

**Rayat Shikshan Sanstha's**  
**Yashavantrao Chavan Institute of Science, Satara**  
**(Autonomous)**  
**Reaccredited by NAAC with A<sup>+</sup> Grade**

**Drug Chemistry**  
**Bachelor of Science**

**Part – III**

**Drug Chemistry Syllabus**  
**W.e.f. from June 2023**

## **B. Sc. III Drug Chemistry Syllabus**

**2023-2024**

### **PREAMBLE:**

This syllabus is prepared for Third year undergraduate students to encourage them to study drug chemistry and excel for the academic and industrial exposure simultaneously. As per the UGC norms and industry requirement content of the syllabus have been framed. The depth of the syllabi is compatible to the syllabi of other universities, at the same time is not rigid for the students at third year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance.

### **GENERAL OBJECTIVES OF THE COURSE:**

1. To introduce drug chemistry which includes detail study of drug will help them to enhance their interdisciplinary approach with vigour.
2. To understand the fundamentals, principles, concepts and recent developments in the subject area.
3. To create a skilled workforce to match the requirements of the society.
4. To develop scientific attitude is the major objective so as to make the students open minded, and curious.
5. To develop laboratory skills through practical work and equipment's along with the collection and interpretation of scientific data to contribute to science.

### **PROGRAM OBJECTIVES AND OUTCOMES**

#### **PROGRAMME OBJECTIVES:**

Students gain a deep knowledge regarding natural products drug resources, analytical skills along with excipients, chemistry involved in SAR (Structure Activity Relationship) in drug development process, commonly used drugs for various therapeutic areas, Drug development process, toxicity and impurity profile.

#### **PROGRAM SPECIFIC OUTCOMES:**

1. Able to apply the knowledge gained during the course of the program from biochemistry, drug analysis, medicinal chemistry and environmental studies.
2. Able to communicate easily and confidently
3. Able to perform multitask in the fields including pharmaceuticals and research.
4. The students will graduate with proficiency in the subject of drug chemistry.
5. The students will be eligible to continue higher studies in their subject.

## Course Structure: Semester V

<i>Semester</i>	<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>No. of lectures per week</b>	<b>Credits</b>
V	Theory Paper XXIX	BDCT - 501	Drug Design and Early Development	3	2
	Theory Paper XXX	BDCT - 502	Reaction Mechanisms Reagents & Name Reactions	3	2
	Theory Paper XXXI	BDCT- 503	Natural Products	3	2
	Theory Paper XXXII (Elective)	BDCT- 504	Industrial Pharmacy ( Elective)	3	2
	Theory Paper XXXII (Elective)	BDCT- 505	Analytical Chemistry (Elective)		
	Theory Paper XXXII (Elective)	BDCT- 506	Analytical Chemistry (Elective)		
	Paper SEDCC Paper I	SEDCCT - 507	Basic Numerical Skill In Drug Chemistry	2	1
	Practical Course Lab XV	BDCP- 508	Drug Design and Early Development & Reaction Mechanisms Reagents & Name Reactions	10	4
	Practical Course Lab XVI	BDCP- 509	Natural Products & Industrial Pharmacy	10	4
Practical SECC Paper I	SEDCCP- 510	Basic Numerical Skill In Drug Chemistry Practical	3	1	

## Course Structure: Semester VI

<i>Semester</i>	<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>No. of lectures per week</b>	<b>Credits</b>
VI	Theory Paper XXXIII	BDCT - 601	Therapeutic Areas and its Drugs	3	2
	Theory Paper XXXIV	BDCT - 602	Heterocyclic Drugs	3	2
	Theory Paper XXXV	BDCT- 603	Herbal Drug Technology	3	2
	Theory Paper XXXVI (Elective)	BDCT- 604	Industrial Chemistry (Elective)	3	2
	Theory Paper XXXVI (Elective)	BDCT- 605	Industrial Chemistry (Elective)		
	Theory Paper XXXVI (Elective)	BDCT- 606	Industrial Chemistry (Elective)		
	Paper SEDCCC Paper II	SEDCCCT - 607	Basic Numerical Skill	2	1
	Practical Course Lab XVII	BDCP- 608	Therapeutic Areas and its Drugs & Heterocyclic Drugs	10	4
	Practical Course Lab XVII	BDCP- 609	Herbal Drug Technology & Industrial chemistry	10	4
	Practical SECC Paper I	SECCP- 610	Entrepreneurship Development in Drug Chemistry	3	1

