

Course No.	Course Name	L-T-P-Credits	Year of introduction
CH207	CHEMISTRY FOR PROCESS ENGINEERING- I	2-1-0-3	2016
Prerequisite : Nil			
Course Objectives:			
<ul style="list-style-type: none"> To impart the knowledge of organic chemistry for Chemical engineering practice To illustrate the reactions in chemical processing. To familiarize the advanced synthetic reagents and mechanisms. To understand the importance of selected industrially used organic compounds 			
Syllabus:			
Aromatic Compounds-Reactions and Synthetic Reagents-Bio-molecules-Industrially important organic compounds-Chemistry of Food and Drugs-Organic Photochemistry			
Expected Outcome:			
At the end of the course the students will be able to:			
(i) Distinguish aromaticity and anti-aromaticity and explain the associated rules			
(ii) Summarize the reactions of aromatic compounds and the related reaction and preparations.			
(iii) Classify amino acids, proteins and carbohydrates along with the tests for their identification.			
(iv) Summarize dyes, reactions involved and their synthesis			
(v) Summarize fats and oils, insecticides, biodegradable polymers, polysaccharides, vitamins and drugs			
(vi) Summarize the principle of photochemistry, mechanisms and reactions involved.			
References:			
<ol style="list-style-type: none"> Morrison & Boyd, Organic Chemistry, Prentice-Hall of India Bah l& Bahl, Advanced Organic Chemistry, S. Chand Finar, Organic Chemistry, Vol. I and II, ELBS Sony, P.L., Organic Chemistry, S. Chand Albert L. Lehninger; David L. Nelson; Michael M. Cox; David L. Nelson, <i>Lehninger</i> Principles of Biochemistry, W H Freeman & Co Tewari, Mehrotra and Vishnoi- Advanced Organic Chemistry 			
Module	Contents	Hours	End Sem. Marks
I	Aromaticity- Conditions of aromaticity- Huckel rule for aromaticity- Benzenoid and non-benzenoid (azulene, tropylium cation, Cyclopentadienyl ion, annulenes) compounds.	6	15%
	Anti-aromaticity and non-aromaticity. Aromaticity and basicity of heterocyclic compounds like furan, pyrrole, thiophene and pyridine.		
	Reactions of aromatic compounds- electrophilic ring substitution reactions with mechanism of aniline, benzoic		

	acid (Halogenation, Nitration, Sulphonation) and directive and activation effects of substituents.		
	Nucleophilic substitution reactions of aryl halides (addition-elimination mechanism, elimination-addition (benzyne) mechanism)		
II	Reaction intermediates- formation, structure, stability and important reactions- carbocation (S_N1 , E1 reactions) – carbanion (aldol condensation, reaction of methyl lithium with ketone)	7	15%
	Free radical (chlorination of methane, addition of HBr to alkenes)- Carbenes -singlet and triplet- (cyclopropanation of carbenes)		
	Rearrangement reactions with mechanism – pinacol-pinacolone, Beckmann, Fries, Claisen rearrangements.		
	Synthetic reagents- NBS (allylic bromination), OsO_4 (hydroxylation of alkenes), Crown ether (structures of 12-crown-4, 15-crown-5, 18-crown-6 and dibenzo-18-crown-6-application in phase transfer catalysis)		
FIRST INTERNAL EXAMINATION			
III	Amino acids-classification-synthesis (Gabriel phthalimide & Strecker reactions)-Zwitter ion formation-Action of heat on alpha, beta and gamma amino acids.	7	20%
	Proteins- classification and biological function-Sanger's end group analysis- Tests of proteins (Biuret, xantho-proteic, Hopkins Cole, Ninhydrin tests)-Structure of proteins (primary-secondary and tertiary)- Denaturation of proteins.		
	Carbohydrates-classification-reactions of glucose & fructose (reduction and oxidation with mild and strong agents-osazone formation)-epimerisation-mutarotation of glucose and fructose- Anomers- Killiani synthesis for ascending the series - Ruff's method to descend the series- Conformation of alpha and beta glucose. Reducing and non-reducing sugars (glucose, fructose and sucrose-explanation with structure)		
IV	Dyes - colour and constitution – chromophores and auxochromes. Azodyes- synthesis and use of Congo Red. Triphenyl methane dyes -Synthesis and use of pararosaniline- Xanthene dye- Synthesis and use of Fluorescein.	8	20%
	Fats and oils- saponification - hydrogenation of oils (vanaspathi)- Soaps and detergents (cleansing action, types of detergents).		
	Biodegradable polymers- classification (agro-polymer & bio-polyesters) - synthesis and applications of polylactide		

	(PLA), polyglycolide (PGA), polycaprolactone (PCL). Insecticides-structures of – organochlorides - pentachlorophenol- pyrethroids- Transfluthrin- Organophosphates -Malathion. Artificial sweeteners- Structure and synthesis of Saccharine, Sucralose and Sorbitol.		
SECOND INTERNAL EXAMINATION			
V	Polysaccharides: Brief study of the chemistry – starch and cellulose- structure, function and hydrolysis by acids. Vitamins-Classification- vitamin – C (Ascorbic acid) – function, structure and anti oxidant property. Vitamin A (Retinol)- structure and function. Vitamin B ₃ (Nicotinic acid)- structure and function. Enzymes-Definition-function- apoenzyme, cofactor (coenzyme), holoenzyme, - Classification based on chemical reactions, specificity, factors affecting the enzyme activity, enzyme inhibitors. Lipids- Classification and functions. Drugs-Antipyretics/analgesics- synthesis of paracetamol and aspirin-Sedatives-synthesis of barbitone- Antibiotics-Different types (pencillin based, aminoglycoside based, Tetracyclin based- (sketetal structures only)- Prodrugs and its importance- Drug design & QSAR (elementary idea only)	7	15%
VI	Fundamentals-absorption of light –MOs, singlet and triplet states of molecules, Jablonski diagram-fluroscence and phosphorescence, sensitization and quenching. Photochemistry of carbon-carbon double bond- cyclisation reactions of conjugated alkenes- [2+2] cycloadditions. Rearrangements- Cope and Claisen- Norrish type I and Norrish type II cleavages. Photosenzitised reactions-photosynthesis (elementary idea only), bioluminescence in fire fly, chemiluminescence (reaction of luminal with H ₂ O ₂)	7	15%
END SEMESTER EXAMINATION			

Evaluation Scheme

- **Internal Evaluation: Total Marks: 50**

- (i) *Total Marks for Assignment/Seminar/Project/Case study or any other appropriate tool used for the evaluation of the course outcomes: 10*
A minimum of above two tools shall be used. If more than 2 tools are used, proportionate change shall be made in the marks so that the total contribution of marks for item (i) above remains at 10.
- (ii) *Marks for Tests: Two tests each carrying 40% weightage shall be conducted with total contribution of 40 marks.*

- **External Evaluation :** University Examination
Maximum Marks : 100
Exam Duration : 3 Hours

Question Paper Pattern:

There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.

(2 x15= 30 Marks)

There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.

(2 x15= 30 Marks)

There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.

(2 x20= 40 Marks)

