KOE 322/3 – Natural Products Chemistry

Course Objectives :

1) To introduce the synthetic pathway of natural products such as acetate, shikimate, mevalonate and alkaloid.
2) To learn the synthetic technique reported by researcher in the field of natural products chemistry.

Topic	**Content**	**Number of lecture hours**	**Expected outcome – upon completion of this course, the student should be able to:**
1. Introduction about natural products	• Types of natural products and organisms that produce them • Comparison with the synthetic products • Plants natural product. • Organic catalyst (enzymes)	2	• Discuss what we mean by the term of natural products. • Familiar with the kinds of organisms that make them. • Understand the uses of enzymes by the microbe to make a chemical.
	• Extraction of volatile components • Extraction of non volatile components • Methods of isolation (TLC, Column chromatography, GC, GC-MS and HPLC • Structure elucidation (eg: flavonoid)	3	• Understand the uses of solvents in the extraction • Familiar with the terms “ydrodistillation and head space” • Suggest the suitable methods for the identification and isolation. • Characterize the structure.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
2. Outline of the biosynthesis of natural secondary metabolites	• The main building blocks and the basic construction mechanisms employed in the biosynthesis of natural products. • Biological alkylation reactions, Wagner-Meerwein Rearrangements, Aldol addition and Claisen condensation, Diels-Alder reactions, Schiff base formation, Mannich reaction, transamination, decarboxylation reactions, phenolic oxidative coupling, redox reactions, oxidative cleavage of aromatic rings and glycosylation reactions • Making new carbon-carbon bonds, malonic ester synthesis, the acetoacetic ester synthesis, acylation, Michael reaction • A biological aldol condensation, Robinson annulation • Designing a synthesis, controlling stereochemistry, hydroxylation of alkene, oxidative cleavage of alkenes, functional group interconversion • Biological oxidation-reductions, oxidation of hydroquinone and reduction of quinines	7	• Relate many of these reactions with the many fundamental principles of organic chemistry.

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3. The acetate pathway	• The biosynthesis of fatty acids, prostaglandins, and polyketides. Cyclization of polyketides.	3	• Discuss the biosynthesis of saturated and unsaturated fatty acids, and prostaglandins. • Rationalize the cyclization of polyketides in terms of Aldol and Claisen condensations. • Suggest biosynthetic route to simple polyketides.
4. The shikimate pathway	• The role of shikimic acid in the formation of aromatic amino acids, benzoic acids and cinnamic acids, along with further modifications leading to lignans and lignin, polypropenes and coumarins. • Combinations of shikimate and acetate pathways in the biosynthesis of styrylpyrones, flavonols, isoflavonols and stibenes.	3	• Discuss the biosynthesis of certain aromatic amino acids and phenylpropanoids. • Suggest biosynthetic route to phenylpropanoids.
5. The mevalonate pathway	• Classification of terpenes according to the number of isoprenoid units incorporated. • The mevalonate pathway leading to terpenes. Steroids as examples of modified triterpenes. • The stereochemistry of steroids.	4	• Discuss the biosynthesis of terpenes via the mevalonate pathway. • Rationalize terpenoid structures through extensive use of carbocation mechanisms and Wagner-Meerwein rearrangements. • Recognize terpenoids among natural products. • Suggest biosynthetic route to simple terpenoids.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
6. Biosynthesis of alkaloids	• Types of alkaloids • Some examples of alkaloid biosynthesis, such as alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine, trytophan, phenylalanine and histidine	3	• Recognize the fact that the major source for the biosynthesis of alkaloids is just a few amino acids, and a major reaction (Mannich reaction).
7. Synthetic work	• Selected total synthesis of natural products • Total synthesis of reserpine • Total synthesis of monensin • The synthesis of marine natural product, neumarinone • The synthesis of warburganal from natural product, confertifolin • Synthesis of natural products analogue - The synthesis of carnosol derivatives • The synthesis of difluorinated analogue of shikimic acid - The synthesis of an analogue of strongylodiols	7	• Understand the important of total synthesis. • Understand the important of the synthesis of natural products analogue.
8. Current developments and future directions	• The current areas in the field of natural products chemistry by discussing recent publications • Drugs discovery and applications • The current topic in the synthesis of natural products such as solid phase synthesis, combinatorial synthesis, catalysis, the uses of enzyme in synthesis, chiral and stereoselective synthesis)	4	• Create student awareness on current ongoing research.
TOTAL		**36**	