**Structure and titles of the B.Sc. III course  
Semester V**

<b>Paper Code</b>	<b>Name of Course</b>	<b>Units</b>
<b>BDCT- 501</b>	<b>Drug Design and Early Development</b>	<b>Unit I:</b> Novel Drug Discovery <b>Unit II :</b> Drug Design <b>Unit III:</b> Preclinical Trials in Drug Development <b>Unit IV:</b> Clinical Trials in Drug Development <b>Unit V:</b> Drug registration process
<b>BDCT- 502</b>	<b>Reaction Mechanisms &amp; Reagents &amp; Name Reactions</b>	<b>Unit I:</b> Basics of Chemical Reactions <b>Unit II :</b> Nucleophilic and Electrophilic Substitution Reactions <b>Unit III:</b> Synthetic Reagents and Applications. <b>Unit IV:</b> Name Reactions
<b>BDCT- 503</b>	<b>Natural Products</b>	<b>Unit I:</b> Introduction To Natural Compounds <b>Unit II:</b> Terpenoids <b>Unit III:</b> Steroids <b>Unit IV:</b> Vitamins <b>Unit V :</b> Lipids
<b>BDCT- 504</b>	<b>Industrial Pharmacy</b>	<b>Unit I :</b> Tablets and Liquid Orals <b>Unit II:</b> Capsules <b>Unit III:</b> Parenteral Products <b>Unit IV:</b> Cosmetics <b>Unit V:</b> Sterile formulation Immunological products.
<b>BDCT- 505</b>	<b>Analytical Chemistry</b>	<b>Unit I :</b> Artificial intelligence <b>Unit II:</b> Food and body fluid analysis <b>Unit III:</b> Petroleum industry and eco-friendly fuels <b>Unit IV:</b> Green synthesis and quality control <b>Unit V:</b> Silicate industries
<b>BDCT- 506</b>	<b>Analytical Chemistry</b>	<b>Unit I :</b> Artificial Intelligence <b>Unit II:</b> Food and body fluid analysis <b>Unit III:</b> Thermal methods of analysis <b>Unit IV:</b> Green Techniques in Chemistry <b>Unit V:</b> Atomic Absorption Spectroscopy
<b>SEDCCT-507</b>	<b>Basic Numerical Skills in Drug Chemistry</b>	<b>Unit I:</b> Statistics <b>Unit II:</b> Computer Programing

<b>Paper Code</b>	<b>Name of Course</b>	<b>Units</b>
<b>BDCT- 601</b>	<b>Therapeutic areas and its drugs</b>	<b>Unit I:</b> Central Nervous system Drugs <b>Unit II :</b> Cardiovascular Drugs <b>Unit III:</b> Drugs for Respiratory System <b>Unit IV:</b> Anti-Neoplastic and Anti-HIV Drugs <b>Unit V:</b> Drugs Acting on Gastrointestinal Tract
<b>BDCT- 602</b>	<b>Heterocyclic Drugs</b>	<b>Unit I :</b> Heterocyclic Chemistry <b>Unit II:</b> Five & Six Membered Heterocyclic Compounds <b>Unit III:</b> Condensed Heterocyclic Compounds. <b>Unit IV:</b> Bridged & Spiro Heterocycles.
<b>BDCT- 603</b>	<b>Herbal Technology Drug</b>	<b>Unit I:</b> Herbs as Raw materials <b>Unit II :</b> Nutraceuticals <b>Unit III:</b> Herbal Cosmetics <b>Unit IV:</b> Evaluation of Drugs <b>Unit V :</b> General Introduction to Herbal Industry
<b>BDCT- 604</b>	<b>Industrial Chemistry</b>	<b>Unit I:</b> Small scale Industries <b>Unit II:</b> Entrepreneurship Development and Management <b>Unit III:</b> Sugar Industry <b>Unit IV:</b> Manufacture of Industrial Heavy Chemicals. <b>Unit V:</b> Electroplating
<b>BDCT- 605</b>	<b>Industrial Chemistry</b>	<b>Unit I:</b> Small scale Industries <b>Unit II:</b> Entrepreneurship Development and Management <b>Unit III:</b> Dairy Chemistry <b>Unit IV:</b> Soil Chemistry <b>Unit V:</b> Leather Chemistry
<b>BDCT- 606</b>	<b>Industrial Chemistry</b>	<b>Unit I:</b> Small scale Industries <b>Unit II:</b> Entrepreneurship Development and Management <b>Unit III:</b> Glass Industry <b>Unit IV:</b> Synthetic Polymer <b>Unit V:</b> Batteries

