



**Dr. Rafiq Zakaria Campus**

Maulana Azad Educational Trust's

**Y. B. CHAVAN COLLEGE OF PHARMACY**

(B. Pharm, M. Pharm & Research Centre)

ISO 21001:2018 & ISO 14001:2015 CERTIFIED | NIRF-2022 ALL INDIA RANK 65<sup>TH</sup>

**NAAC ACCREDITATION "A" GRADE WITH 3.23 CGPA SCORE**

# COURSE MODULE

<b>Program Title</b>	M. Pharmacy
<b>Department</b>	Pharmaceutical Chemistry
<b>Course Title</b>	Chemistry of Natural Products (MPC 104T)

1. **NAME OF INSTITUTION** : Y. B. CHAVAN COLLEGE OF PHARMACY,  
AURANGABAD
2. **AFFILIATED UNIVERSITY** : DR. BABASAHEB AMBEDKAR  
MARATHWADA UNIVERSITY, AURANGABAD
3. **DEPARTMENT** : PHARMACEUTICAL CHEMISTRY
4. **PROGRAM TITLE** : M. PHARM.

#### 4.1. Program Specific Outcome: After completing the program, student will be able to:

PSO-1: Highlight advancements in knowledge associated with medicinal chemistry, Natural products chemistry, drug discovery, drug design and analytical techniques.

PSO-2: Independently carry out the design of bioactive molecules and synthetic research work.

PSO-3: Interpret the spectra of synthetic compounds, natural products and determine their structures.

PSO-4: Build professional, computational, analytical and critical thinking skills

PSO-5: Explain the unit operation and unit reactions in process chemistry

## 5. COURSE SPECIFICATION :

### 5.1. Course Identification and General Information

a. Course Title:	<b>Chemistry of Natural Products</b>	
b. Course Number/Code	<b>MPC 104T</b>	
c. Credit Hours	Theory	Practical
	<b>60(4hr/wk)</b>	<b>00</b>
d. Study level/semester at which this course is offered	<b>First Semester M. Pharm.</b>	
e. Pre-requisite	<b>Advance organic Chemistry, Spectroscopic techniques</b>	
f. Co-requisite	Phytoconstituents, Spectroscopy, medicinal chemistry	
g. Program in which the course is offered	M. Pharm	
h. Language of teaching the course	English	
i. Prepared by	<b>Dr. Mirza Shahed Baig (M. Pharm I<sup>st</sup> SEM)</b>	
j. Approved by HOD	<b>Dr. K. G. Baheti</b>	

### 5.2. Course Description:

The Course is designed to provide detail knowledge about chemistry of medicinal compounds from natural origin and general methods of structural elucidation of such compounds. It also emphasizes on isolation, purification and characterization of medicinal compounds from natural origin.

### 5.3. Course Objectives:

At completion of this course it is expected that students will be able to understand-

- Different types of natural compounds and their chemistry and medicinal importance
- The importance of natural compounds as lead molecules for new drug discovery
- The concept of rDNA technology tool for new drug discovery
- General methods of structural elucidation of compounds of natural origin
- Isolation, purification and characterization of simple chemical constituents from natural source

### 6.0. Course Outcomes (COs) : (Min. 4 and Max. 6)

(Use Bloom's Taxonomy words)

After completion of course student should be able to,

CO Code	Course outcome
CO 104.01	Describe the chemistry of medicinal compounds from plant origin and Recombinant DNA Technology products.
CO 104.02	Elucidate the structure of medicinally active natural compounds
CO 104.03	Characterize medicinally active natural compounds by physical and spectroscopic methods
CO 104.04	Outline the synthetic plan for the phytoconstituents

### 6.1. Knowledge and Understanding

(Alignment of PSOs to COs)

Course Code	Program Specific Outcome				
	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CO 104.01	H	-	-	-	-
CO 104.02	M	-	H	M	-
CO 104.03	H	H	-	-	H
CO 104.04	M	H	-	H	-

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low); 2: Moderate (Medium); 3: Substantial (High); If there is no correlation, put '-'

