

SEMESTER VI

KU6DSCCHE301: ORGANIC CHEMISTRY- III

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
VI	DSC	300	KU6DSCCHE301	4	75

Learning Approach (Hours/ Week)		Marks Distribution			Duration of ESE (Hours)
Lecture/ Tutorial	Practical/ Internship	CE	ESE	Total	
3	2	35	65	100	1.5

Course Description: The course comprises of modules on amino acids, proteins, nucleic acids, natural products, photochemistry, pericyclic reactions, heterocyclic compounds, pharmaceutical compounds and a teacher specific module

Course Prerequisite: Basic knowledge about- functional groups and homologous series. Awareness on IUPAC names and common names of first five members of different class of compounds such as amino compounds and carboxylic acids. Basic idea regarding vitamins.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Analyze the structure of amino acids and proteins	An
2	Understand the properties of different heterocyclic compounds	U
3	Recognize different types of pericyclic reactions	U
4	Examine the photochemistry of chemical reactions	U
5	Estimate the amount of amines and phenols in samples in laboratory	An

6	Develop the skill to synthesize simple organic compounds.	A
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***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	3	0	3	3	3	0
CO 2	3	3	0	3	3	3	1
CO 3	3	3	1	3	3	3	0
CO 4	3	3	0	3	3	3	1
CO 5	3	3	1	3	3	3	1
CO 6	3	3	0	3	3	3	0

Course Contents for Classroom Transaction:

M O D U L E	U N I T	DESCRIPTION	HOURS
1	AMINO ACIDS, PROTEINS AND NUCLEIC ACIDS		14
	1	Classification of amino acids. α -Amino Acids: Synthesis – Gabriel's phthalimide synthesis, Strecker's synthesis and Erlenmeyer azlactone synthesis.	
	2	Properties of aminoacids: Zwitterions, pKa values, isoelectric point and electrophoresis-Reactions of aminoacids. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation - Edman	

		degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme)	
	3	Synthesis of simple peptides (up to dipeptides) by N-protection [(t-butyloxycarbonyl (t-boc) and Fluorenylmethyloxy carbonyl (Fmoc)& C-activating groups and Merrifield solid-phase peptide synthesis. Denaturation of proteins.	
	4	Components of nucleic acids: nucleosides and nucleotides. Structure of: Adenine, Guanine, Cytosine, Uracil and Thymine- Synthesis of Adenine and Thymine. Structure of DNA (Watson-Crick model) and RNA (types of RNA)- Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. Polymerase chain reaction (PCR).	
	INTRODUCTION TO NATURAL PRODUCTS, SYNTHETIC REAGENTS & GREEN CHEMISTRY		12
2	1	Alkaloids- Introduction- Properties and structure of Coniine, Nicotine and Quinine- Medicinal importance of Nicotine, Quinine, Morphine, Cocaine and Reserpine - Steroids: General characteristics and structure of cholesterol, Testosterone and Oestrone	
	2	Vitamins: Water soluble and fat-soluble vitamins. Synthesis of Vitamin C- Terpenes: Definition- Isoprene rule. -Classification of terpenes with examples. Occurrence and isolation of citral. Natural rubber	
	3	Lipids: Introduction to oils and fats -Common fatty acids present in oils and fats - Hydrogenation of fats and oils-Saponification value-acid value-iodine number	
	4	Synthetic reagents: Active methylene group- Preparation and synthetic application of Ethyl acetoacetate- Preparation and synthetic application of Aluminium isopropoxide, N-Bromo Succinimides, Diazo methane and Wittig reagent-Reformatsky reaction and its application-	

	5	Green chemistry:Need for Green chemistry - Goals of green chemistry – Limitations- Twelve principles of green chemistry with their explanations and examples	
	6	Designing a green synthesis - Prevention of waste / byproducts - Atom economy (maximum incorporation of materials used in the process) - Minimization of hazardous / toxic products	
	7	Green synthesis - Microwave assisted reactions in water - Hoffmann Elimination - Microwave assisted reaction in organic solvent - Diels Alder reaction, Ultrasound assisted reaction -Esterification, Saponification Green chemistry in day-to-day life.	