<b>SEDCCCT-607</b>	<b>Entrepreneurship Development in Drug Chemistry</b>	<b>Unit I:</b> Entrepreneurship, Creativity & Opportunities <b>Unit II:</b> Business Finance & Accounts <b>Unit III:</b> Enterprise Management and Modern Trends <b>Unit IV:</b> Chemistry Entrepreneur
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	<b>Semester – V BDCT-501 Drug Design and Early Development</b>	<b>45 Lectures</b>
<b>Credits 2</b>	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand the novel drug discovery term.</li> <li>2. Know the biological targets involved in different diseases.</li> <li>3. Know different types of screening.</li> <li>4. Study the parameters involved in DMPK.</li> </ol>	<b>No of lectures per week</b>
<b>UNIT - I</b>	<b>Novel Drug Discovery</b>	<b>08</b>
	1.1 Disease 1.2 Biological target 1.3 Binding sites of the drug candidate 1.4 Structural designing of the pharmacophore 1.5 Synthesis 1.6 in-vitro study, in-vivo study 1.7 PK study and PD study.	
<b>UNIT-II</b>	<b>Drug Design</b>	<b>10</b>
	2.1 Screening and types of the screening 2.2 Lead candidate identification and its modification for generating SAR with the help homologation 2.3 Chain branching 2.4 Ring chain transformation 2.5 Bio-isomerism.	
<b>UNIT-III</b>	<b>Preclinical Trials in Drug Development</b>	<b>09</b>
	3.1 In-vitro study and in-vivo study 3.2 DMPK, toxicity 3.3 Drug metabolite study 3.4 stability, formulation and solubility.	
<b>UNIT- IV</b>	<b>Clinical trials in Drug Development</b>	<b>12</b>
	4.1 Phase I 4.2 Phase II 4.3 Phase III 4.4 Phase IV 4.5 IND Filling 4.6 process of FDA Approval	
<b>UNIT- V</b>	<b>Drug Registration Process</b>	<b>06</b>
	5.1 Drug registration process in Us 5.2 Europe 5.3 Japan 5.4 India	



**Course Outcomes: After completion of the course student should be able to:**

1. Explain biological targets and binding sites for the drug.
2. Perform various types of screenings.
3. Carry out comparative DMPK study for different drugs.
4. Explain volunteers detail required for clinical study and their importance in assessing safety and efficacy.

**References:**

1. Wilson C. O. Delgado J. N., 1998, 'Textbook of Organic Medicinal and Pharmaceutical Chemistry,' William and Wilkinson's publications.
2. Patrick G. L., 2006, 'A textbook of Medicinal Chemistry', Oxford publications.
3. Silverman R. B., 2004 'Organic Chemistry of Drug Design and Drug Action', Elsevier Academic Press.
4. Lemke T. L. Williams D. A., Roche V. F., Zito S. W., 2013, 'Foye's Principles of Medicinal Chemistry,' 7<sup>th</sup> edition, Lippincott William and Wilkinson's publications.