### 6.2. Teaching and Assessment Methods for achieving learning outcome:

Teaching Strategies(methods)/Tools used	Methods of Assessment
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Lectures (Constructivist learning)	Formative Assessment
Collaborative learning (Discussion)	Case study
Project based Learning	Class test
Blended learning	Multiple choice questions
Inquiry based learning	Assignments
Flash cards	Seminar
Video	Viva Voce
Equipment models	Synopsis
	Tutorials
	Summative Assessment

### 6.3. Tools for the Teaching and learning

Theory subjects	Practical Subjects
<ul style="list-style-type: none"> <li>• PowerPoints presentation</li> <li>• Videos</li> <li>• Flash Card</li> <li>• Models</li> <li>• Software</li> <li>• Charts</li> <li>• Smart Boards</li> <li>• White boards</li> <li>• Online Platform</li> </ul>	<ul style="list-style-type: none"> <li>• White boards</li> <li>• Glassware</li> <li>• Chemicals</li> <li>• Instruments</li> <li>• Equipment</li> <li>• Software</li> <li>• Models</li> <li>• Plants/Crude Drugs</li> <li>• Animal</li> </ul>

### 6.4. COURSE CONTENT

#### 6.1. Theoretical Aspect:

Order	Topic list/units	Subtopics list	Number of Weeks	Contact Hours
1	<b>Unit-I: Study of Natural products as</b>	a) Drugs Affecting the Central Nervous System: Morphine Alkaloids b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide	<b>03</b>	<b>12 Hrs</b>

	<b>leads for new pharmaceuticals for the following class of drugs</b>	<p>c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol</p> <p>d) Neuromuscular Blocking Drugs: Curare alkaloids</p> <p>e) Anti-malarial drugs and Analogues</p> <p>f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and <math>\beta</math> - Lactam antibiotics (Cephalosporins and Carbapenem)</p>		
2	<b>UNIT-II</b> <b>a) Alkaloids</b> <b>b) Flavonoids</b> <b>c) Steroids</b>	<p>a) Alkaloids General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine.</p> <p>b) Flavonoids Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin.</p> <p>c) Steroids General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male &amp; female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D).</p>	<b>03</b>	<b>12 Hrs</b>
3	<b>UNIT-III</b> <b>a) Terpenoids</b> <b>b) Vitamins</b>	<p>a) Terpenoids Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di (retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside) carotinoids (<math>\beta</math> carotene).</p> <p>b) Vitamins Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.</p>	<b>03</b>	<b>12 Hrs</b>

4	<b>UNIT-IV</b> a) <b>Recombinant DNA technology and drug discovery</b> b) <b>Active constituent of certain crude drugs used in Indigenous system Diabetic therapy</b>	a) Recombinant DNA technology and drug discovery rDNA technology, hybridoma technology, New pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation b). Active constituent of certain crude drugs used in Indigenous system Diabetic therapy – Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupium, Swertia chirata, Trigonella foenum graccum; Liver dysfunction – Phyllanthus niruri; Antitumor – Curcuma longa Linn.	<b>03</b>	<b>12 Hrs</b>
5	<b>UNIT-V</b> <b>Structural Characterization of natural compounds</b>	Structural characterization of natural compounds using IR, <sup>1</sup> HNMR, <sup>13</sup> CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides.	<b>03</b>	<b>12 Hrs</b>
	<b>TOTAL</b>			<b>60 Hrs</b>

## 6.2. Practical Aspects

Order	Name of Experiment	Number of Weeks
1	1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation 2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry 3. Experiments based on Column chromatography 4. Experiments based on HPLC	<b>12</b>

	<p>5. Experiments based on Gas Chromatography</p> <p>6. Estimation of riboflavin/quinine sulphate by fluorimetry</p> <p>7. Estimation of sodium/potassium by flame photometry</p>	
2	<p>To perform the following reactions of synthetic importance</p> <ol style="list-style-type: none"> <li>1. Purification of organic solvents, column chromatography</li> <li>2. Claisen-schimidt reaction.</li> <li>3. Benzilic acid rearrangement</li> <li>4. Beckmann rearrangement.</li> <li>5. Hoffmann rearrangement</li> <li>6. Mannich reaction</li> <li>7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)</li> <li>8. Estimation of elements and functional groups in organic natural compounds</li> <li>9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.</li> </ol>	<b>12</b>

	10. Some typical degradation reactions to be carried on selected plant constituents	
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### 7.0. ASSESSMENT MECHANISM:

Sr. No.	Assessment Mechanism	Week due	Marks	Proportion of Final Assessment
1	Continuous Assessment (Theory)	2 <sup>nd</sup> week of every month	10	4%
2	Sessional (Internal Theory exam)	As per schedule of examination	15	6%
3	Continuous Practical Assessment (Sessional Practical exam)	Weekly during practical	20	8%
4	Sessional (Internal Practical exam)	As per schedule of examination	30	12%
5	Final exam (theory)	As per University at end of course	75	30%
6	Final exam(practical)		100	40%
Total			150	<b>100%</b>

### 8.0.STUDENT SUPPORT:

Office hours/week	Other procedures
<b>Two hours minimum</b>	<b>MENTORING AND GUIDING</b>

### 9.0.TEACHER'S AVAILABILITY FOR STUDENT SUPPORT:

Days	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Time	<b>4:00-5:00</b>	<b>4:00-5:00</b>	<b>4:00-5:00</b>	<b>4:00-5:00</b>	<b>4:00-5:00</b>	<b>4:00-5:00</b>

### 10.0. LEARNING RESOURCES:

Sr. No.	Title of Learning Material	Details
1	Text books	1. Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer – Verlag, Berlin, Heidelberg.



		<p>2. Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.</p> <p>3. Recent advances in Phytochemistry Vol. I to IV – Scikel Runeckles, Springer Science &amp; Business Media.</p> <p>4. Chemistry of natural products Vol I onwards IWPAC.</p> <p>5. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.</p> <p>6. Natural Product Chemistry “A laboratory guide” – Rapheal Khan.</p> <p>7. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.</p> <p>8. Introduction to molecular Phytochemistry – CHJWells, Chapmanstall.</p> <p>9. Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.</p> <p>10. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, Krishan Prakashan.</p> <p>11. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.</p> <p>12. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.</p> <p>13. Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.</p> <p>14. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.</p> <p>15. Phytochemical methods of Harborne, Springer, Netherlands.</p> <p>16. Burger’s Medicinal Chemistry.</p>
2	Reference material	<p>1) Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.</p> <p>2. Chemistry of Natural Products By Sujata V. Bhat, B.A. Nagasampagi, Meenakshi Sivakumar. Narosa Publishing House.</p>
3	E-materials and websites	PPT’s, Text Notes, Soft copies (word/Pdf files),
4	Other learning material	College WhatsApp Group

#### 11.0. FACILITIES REQUIRED:

Sr. No.	Particular of Facility Required
1	Lecture Rooms (capacity for 60 students)
2	Laboratory (capacity for 20 students)

3	Computing resources: PC with latest version and hardware/software and utilization of open source and licensed application software
4	Other resources: Appropriate laboratory tools, Chemicals, Glass ware, Apparatus, Instrumentation

## 12.0. COURSE IMPROVEMENT PROCESSES:

### 12.1. Strategies for obtaining student feedback on effectiveness of teaching:

Course delivery evaluation by students using: Questionnaire forms and online questionnaires

### 12.2. Other strategies for evaluation of teaching by the instructor or by the department:

Periodic review by Academic Planning & Monitoring Committee and departmental review committee, Observations and assistance of colleagues, External assessments by advisors/examiners and auditors.

### 12.3. Process for improvement of teaching:

Use of ICT tools, teaching aids, Simultaneous practical orientation and theory classes (SPOT), Adoption of reflective teaching.

### 12.4. Describe the planning procedures for periodically reviewing of course effectiveness and planning for improvement:

Periodic review by departmental meeting, Review of course delivery and outcome through assessment and feedback from all stake holders.

### 12.5. Course development plans:

Provide inputs for course improvement and update to University Course development Committees (Board of Studies)

## 13.0. INFORMATION ABOUT FACULTY MEMBER RESPONSIBLE FOR THE COURSE:

<b>Name</b>	<b>Dr. Mirza Shahed Baig (MSB)</b>
<b>Location</b>	<b>Department of Pharmaceutical Chemistry</b>
<b>Contact Detail (e-mail &amp; cell no.)</b>	<b>mirzashahedbaig@ybccpa.ac.in &amp; 9890336238</b>
<b>Office Hours</b>	<b>10:00 AM to 5:00 PM</b>

