



## SECOND-YEAR OF MASTER OF SCIENCE CHEMISTRY REVISED SYLLABUS ACCORDING TO CBCS NEP 2020

COURSE TITLE: NATURAL PRODUCTS AND HETEROCYCLIC  
CHEMISTRY  
SEMESTER-IV  
W.E.F. 2024-2025

**RECOMMENDED BY THE BOARD OF STUDIES IN CHEMISTRY AND  
APPROVED BY THE ACADEMIC COUNCIL**

Devrukh Shikshan Prasarak Mandal's  
Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and Vid. Dadasaheb Pitre Science  
College (Autonomous), Devrukh.  
Tal. Sangameshwar, Dist. Ratnagiri-415804, Maharashtra, India

Academic Council Item No:

Name of the Implementing Institute	:	Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh. Tal. Sangameshwar, Dist. Ratnagiri-415804,
Name of the Parent University	:	University of Mumbai
Name of the Programme	:	Master of Science
Name of the Department	:	Chemistry
Name of the Class	:	Second Year
Semester	:	Four
No. of Credits	:	04
Title of the Course	:	Natural Products and Heterocyclic Chemistry
Course Code	:	S612CHT
Name of the Vertical in adherence to NEP 2020	:	Compulsory major
Eligibility for Admission	:	Chemistry Graduate learner seeking Admission to Post Graduate Programme in adherence to Rules and Regulations of the University of Mumbai and Government of Maharashtra
Passing Marks	:	40%
Mode of Assessment	:	Formative and Summative
Level	:	PG
Pattern of Marks Distribution for SEE and CIA	:	60:40
Status	:	NEP-CBCS
To be implemented from Academic Year	:	2024-2025
Ordinances /Regulations (if any)		

## Syllabus for Second Year of Master of Science in Chemistry

(With effect from the academic year 2024-2025)

**SEMESTER-IV**

**Paper No. - III**

**Course Title: Natural Products and  
Heterocyclic Chemistry**

**No. of Credits: 04**

**Type of Vertical: Compulsory major**

**COURSE CODE: S612CHT**

**Learning Outcomes Based on BLOOM's Taxonomy:**

After completing the course, the learner will be able to...		
Course Learning Outcome No.	Blooms Taxonomy	Course Learning Outcome
CLO-01	Remember	write structure, sources, biological role of steroids and vitamins and nomenclature of heterocyclic compounds.
CLO-02	Understand	discuss structural elucidation of antibiotics and terpenoids, important structural and stereochemical features of the corticosteroids, steroidal hormones, steroidal alkaloids, sterols and bile acids.
CLO-03	Apply	derive the synthesis of natural products and heterocyclic compounds.
CLO-04	Analyze	explain naturally occurring insecticides and reactivity of heterocyclic compounds.

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**No. of Credits: 04**

**Type of Vertical: Compulsory major**

**COURSE CODE: S612CHT**

COURSE CONTENT			
Module No.	Content	Credits	No. of Hours
1	<p><b>UNIT-I: Natural products-III</b></p> <ul style="list-style-type: none"> <li>○ <b>Steroids:</b> General structure, classification. Occurrence, biological role, important structural and stereochemical features of the following: corticosteroids, steroidal hormones, steroidal alkaloids, sterols and bile acids.</li> <li>○ Synthesis of 16-DPA from cholesterol and plant sapogenin.</li> <li>○ Synthesis of the following from 16-DPA: androsterone, testosterone, oestrone, oestriol, oestradiol and progesterone.</li> <li>○ Synthesis of cinerolone, jasmolone, allethrolone, exaltone and muscone.</li> </ul>	01	15
2	<p><b>UNIT-II: Natural products-IV</b></p> <ul style="list-style-type: none"> <li>❖ <b>Vitamins:</b> Classification, sources and biological importance of vitamin B1, B2, B6, folic acid, B12, C, D1, E (<math>\alpha</math>-tocopherol), K1, K2, H (<math>\beta</math>- biotin).</li> <li>❖ <b>Synthesis of the following:</b> <ul style="list-style-type: none"> <li>○ Vitamin A from <math>\beta</math>-ionone and bromoester moiety.</li> <li>○ Vitamin B1 including synthesis of pyrimidine and thiazole moieties</li> <li>○ Vitamin B2 from 3, 4-dimethylaniline and D(-)ribose</li> <li>○ Vitamin B6 from: 1) ethoxyacetylacetone and cyanoacetamide, 2) ethyl ester of N-formyl-DL-alanine (Harris synthesis)</li> <li>○ Vitamin E (<math>\alpha</math>-tocopherol) from trimethylquinol and phytyl bromide</li> <li>○ Vitamin K1 from 2-methyl-1, 4-naphthaquinone and phytol.</li> </ul> </li> </ul>	01	15