Credits 2	SEMESTER-V BDCT 502 Reaction Mechanisms, Reagents & Name Reactions	45 Lectures
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand basics of chemical reactions.</li> <li>2. Learn nucleophilic and electrophilic reactions.</li> <li>3. Familiar with reagents used in organic chemistry.</li> <li>4. Get and adequate knowledge of name reactions in chemistry.</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Basics of Chemical Reactions</b>	<b>11</b>
	1.1 Types of organic reactions addition, substitution, elimination 1.2 electronic movement in organic reactions 1.3 fission of a covalent bond 1.4 concepts of electrophiles and nucleophiles 1.5 factors affecting on chemical reactions 1.6 order of reactivity 1.7 acidity and basicity.	
<b>UNIT-II</b>	<b>Nucleophilic and Electrophilic Substitution Reactions.</b>	<b>8</b>
	2.1 SN <sup>1</sup> reaction 2.2 SN <sup>2</sup> reaction 2.3 SN <sup>i</sup> reaction 2.4 Aliphatic electrophilic substitution 2.5 Aromatic electrophilic substitution 2.6 Aliphatic nucleophilic substitution 2.7 Aromatic nucleophilic substitution.	
<b>UNIT-III</b>	<b>Synthetic Reagents and Applications</b>	<b>12</b>
	Preparation and Applications of following reagents. <ol style="list-style-type: none"> <li>3.1 Lithium aluminum hydride LiAlH<sub>4</sub></li> <li>3.2 Osmium tetroxide (OsO<sub>4</sub>)</li> <li>3.3 Dicyclohexyl Carbodiimide (DCC)</li> <li>3.4 Raney Nickel</li> <li>3.5 2,3 - Dichloro - 5,6 - dicyano -1,4-benzoquinone (DDQ)</li> <li>3.6 Polyphosphoric acid (PPA)</li> <li>3.7 Diazomethane</li> <li>3.8 Ceric ammonium nitrate (CAN)</li> <li>3.9 N-Bromosuccinamide (NBS)</li> <li>3.10 Selenium dioxide (SeO<sub>2</sub>)</li> <li>3.11 Sodium borohydride (NaBH<sub>4</sub>)</li> </ol>	

<b>UNIT- IV</b>	<b>Name Reactions Statement, General Reaction, Mechanism and Synthetic applications</b> 4.1 Diels-Alder reaction 4.2 Oppenauer Oxidation 4.3 Meerwein – Ponderff- Verley reduction 4.4 Schmidt rearrangement 4.5 Hofmann rearrangement	<b>14</b>
	4.6 Wittig reaction 4.7 Wagner-Meerwein rearrangement 4.8 Favorskii rearrangement 4.9 Michael reaction 4.10 Dieckmann's reaction or condensation 4.11 Benzil- Benzilic acid rearrangement 4.12 Benzidine rearrangement.	

**Course Outcomes: After completion of the course student should be able to:**

1. Differentiate nucleophiles and electrophiles.
2. Explain reaction pathway.
3. Understand different roles of reagents in chemistry.
4. Recognize different scientist as per their contribution made.

**References:**

1. Finar I. L., 2002, 'Organic Chemistry Vol. 1 and 2,' Pearson publications.
2. Smith M. B. March's, March J. 2013, Advanced Organic Chemistry, 6<sup>th</sup> edition, Wiley India.
3. Bahl B.S., Bahl A, 2019, 'A textbook of Organic Chemistry,' S. Chand Publication.
4. Sanyal S. N., 2019, ' Reactions Rearrangements and reagents, Bharati Bhavan Publishers and distributors.
5. Kalsi P. S., 2020, Organic Reactions and their Mechanisms, New age international Publications.
6. Clayden J, Greeves N., Warren P., 2021. 'Organic Chemistry,' Oxford Press.

