPR and laws for protection.								
<b>CO2</b>	An analysis of the genesis and development of IPR in India is done in the form of various laws and acts.								
<b>CO3</b>	An understanding of different branches of IPR including copyrights and patents etc. is inculcated.								
<b>CO4</b>	How various conventions and treaties can be applied to protect intellectual rights would be taught for the creation of innovations.								
<b>CO5</b>	Evaluation of malpractice and infringements and penalties would be analysed.								
<b>10.Unitwisedetailedcontent</b>									
<b>Unit-1</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Overview of Intellectual Property</b>							
Introduction and the need for intellectual property right (IPR). IPR in India – Genesis and Development IPR in abroad. Some important examples of IPR.									
<b>Unit-2</b>	<b>Number of lectures= 08</b>	<b>Title of the unit: Patents</b>							
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).									
<b>Unit-3</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Patents &amp; Copyright</b>							
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.									
<b>Unit-4</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Trademarks</b>							
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.									
<b>Unit-5</b>	<b>Number of lectures=08</b>	<b>Title of the unit: Industrial Designs</b>							
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.									
<b>11. CO-PO mapping</b>									
<b>COs</b>	<b>Attributes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Awareness is created among students regarding the importance of ethics, IPR and laws for protection.	1	1	1	2	3	3		2
<b>CO2</b>	An analysis of the genesis and development of IPR in India is done in the form of various laws and acts.	2				3	2		
<b>CO3</b>	An understanding of different branches of IPR including copyrights and patents etc. is inculcated.	2				3	2		
<b>CO4</b>	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
<b>CO5</b>	Evaluation of malpractice and infringements and penalties would be analysed.	1		2	2	3	2		2
<b>3 Strong contribution, 2 Average contribution, 1 Low contribution</b>									
<b>12.Brief description of self-learning /E-learning component</b>									
1. <a href="https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627956/IP-Rights-in-India.pdf">https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627956/IP-Rights-in-India.pdf</a>									
2. <a href="https://nptel.ac.in/courses/109106128/">https://nptel.ac.in/courses/109106128/</a>									
3. <a href="https://nptel.ac.in/content/storage2/courses/downloads/121106007/Assignment-6_noc18_ge12_108.pdf">https://nptel.ac.in/content/storage2/courses/downloads/121106007/Assignment-6_noc18_ge12_108.pdf</a>									
4. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109105112/lec25.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109105112/lec25.pdf</a>									
5. <a href="https://www.shiksha.com/careers/industrial-designer-63">https://www.shiksha.com/careers/industrial-designer-63</a>									
<b>13. Books recommended:</b>									
1. Ajit Parulekar and Sarita D’ Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd, 2006									
2. B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000									
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010									
4. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).									
5. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).									
6. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).									

<b>1.Name of the Department: Chemistry</b>											
<b>2.Course Name</b>	<b>GREEN CHEMISTRY</b>			<b>L</b>	<b>T</b>	<b>P</b>					
<b>3.Course Code</b>	<b>CH509</b>			3	1	0					
<b>4.Type of Course (use tick mark)</b>				<b>Core( )</b>	<b>DE(√ )</b>	<b>FC( )</b>					
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency(use tick marks)</b>	Even ( √ )	Odd ( )	Either Sem ( )	Every Sem( )					
<b>7.Total Number of Lectures,Tutorials,Practicals</b>											
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>						
<b>8. COURSE OBJECTIVES:</b> 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.											
<b>9. COURSE OUTCOMES (CO):</b>											
<i>After the successful course completion, learners will develop following attributes:</i>											
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>										
<b>CO1</b>	Students would be able to create new routes for the synthesis of useful compounds without consuming harmful solvents.										
<b>CO2</b>	Students would be able to understand the principles of green chemistry										
<b>CO3</b>	Students would be able to apply the important tools for the synthesis of useful compounds without harming of environment.										
<b>CO4</b>	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.										
<b>CO5</b>	Students would be able to illustrate the future of green chemistry										
<b>10.Unit wise detailed content</b>											
<b>Unit-1</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Introduction</b>								
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.											
<b>Unit-2</b>	<b>Number of lectures= 08</b>		<b>Title of the unit: Principles of Green Chemistry and Designing a Chemical synthesis</b>								
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.											
<b>Unit-3</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Green Synthesis/Reactions-I</b>								
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.											
<b>Unit-4</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Green Synthesis/Reactions-II</b>								
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.											
<b>Unit-5</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Future Trends in Green Chemistry</b>								
Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development.											
<b>11. CO-PO mapping</b>											
<b>COs</b>	<b>Attributes</b>			<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	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
<b>CO2</b>	Students would be able to understand the principles of green chemistry			3	1	1	2	1	3	2	3
<b>CO3</b>	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
<b>CO4</b>	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
<b>CO5</b>	Students would be able to illustrate the future of green chemistry			3	2	1	2	3	3	1	2
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>											
<b>12.Brief description of self-learning /E-learning component</b>											
1. <a href="http://www.ch.ic.ac.uk/marshall/4110/41101.pdf">http://www.ch.ic.ac.uk/marshall/4110/41101.pdf</a>											
2. <a href="https://oregonstate.edu/instruct/ch390/lessons/media/lesson1.pdf">https://oregonstate.edu/instruct/ch390/lessons/media/lesson1.pdf</a>											
3. <a href="https://freevideolectures.com/course/2908/green-chemistry-an-interdisciplinary-approach-to-sustainability">https://freevideolectures.com/course/2908/green-chemistry-an-interdisciplinary-approach-to-sustainability</a>											
4. <a href="http://airconline.com/ijci/V6N2/6217ijci15.pdf">http://airconline.com/ijci/V6N2/6217ijci15.pdf</a>											
5. <a href="https://www.researchgate.net/publication/228333980_GREEN_CHEMISTRY_POTENTIAL_FOR_PAST_PRESENT_AND_FUTURE_PERSPECTIVES">https://www.researchgate.net/publication/228333980_GREEN_CHEMISTRY_POTENTIAL_FOR_PAST_PRESENT_AND_FUTURE_PERSPECTIVES</a>											
<b>13. Books recommended:</b>											
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).											