	PHOTOCHEMISTRY AND PERICYCLIC REACTIONS		9
3	1	Introduction to photochemistry- Photochemical reactions of carbonyl compounds - Norrish type I and II cleavages (Acyclic only)-Photo reduction of ketone Concerted reactions.	
	2	LCAO-MO theory of ethene, 1,3-butadiene and cyclic polyenes- Symmetry properties of MOs, HOMO, LUMO, Thermal and photochemical pericyclic reactions	
	3	Types of pericyclic reactions – electrocyclic, cycloaddition, sigmatropic, chelotropic, and group transfer reactions – one example each. Explanation of these reactions by FMO theory.	
	4	Mechanism and stereo course of electrocyclic, cyclo addition, and sigmatropic reactions	

4	HETEROCYCLIC COMPOUNDS AND PHARMACEUTICAL COMPOUNDS		10
	1	Classification and nomenclature- Structure and aromaticity in 5-membered and 6-membered rings containing one heteroatom - Preparation, properties and structure of the following compounds: Pyrrole, Pyridine, Indole, Quinoline, Isoquinoline	
	2	Relative basic character of pyrrole, pyridine and piperidine. Hofmann's exhaustive methylation of piperidine-Classification of drugs - Antibiotics- Discovery and importance, mode of action and examples- Misuse of antibiotics	
	3	Antibacterial and antifungal agents- Sulpha drugs-mode of action- Importance- Examples and uses- Antipyretic, Analgesic and Anti-inflammatory agents	
	4	Narcotic and non-narcotic analgesic, examples and uses. Synthesis of Paracetamol and Aspirin -Anti histamine-example-CNS Drugs – Synthesis of Phenobarbital, Psychoactive drugs – Hallucinogens, tranquillizers, Examples.	

5	TEACHER SPECIFIC MODULE- PRACTICALS		
	ORGANIC QUALITATIVE ANALYSIS*		30
	Total 8 experiments must be done- A minimum of 6 compounds must be synthesized and recorded. Out of the six experiments two are open-ended and is subjected to teacher's choice.		
	1. Synthesis of Organic Compounds.		
	a. Aromatic electrophilic substitution Nitration - Preparation of dinitrobenzene from nitrobenzene, preparation of p-nitroacetanilide Halogenation -Preparation of <i>p</i> -bromoacetanilide, preparation of 2, 4, 6 - tribromophenol.		
	b. Diazotization and coupling Preparation of phenyl azo -naphthol. Preparation of methyl orange.		

c.Oxidation Preparation of benzoic acid from benzyl chloride or benzaldehyde	
d.Esterification Benzoylation of phenol/aniline to phenyl benzoate.	
e. Hydrolysis Benzamide or ethyl benzoate to benzoic acid.	
Quantitative analysis (Open ended)	
Estimate, any one organic compound(suggestions)	
a) Phenol (Using bromated-bromide mixture)	
b) Aniline (Using bromated-bromide mixture)	
Estimate any one biomolecule(suggestions)	
a) Reducing sugars (Using Fehling's solution)	
b) Saponification value of vegetable oil	
c) Estimation of ascorbic acid (Colorimetric method)	

Essential Readings:

1. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry' 3rd Edition, Visal Publishing Company Co.
2. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House
3. B. S. Bahl 'Advanced organic Chemistry', S. Chand.
4. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India.
5. I. L. Finar 'Organic Chemistry', Vol.- 1, Pearson Education
6. P. S. Kalsi 'Organic Reactions and their Mechanisms'' New Age International Publishers.
7. Graham Solomons, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
8. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013
9. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, *Vogel's Textbook of Practical Organic Chemistry*, 5th Edn., Pearson Education, Noida, 2014.

10. F. G. Mann, B. C. Saunders, *Practical Organic Chemistry*, 4thEdn., Pearson Education, Noida, 2011.
11. Arthur I. Vogel, *Elementary Practical Organic Chemistry- Small Scale Preparations*, 2ndEdn., Pearson Education, Noida, 2013

Suggested Readings:

1. P. Y. Bruice, 'Organic Chemistry', Pearson Education.
2. J. March, 'Advanced Organic Chemistry', John Wiley & Sons, NY
3. S. H. Pine 'Organic Chemistry', McGraw Hill
4. J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', Oxford University

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation (ESE)		65 (50T+15P)
Continuous Evaluation (CCA)		35 (25T+10P)
Theory		25
a)	Test Paper*	10
b)	Assignment	5
c)	Viva-Voce	5
d)	Seminar	5
Practical10		
a)	Skill	4
b)	Record	4
c)	Punctuality	2
Total		100

* Average mark of the best two written tests may be considered for internal mark.