<b>Credits 4</b>	<b>SEMESTER-V BDCP 508 Lab XV(Practical for: Drug Design and Early Development &amp; Reaction Mechanisms Reagents &amp; Name Reactions)</b>	
	<p><b>Course Objectives: Student will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Draw chemical structure and check its physico-chemical properties.</li> <li>2. Collect and compile data for drug from history to market.</li> <li>3. Calculate Saponification value of oils.</li> <li>4. Estimate amount of unsaturation in the given sample.</li> </ol>	
	<ol style="list-style-type: none"> <li>1. Structure drawing with the help chem-draw and calculation of Physico-chemical properties. (TPSA, C logP, Mol. Wt., Hydrogen bond donor, hydrogen bond acceptors etc.) And add comment whether compounds follow the Lipinski rule.</li> <li>2. Project: Detailed information of any one drug and its presentation.</li> <li>3. Diels Alder reaction between furan and maleic anhydride.</li> <li>4. Benzil Benzilic acid rearrangement.</li> <li>5. Aldol condensation reaction (dibenzal propane).</li> <li>6. Electrophilic aromatic substitution reaction, Bromination of acetanilide by KBr and CAN.</li> <li>7. Preparation of derivatives: 2, 4-DNP, Osazone, Oxime.</li> <li>8. Estimation of acid and ester by hydrolysis method.</li> <li>9. Saponification of oil.</li> <li>10. Estimation of unsaturation by bromate bromide</li> </ol> <p><b>Note- Any other relevant practical may be added.</b></p>	
<p><b>Course Outcomes: After completion of the course student should be able to:</b></p> <ol style="list-style-type: none"> <li>1. Estimate acid and ester by hydrolysis method</li> <li>2. Calculate saponification value of oil</li> <li>3. Prepare derivatives</li> <li>4. Synthesize different compounds and develop skills in synthesis, workup and product isolation.</li> </ol>		

Credits 2	SEMESTER-V BDCT 503 Natural Products	45 Lectures
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Know the sources of natural products.</li> <li>2. Understand synthesis of different natural products.</li> <li>3. Learn vitamin synthesis.</li> <li>4. Categories different structure into alkaloids, steroids, terpenes and vitamins.</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Introduction To Natural Compounds</b>	<b>10</b>
	1.1 Introduction to natural products history Pharmaceutical applications, 1.2 Natural products as leads for new Pharmaceuticals eg. CNS, Anticancer, Cardiovascular, Antimalarial, antibiotics. <b>1.3 Alkaloid:</b> Occurrence, Isolation, Classification, Properties, General methods for structure determination, synthesis of nicotine, morphine, codeine, berberine and its applications.	
<b>UNIT-II</b>	<b>Terpenoids</b>	<b>09</b>
	2.1 Occurrence, 2.2 Classification, 2.3 Extraction, 2.4 General Characteristics, 2.5 Isoprene rule, 2.6 synthesis of Citral, menthol, camphor and its applications.	
<b>UNIT-III</b>	<b>Steroids</b>	<b>10</b>
	3.1 Introduction, 3.2 Occurrence, 3.3 Classification, 3.4 Biological Significance and Biosynthesis, 3.5 Mevalonate pathway: oestrone, cortisol, testosterone, progesterone.	
<b>UNIT- IV</b>	<b>Vitamins</b>	<b>07</b>
	4.1 Overview on Vitamin A, B, C, D, E and K. 4.2 Synthesis of vitamin B and C.	
<b>UNIT- V</b>	<b>Lipids</b>	<b>09</b>

	5.1 Introduction, 5.2 Classification, 5.3 Properties and biological importance. 5.4 Fatty acids Nomenclature and Structures, 5.5 Lipids in cell membrane Cholesterol and steroids, 5.6 Hormones- structure and functions.	
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**Course Outcomes: After completion of the course student should be able to:**

1. Differentiate steroids, alkaloids and terpenoids.
2. Explain synthesis of vitamins.
3. Understand importance of vitamins and steroids.
4. Find the occurrence of natural products.

**References:**

1. Charles S., 2003, A fragrant introduction to terpenoids chemistry, 1<sup>st</sup> edition, RSC.
2. Matthew R. R., Pero J. M., Mark D. P., Alexander J. L., 2008 Anabolics steroids,
3. Satyanarayana U. Textbook of Biochemistry,
4. Algarsamy V. 2010, Pharmaceutical Chemistry of Natural Products, Elsevier.
5. Comb G. James J., The Vitamins fundamental aspects in nutritional and health. 2015 5<sup>th</sup> edition McClung.
6. Banik B. K., Bishwa M. S., Tiwari A. 2022, Terpenoids Chemistry, Biochemistry, Medicinal effects and Ethno-pharmacology, CRC press.
7. Honour J. W. 2023, "Steroids in laboratory and clinical practice," Elsevier Publications.