<b>1.Name of the Department: Chemistry</b>											
<b>2.Course Name</b>	<b>INDUSTRIAL HYGIENE AND CHEMICAL SAFETY</b>			<b>L</b>	<b>T</b>	<b>P</b>					
<b>3.Course Code</b>	<b>CH510</b>			<b>3</b>	<b>1</b>	<b>0</b>					
<b>4.Type of Course (use tick mark)</b>				<b>Core()</b>	<b>DE(✓ )</b>	<b>FC( )</b>					
<b>5.Pre-requisite (if any)</b>	B.Sc. with Chemistry	<b>6.Frequency(use tick marks)</b>	Even ( ✓ )	Odd ( )	Either Sem ( )	EverySem( )					
<b>7.Total Number of Lectures,Tutorials,Practicals</b>											
<b>Lectures=30</b>			<b>Tutorials=10</b>		<b>Practical=Nil</b>						
<b>8. COURSE OBJECTIVES:</b> 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.											
<b>9. COURSE OUTCOMES (CO):</b> <i>After the successful course completion, learners will develop following attributes:</i>											
<b>COURSE OUTCOME (CO)</b>	<b>ATTRIBUTES</b>										
<b>CO1</b>	Students will be able to understand the objectives, principles and practices of industrial hygiene cummings memorial lecture american industrial hygiene association										
<b>CO2</b>	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.										
<b>CO3</b>	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.										
<b>CO4</b>	Students will be able to understand about the key challenges of Some occupational hygienists working in manufacturing, petrochemical, pharmaceutical, steel, mining and other industries.										
<b>CO5</b>	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).										
<b>10.Unit wise detailed content</b>											
<b>Unit-1</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Industrial hygiene</b>								
Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments											
<b>Unit-2</b>	<b>Number of lectures= 08</b>		<b>Title of the unit: Occupational Safety; Health and Environment Management</b>								
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.											
<b>Unit-3</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Safety and Health Management</b>								
Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Importance of Industrial safety, role of safety department, Safety committee and Function.											
<b>Unit-4</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Chemical Hazards</b>								
Classification of hazardous chemicals, storage, transportation, handling, risk assessments, challenges and solutions.											
<b>Unit-5</b>	<b>Number of lectures=08</b>		<b>Title of the unit: Radiation and Industrial Hazards</b>								
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.											
<b>11. CO-PO mapping</b>											
<b>COs</b>	<b>Attributes</b>			<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	Students will be able to understand the objectives, principles and practices of industrial hygiene cummings memorial lecture american industrial hygiene association			<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>
<b>CO2</b>	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.			<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO3</b>	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.			<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO4</b>	Students will be able to understand about the key challenges of Some occupational hygienists working in manufacturing, petrochemical, pharmaceutical, steel, mining and other industries.			<b>3</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>CO5</b>	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).			<b>3</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>3 Strong contribution, 2 Average contribution , 1 Low contribution</b>											
<b>12.Brief description of self-learning /E-learning component</b>											
1. <a href="https://www.osha.gov/Publications/OSHA3143/OSHA3143.htm">https://www.osha.gov/Publications/OSHA3143/OSHA3143.htm</a>											
2. <a href="https://nptel.ac.in/courses/114106017/">https://nptel.ac.in/courses/114106017/</a>											
3. <a href="https://www.academia.edu/38181906/SAFETY_AND_HEALTH_MANAGEMENT_AND_ORGANIZATIONAL_PRODUCTIVITY_edited.pdf">https://www.academia.edu/38181906/SAFETY_AND_HEALTH_MANAGEMENT_AND_ORGANIZATIONAL_PRODUCTIVITY_edited.pdf</a>											
4. <a href="https://nptel.ac.in/content/storage2/courses/108101092/Week-2-RF-Radiation-Hazards-July2016-extra.pdf">https://nptel.ac.in/content/storage2/courses/108101092/Week-2-RF-Radiation-Hazards-July2016-extra.pdf</a>											
5. <a href="https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107156/lec56.pdf">https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103107156/lec56.pdf</a>											
<b>13. Books recommended:</b>											
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)											

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