University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK3DSCCHE203**				
Course Title	**NATURAL PRODUCT CHEMISTRY**				
Type of Course	**DSC**				
Semester	3				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge 2. First & second semester DSCs (chemistry) offered by UoK (preferable)				
Course Summary	The course covers chromatography principles and applications, biochemistry of amino acids, proteins, and nucleic acids, analysis of oils, fats, alkaloids, vitamins, and terpenes, carbohydrate and natural polymer chemistry, and practical organic preparations and analytical techniques. Students gain comprehensive knowledge and practical skills in organic chemistry, biochemistry and analytical chemistry.				

Detailed Syllabus:

Module	Unit	Content	Hrs
		NATURAL PRODUCT CHEMISTRY	**75**
I	**BIOINORGANIC CHEMISTRY**		**9**
	1	Metalloporphyrins – cytochromes – Chlorophyll - photosynthesis and respiration	3
	2	Haemoglobin and myoglobin, mechanism of O_2 – CO_2 transportation	2
	3	Nitrogen fixation, carbon fixation and carbon cycle	2
	4	Biochemistry of iron toxicity and nutrition, essential and trace elements in biological systems	2
II	**AMINO ACIDS, PROTEINS & NUCLEIC ACIDS**		**9**
	5	Classification and properties of amino acids, Synthesis of glycine, alanine and tryptophan	2
	6	Polypeptides and proteins, peptide linkage, peptide synthesis Primary, secondary, tertiary and quaternary structure of proteins, Test for proteins	3
	7	Enzymes – Characteristics, catalytic action, theory of enzyme catalysis – Michaelis – Menton theory- Co-enzymes	2

	8	RNA, DNA – their biological role, hydrolysis of nucleoproteins, elementary idea regarding the structure of nucleic acids Replication of DNA- Transcription and Translation - Genetic code	2
III	**OILS, FATS, ALKALOIDS, VITAMINS AND TERPENES**		**9**
	9	Oils and Fats: Occurrence and extraction-Analysis of oils and fats saponification value, iodine value and acid value	2
	10	Alkaloids: - Extraction and structural elucidation of conine and importance of quinine, morphine and codeine	3
	11	Terpenes: Classification- Isoprene and special isoprene rule-Isolation of essential oils citral and geraniol (No structural elucidation)	2
	12	Vitamins: - Classification and structure, functions and deficiency diseases (structures of vitamin A, B1 and C but no structural elucidation	2
IV	**CARBOHYDRATES AND NATURAL POLYMERS**		**18**
	13	Classification. Configuration- glyceraldehyde, erythrose, threose, ribose, 2-deoxy ribose, arabinose, glucose, fructose and mannose	2
	14	Preparation and properties of glucose and fructose	3
	15	Pyranoside structures of glucose and fructose, furanoside structure of fructose (structure elucidation not expected) Mutarotation and epimerization Properties and structure of sucrose. (structure elucidation not expected)	4
	16	Structure of starch and cellulose (Elementary idea only)	2
	17	Natural rubber – Isolation, vulcanisation - characteristics and applications	3
	18	Synthesis and applications of biodegradable polymers – PLA, PGA, PHBV, PHB, Nylon – 2 –nylon - 6	4
V	**PRACTICALS – Organic Preparations, Dyes, Food analysis, Drug analysis, Fertilizer analysis**		**30**
	19	**Section A (Any 3 Experiments from Section A are compulsory)** Organic preparation: 1. Acetylation of salicylic acid or aniline 2. Benzoylation of phenol or aniline 3. Nitration of Acetanilide or nitrobenzene 4. Halogenation: Bromination of acetanilide 5. Oxidation of benzaldehyde/Toluene/Benzyl chloride 6. Hydrolysis of ethyl acetate and benzamide 7. Methyl orange 8. Picric acid 9. Phenyl urea 10. Methylene blue Purification of organic compounds Purity of organic compounds – MP and BP Recrystallisation of organic compounds Preparation of dyes Preparation of aspirin TLC of simple organic compounds- cresol, napthol, nitrobenzene	15