Credits 2	SEMESTER-V BDCT 504 Industrial Pharmacy	45 Lectures
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand tablets and their Formulation methods.</li> <li>2. Learn Capsules and their types.</li> <li>3. Know advantages and Limitations of Parenteral Products.</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT – I</b>	<b>Tablets and Liquid Orals</b>	<b>11</b>
	1.1 Introduction, ideal characteristics of tablets, 1.2 Classification of tablets, excipients, 1.3 Formulation of tablets, granulation methods, 1.4 Compression and processing problems, equipment's and tablet tooling, 1.5 Tablet coating: types of coating, coating material formulation of coating compositions methods of coating equipment employed and defects in coating. 1.6 Quality control tests: in process and finished product tests. <b>1.7 Liquid orals:</b> formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging evaluation of liquid orals official in pharmacopoeia.	
<b>UNIT-II</b>	<b>Capsules</b>	<b>09</b>
	<b>A) Hard gelatin capsules:</b> <ol style="list-style-type: none"> <li>2.1 Introduction,</li> <li>2.2 Production of hard gelatin capsule shells.</li> <li>2.3 Size of capsules Filling,</li> <li>2.4 Finishing and special techniques of formulation of hard gelatin capsule,</li> <li>2.5 Manufacturing defects, in process and final products quality control tests for capsules.</li> </ol> <b>B) Soft gelatin capsules:</b> <ol style="list-style-type: none"> <li>2.6 Nature of shell and capsule contain,</li> <li>2.7 Size of capsule importance of base adsorption and minimum/gm factors production in process and final product quality control tests.</li> <li>2.8 Packaging, storage and stability testing of soft gelatin capsules and their applications.</li> </ol>	

<b>UNIT-III</b>	<b>Parenteral Products:</b>	<b>10</b>
	3.1 Definition, types, advantages and limitations. 3.2 Preformulation factors and essential requirements, 3.3 Vehicles, additives, importance of isotonicity, Production procedure, production facilities and controls, aseptic processing, Formulation of injections, sterile powders, 3.4 Large volume parenteral and Lyophilized products.	
<b>UNIT- IV</b>	<b>Cosmetics</b>	<b>06</b>
	4.1 Introduction, 4.2 types, its formulation and preparation of the following cosmetics: 4.3 Lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and Sunscreens.	
<b>UNIT- V</b>	<b>Sterile formulations &amp; Immunological Products</b>	<b>09</b>
	5.1 Injectable, 5.2 Eye drops, eye ointments 5.3 Immunological Products: Sera, Vaccines, Toxoids and their manufacturing methods.	

**Course Outcomes: After completion of the course student should be able to:**

1. Explain formulation and its types.
2. Differentiate capsule and tablets.
3. Collect and find out contents in the various cosmetics.
4. Categorize tablets, capsules and cosmetics.

**References:**

1. Liberman H. A., Leon L., Schwartz J. B., 1989,'Pharmaceutical Dosage forms- tablets volume I II III', CRC Press
2. Liberman H. A., Leon L., 1989,'Pharmaceutical Dosage forms- tablets volume I II III', CRC Press



Credits 4	<b>SEMESTER-V</b> <b>BDCP 509</b> <b>Lab XVI</b> <b>(Practical For: Natural Products &amp; Industrial Pharmacy)</b>	45
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand the extraction process of natural products from plant sources.</li> <li>2. Learn Preparation of shampoo.</li> <li>3. Know the synthesis of vitamin B.</li> <li>4. Learn to prepare balms.</li> </ol>	<b>No. of Lectures per unit</b>
	<ol style="list-style-type: none"> <li>1. Vitamin B synthesis (1)</li> <li>2. Extraction of nicotine from Tobacco.</li> <li>3. Determination of total contents of alkaloids.</li> <li>4. Shampoo</li> <li>5. Lipsticks</li> <li>6. Balm</li> <li>7. Cold Creams</li> <li>8. Vanishing Creams</li> <li>9. Tooth paste</li> </ol> <p><b>Note- Any other relevant practical may be added.</b></p>	
<b>Course Outcomes: After completion of the course student should be able to</b> <ol style="list-style-type: none"> <li>1. Extract natural products from plant sources.</li> <li>2. Determine total contain of alkaloids</li> <li>3. Prepare toothpaste</li> <li>4. Synthesize vitamin.</li> </ol>		

