



**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>	Advance Spectral Analysis

- 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.

**5. 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, green chemistry, peptide chemistry, catalysis, stereochemistry 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

### Course Description:

The subject is designed to provide in-depth knowledge about various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LC-MS, GC-MS, ATR-IR, DSC

### Course objective :

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

- Interpretation of the NMR, Mass and IR spectra of various organic compounds
- Theoretical and practical skills of the hyphenated instruments
- Identification of organic compound

## 5.1.COURSE SPECIFICATION : Course Identification and General Information

<b>a. Course Title:</b>	ADVANCED SPECTRAL ANALYSIS	
<b>b. Course Number/Code</b>	MPC 201T	
<b>c. Credit Hours</b>	<b>Theory</b>	<b>Practical</b>
	60	180
<b>d. Study level/semester at which this course is offered</b>	Second semester	
<b>e. Pre-requisite</b>	Basic Organic chemistry	
<b>f. Co-requisite</b>	Stereochemistry and catalysis	
<b>g. Program in which the course is offered</b>	M Pharm	
<b>h. Language of teaching the course</b>	English	
<b>i. Prepared by</b>	Dr. K G Baheti	
<b>j. Approved by HOD</b>	Dr. K G Baheti	

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

(Use Bloom's Taxonomy words)

After completing the course, student will be able to:

CO Code	Course outcome
CO 201.01	Explain the applications of analytical techniques in pharmaceuticals
CO 301.02	Select appropriate analytical technique for a given analytical problem
CO 201.03	Describe thermal method of analysis, radioimmuno assay and their applications
CO 201.04	Interpret spectroscopic data and propose structure features present in compound

### 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 201.01	H	---	M	L	--
CO 301.02	H	--	M	L	---
CO 201.03	H	--	M	L	--
CO 201.04	H	--	H	L	---

Correlation levels 1, 2 or 3 as defined below:

2: Moderate (Medium); 3: Substantial

1: Slight (Low); (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
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

### Theoretical Aspect:

Order	Topic list/units	Subtopics list	Number of Weeks	Contact Hours
1	<b>Unit I</b>	UV and IR spectroscopy: Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and $\alpha,\beta$ -carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds.	3	12
2	<b>Unit II</b>	NMR spectroscopy: 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.	3	12
3	<b>Unit III</b>	Mass Spectroscopy Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.	3	12
4	<b>Unit IV</b>	Chromatography: Principle, Instrumentation and Applications of the following : a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CEMS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-	3	12

		EC (Ion-Exclusion Chromatography) k) Flash chromatography		
5	<b>Unit V</b>	a). Thermal methods of analysis Introduction, principle, instrumentation and application of DSC, DTA and TGA. b). Raman Spectroscopy Introduction, Principle, Instrumentation and Applications. c). Radio immuno assay Biological standardization , bioassay, ELISA, Radioimmuno assay of digitalis and insulin...	<b>3</b>	<b>12</b>
	<b>TOTAL</b>		<b>15</b>	<b>60</b>

### Practical Aspects

Sr.no	Practical	Number of Weeks
<b>1</b>	Synthesis of organic compounds by adapting different approaches involving (3 experiments) a) Oxidation b) Reduction/hydrogenation c) Nitration	<b>3</b>
<b>2</b>	Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)	<b>2</b>
<b>3</b>	assignments on regulatory requirements in API (2 experiments)	<b>2</b>
<b>5</b>	Comparison of absorption spectra by UV and Woodward – Fieser rule	<b>1</b>
<b>5</b>	Interpretation of organic compounds by FT-IR	<b>1</b>
<b>6</b>	Interpretation of organic compounds by NMR	<b>1</b>
<b>7</b>	Interpretation of organic compounds by MS	<b>1</b>
<b>8</b>	Determination of purity by DSC in pharmaceuticals	<b>1</b>
<b>9</b>	Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra	<b>1</b>
<b>10</b>	To carry out the preparation of following organic compounds	<b>1</b>
<b>11</b>	Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).	<b>1</b>
<b>12</b>	Preparation of 4-iodotoluene from p-toluidine.	<b>1</b>
<b>13</b>	NaBH <sub>4</sub> reduction of vanillin to vanillyl alcohol	<b>1</b>
<b>14</b>	Preparation of umbelliferone by Pechhman reaction	<b>1</b>
<b>15</b>	Preparation of triphenyl imidazole	<b>1</b>
<b>16</b>	To perform the Microwave irradiated reactions of synthetic importance	<b>1</b>

	(Any two)	
<b>17</b>	Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares	<b>1</b>
<b>18</b>	Calculation of ADMET properties of drug molecules and its analysis using softwares Pharmacophore modelling	<b>1</b>
<b>19</b>	2D-QSAR based experiments	<b>1</b>
<b>20</b>	3D-QSAR based experiments	<b>1</b>
<b>21</b>	Docking study-based experiment	<b>1</b>
<b>22</b>	Virtual screening based experiment	<b>1</b>

#### 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>	---

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

Days	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Time	12:00-1:00	12:00-1:00	12:00-1:00	12:00-1:00	12:00-1:00	12:00-1:00

**10.0. LEARNING RESOURCES:**

Sr. No.	Title of Learning Material	Details
1	Text books	---
2	Reference material	1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004. 2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998. 3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers. 4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991. 5. Quantitative analysis of Pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi. 6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997. 7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series
3	E-materials and websites	---
4	Other learning material	--

**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>	Dr. K G Baheti
<b>Location</b>	IQAC, 3 <sup>rd</sup> floor
<b>Contact Detail (e-mail &amp; cell no.)</b>	9422340342, nk_baheti@yahoo.com
<b>Office Hours</b>	10:00 AM to 5:00 PM