	20	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add experiments)** 1. Dichrometric titrations: 2. Iodimetry and Iodometry 3. Complexometric titrations: 4. Complexometric Titration: Determination of calcium content in milk. 5. Precipitation Titration: Determination of salt content in potato chips 6. Estimation of saponification value of fats/oils. 7. Determination of hardness of water. 8. Determination of available chlorine in bleaching powder. 9. Redox Titration: Determination of Vitamin C Content in Tablets. 10. Complexometric Titration: Determination of Magnesium Content in Antacids. 11. Precipitation Titration: Determination of Chloride Content in Saline Solutions. 12. Redox Titration: Determination of Iron Content in Iron Supplements 13. Complexometric Titration: Determination of Zinc Content in Zinc Supplements. 14. pH meter: Determination of pH of Fertilizer Solution.	15

References

1. B. K. Sharma, *Instrumental methods of Chemical Analysis*.
2. D.A Skoog, D M West, F J, Holler, S R Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brookes/Cole, Thomson Learning, Inc, USA,2004
3. B. K. Sharma, *Industrial Chemistry*
4. Dr, U. Satyanarayana and Dr. U. Chakrapani, *Biochemistry*, Books and Allied (P) Ltd
5. J. L. Jain, Sunjay Jain, Nitin Jain, *Fundamentals of Biochemistry*, S. Chand & Co. Ltd.
6. R K Murray, DK Granner, PA Mayers, VW Rodwell, *Harper's Biochemistry*, Prentiace- Hall International Editions.
7. I. L Finar, *Organic Chemistry – Vol. 1*
8. *Vogel's Textbook of Practical Organic Chemistry* Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R., 5th ed., Pearson Education.
9. *Practical Organic Chemistry,* Mann, F.G.; Saunders, B.C., 4th ed., Pearson Education.
10. *Comprehensive Practical Organic Chemistry – Preparation and Quantitative Analysis* Ahluwalia, V.K.; Aggarwal, R. Universities Press.
11. *Advanced Practical Organic Chemistry,* Vishnoi, N.K., 3rd ed., Vikas Publishing House, New Delhi, 2010.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand and analyze the structure, function, and biochemical significance of metalloporphyrins; explain the mechanisms of oxygen and carbon dioxide transport in biological systems; describe key biochemical processes including photosynthesis, respiration, nitrogen fixation, and carbon fixation within the carbon cycle; and evaluate the roles of essential and trace elements, particularly iron, in nutrition and toxicity in living organisms.	An	PSO-1,2,3
CO-2	Understand the classification, properties, and synthesis of amino acids; explain the structure and function of polypeptides and proteins including structure; describe peptide linkage and methods of peptide synthesis; analyze the characteristics and catalytic mechanisms of enzymes with emphasis on Michaelis-Menten kinetics and coenzymes; comprehend the biological roles and structural features of RNA and DNA; and demonstrate foundational knowledge of nucleoprotein hydrolysis, DNA replication, transcription, translation, and the genetic code.	An	PSO-1,2,3
CO 3	Understand the occurrence, extraction, and analysis of oils, fats, alkaloids, terpenes, and vitamins, including their classification, key properties, biological significance, and related deficiency diseases.	E	PSO-1,2,3
CO 4	Analyze and classify carbohydrates based on their stereochemistry and configurations, understand the preparation, structural variations, and properties of key monosaccharides and disaccharides, explain the elementary structure and functional roles of polysaccharides and natural polymers, and evaluate the synthesis, characteristics, and applications of biodegradable and synthetic polymers in modern materials science.	C	PSO-1,2,3
CO 5	Develop advanced practical skills in organic synthesis, purification, and qualitative analysis, alongside quantitative titrimetric and instrumental techniques for the determination of chemical composition and purity in diverse real-world samples, thereby enhancing analytical reasoning and problem-solving abilities in chemical experimentation.	C	PSO-1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: NATURAL PRODUCT CHEMISTRY

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1,2,3	An	F, C	L	-
2	CO-2	PO-1,6 PSO-1,2,3	An	F, C	L	-
3	CO 3	PO-1,6 PSO-1,2,3	E	F, C	L	-
4	CO 4	PO-1,2,6 PSO-1,2,3	C	C, P	L	-
5	CO 5	PO-1,2,3,6 PSO-1,2,3,4,5	C	C, P, M	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	3	3	-	-	1	-	-	-	-	2	-	-
CO 2	3	3	3	-	-	1	-	-	-	-	2	-	-
CO 3	3	3	3	-	-	1	-	-	-	-	2	-	-
CO 4	3	3	3	-	-	1	1	-	-	-	3	-	-
CO 5	2	3	3	2	3	1	1	2	-	-	3	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4	✓		✓	✓
CO 5	✓		✓	✓