<b>Credits 2</b>	<b>SEMESTER-V BDCT 505 Analytical Chemistry ( Elective)</b>	<b>45</b>
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand importance of artificial intelligence.</li> <li>2. Learn food and body fluid analysis.</li> <li>3. Know composition of petroleum and other fuels.</li> </ol>	No. of Lectures per unit
<b>UNIT - I</b>	<b>Artificial intelligence</b>	<b>11</b>
	1.1 Introduction, 1.2 fundamentals: classical/symbolic approach to Artificial Intelligence and Serves as a basis for more in depth treatment of specific theories and technologies for building complete A.I. systems integrating different approaches and methods.-Advanced search-Constraint satisfaction problems. 1.3 Knowledge representation and reasoning Non-standard logics-Uncertain and probabilistic reasoning (Bayesian networks, fuzzy sets). 1.4 Foundations of semantic web: semantic networks and description logics. Rules systems: se and efficient implementation. Planning systems. ARVR introduction fundamentals etc.	
<b>UNIT-II</b>	<b>Food and Body fluid Analysis</b>	<b>12</b>
	2.1 Food analysis: Determination of moisture, ash content, fibres, protein, carbohydrates, and fat in different food items. 2.2 Body Fluid analysis: Analysis of blood for hemoglobin, biochemical properties of glucose and carbohydrates Protein, lipid and cholesterol analysis. Urine analysis: physical and chemical.	
<b>UNIT-III</b>	<b>Petroleum industry and eco-friendly fuels</b>	<b>08</b>

	<p><b>A] Petroleum industry</b>  3.1 Introduction, Occurrence, composition of petroleum,  3.2 resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane number, flash point, petroleum refineries,  3.3 applications of petrochemicals, synthetic petroleum, lubricating oils &amp; additives.</p> <p><b>B] Fuels</b>  3.4 Fuels and eco-friendly fuels: liquid, gaseous fuel (LPG, CNG), fossil fuels, diesel, bio diesel, gasoline, aviation fuels. Use of solar energy for power generation.</p>	
<b>UNIT- IV</b>	<b>Green synthesis and quality control</b>	<b>08</b>
	<p>Green Synthesis of the following compounds:  4.1 Adipic acid,  4.2 Catechol,  4.3 BHT,  4.4 Methyl methacrylate,  4.5 Urethane, aromatic amines (4-aminodiphenylamine),  4.6 Benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis),  4.7 Citral,  4.8 Ibuprofen,  4.9 Paracetamol,  4.10 furfural.</p>	
<b>UNIT- V</b>	<b>Silicate Industries</b>	<b>07</b>
	<p><b>Ceramics:</b>  5.1 Important clays and feldspar,  5.2 Ceramic, their types and manufacture.  5.3 High technology ceramics and their applications,  5.4 Superconducting and semiconducting oxides,  5.5 Fullerenes carbon nanotubes and carbon fiber.</p>	
<p><b>Course Outcomes: After completion of the course student should be able to-</b></p> <ol style="list-style-type: none"> <li>1. Explain Composition of petroleum</li> <li>2. Explain the process of determination of carbohydrates proteins and fats in food material</li> <li>3. Illustrate green synthesis of various compounds.</li> </ol>		