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	<ul style="list-style-type: none"><li>❖ <b>Antibiotics:</b> Classification on the basis of activity. Structure elucidation, spectral data of penicillin-G, cephalosporin-C and chloramphenicol. Synthesis of chloramphenicol (from benzaldehyde and <math>\beta</math>-nitroethanol) penicillin-G and phenoxymethylpenicillin from D-penicillamine and t-butyl phthalimide malonaldehyde (synthesis of D-penicillamine and t-butyl phthalimide malonaldehyde expected).</li><li>❖ <b>Naturally occurring insecticides:</b> Sources, structure and biological properties of pyrethrums (pyrethrin I), rotenoids (rotenone). Synthesis of pyrethrin I.</li><li>❖ <b>Terpenoids:</b> Occurrence, classification, structure elucidation, stereochemistry, spectral data and synthesis of zingiberene .</li></ul>		
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3	<b>UNIT-III : Heterocyclic compounds-I</b> <ul style="list-style-type: none"><li>○ Heterocyclic compounds: Introduction, classification, Nomenclature of heterocyclic compounds of monocyclic (3-6 membered) (Common, systematic (Hantzsch-Widman ) and replacement nomenclature) Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyridazines, pyrimidine, pyrazines and oxazines.</li></ul>	01	15
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4	<b>Unit-IV: Heterocyclic compounds-II</b> <ul style="list-style-type: none"><li>○ Nomenclature of heterocyclic compounds of bicyclic/tricyclic (5-6 Membered) fused heterocycles (up to three hetero atoms). (Common, systematic (Hantzsch-Widman) and replacement nomenclature) Nucleophilic ring opening reactions of oxiranes, aziridines, oxetanes and azetidines. Structure, reactivity, synthesis and reactions of coumarins, quinoxalines, cinnolines, indole, benzimidazoles, benzoxazoles, benzothiazoles, Purines and acridines.</li></ul>	01	15
	<b>Total</b>	<b>04</b>	<b>60</b>

### Access to the Course

The course is available for all the students admitted for second year of Master of Science.

### Methods of Assessment

The assessment pattern would be 60:40, 60% for Semester End Examination (SEE) and 40% for Continuous Internal Assessment (CIA). The structure of the SEE and CIA would be as recommended by the Board of Studies and approved by the Board of Examination and the Academic Council of the college.

### References:

1. Natural product chemistry, A mechanistic, biosynthetic and ecological approach, Kurt B.G. Torssell, Apotekarsocieteten –Swedish Pharmaceutical Press.
2. Natural products chemistry and applications, Sujata V. Bhat, B.A.Nagasampagi and S. Meenakshi, Narosa Publishing House, 2011.
3. Organic Chemistry Natural Products Volume-II, O. P. Agarwal, Krishna Prakashan, 2011.
4. Chemistry of natural products, V.K. Ahluwalia, Vishal Publishing Co. 2008.
5. The structure and total synthesis of 5-Vetivone, J. A. Marshall and P. C. Johnson, J. Org. Chem., 35, 192 (1970).
6. Total synthesis of spirovetivanes, J. Am. Chem. Soc. 1967, 89,2750.
7. The Total Synthesis of Reserpine, Woodward, R. B.; Bader, F. E.;Bickel, H., Frey, A. J.; Kierstead, R. W. Tetrahedron 1958, 2, 1-57.
8. Total synthesis of Griseofulvin, Stork, G.; Tomasz, M. J. Am.Chem. Soc. 1962, 84, 310.
9. Synthesis of ( $\pm$ )-4-demethoxydaunomycinone,A. V. Rama Rao ,G. Venkatswamy , S. M. Javeed M. , V. H. Deshpande, B.Ramamohan Rao, J. Org. Chem., 1983, 48 (9), 1552.
10. The Alkaloids, The fundamental Chemistry A biogenetic approach, Marcel Dekker Inc. New York, 1979.
11. Heterocyclic chemistry, 3rd edition, Thomas L. Gilchrist, Pearson Education, 2007.
12. Heterocyclic Chemistry, Synthesis, Reactions and Mechanisms, R.K. Bansal, Wiley Eastern Ltd., 1990.
13. Heterocyclic Chemistry, J. A. Joule and G. F. Smith, ELBS, 2<sup>nd</sup> edition, 1982.
14. The Conformational Analysis of Heterocyclic Compounds, F.G.Riddell, Academic Press,1980.
15. Principles of Modern Heterocyclic Chemistry, L.A. Paquette, W.B. Benjamin, Inc., 1978.
16. An Introduction to the Chemistry of Heterocyclic Compounds, 2nd edition, B.M. Acheson, 1975.