**References:**

1. Vogel's. G.S 1996, 'Qualitative inorganic analysis', 7<sup>th</sup> edition, Longman publisher.
2. Willard, Meritt, Dean Settle, 2004, 'Instrumental methods of analysis' 7<sup>th</sup> edition CBS Publisher
3. Chatwal.A, 2011, 'Instrumental method of analysis' Himalayan publication house.
4. Skoog & D. M. Anand,2022, 'Fundamentals of analytical chemistry' 10<sup>th</sup> edition
5. Khopkar, S. M, 2008, 'Basic concepts of analytical chemistry' 3<sup>rd</sup> edition, New age international pvt Ltd publisher.
6. Kaur.H, 2021, 'Instrumental method of analysis' by Pāgbati prakashan.
7. Ahluwalia. V. K & R. S. Verma, 2009, Green solvent for organic synthesis.
8. Shrama. B. K, 2014.'Industrial chemistry', Gel publishing house Krishan Prakashan.
9. Stuart Russell and Peter Norvig, 2022, "Artificial Intelligence: A Modern Approach "4<sup>th</sup> edition.
- 10.Nilsson. N. J, 1998. "Artificial Intelligence: A New Synthesis" by A New synthesis CBS Publisher and distributors.
11. Micheal Negnevitsky "Artificial Intelligence" A Guide to intelligent system. 3<sup>rd</sup> edition, Addison Wesly publisher.
13. Akerkar R, 2014, "Intro. To artificial intelligence" 2<sup>nd</sup> edition, PHL.learing Pvt.Ltd.

Credits 2	SEMESTER-V BDCT 506 Analytical Chemistry ( Elective)	45
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand importance of artificial intelligence.</li> <li>2. Learn food and body fluid analysis.</li> <li>3. Know thermal methods of analysis.</li> <li>4. Gain knowledge of atomic absorption spectroscopy</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Artificial intelligence</b>	<b>11</b>
	1.1 Introduction, 1.2 fundamentals: classical/symbolic approach to Artificial Intelligence and Serves as a basis for more in depth treatment of specific theories and technologies for building complete A.I. systems integrating different approaches and methods.-Advanced search-Constraint satisfaction problems. Knowledge representation and reasoning Non-standard logics-Uncertain and probabilistic reasoning (Bayesian networks, fuzzy sets). 1.3 Foundations of semantic web: semantic networks and description logics. Rules systems: se and efficient implementation. 1.4 Planning systems. 1.5 ARVR introduction fundamentals etc.	
<b>UNIT-II</b>	<b>Food and Body fluid Analysis</b>	<b>12</b>
	2.1 Food analysis: Determination of moisture, ash content, fibers, protein, carbohydrates, and fat in different food items. 2.2 Body Fluid analysis: Analysis of blood for hemoglobin, biochemical properties of glucose and carbohydrates 2.3 Protein, lipid and cholesterol analysis. 2.4 Urine analysis: physical and chemical.	
<b>UNIT-III</b>	<b>Thermal methods of Analysis (TGA &amp; DTA)</b>	<b>07</b>
	3.1 Classification of thermal methods. 3.2 Thermo gravimetric analysis, 3.3 Derivative thermo gravimetric analysis DTG, 3.4 Differential thermal analysis DTA	
<b>UNIT- IV</b>	<b>Green techniques in chemistry</b>	<b>08</b>

	<p>Introduction;</p> <p>4.1 Principles of green Chemistry;</p> <p>4.2 Emerging green technologies-Microwave chemistry,</p> <p>4.3 Sonochemistry,</p> <p>4.4 Photochemistry,</p> <p>4.4 Electro chemistry,</p> <p>4.5 Mechanochemistry.</p> <p>4.6 Green organic Synthesis by use of Zeolites, Natural catalysts and Biocatalysts.</p> <p>4.7 Green Synthesis of polycarbonate, carbaryl Pesticide, Ibuprofen.</p>	
<b>UNIT- V</b>	<b>Atomic Absorption Spectroscopy</b>	<b>07</b>
	<p>5.1 Principles of AAS,</p> <p>5.2 Difference between AAS and flame Photometry,</p> <p>5.3 Instrumentation of single beam for atomic absorption spectrometer (Source, chopper, nebulizer, monochromator, detector, amplifier),</p> <p>5.4 Interference: Spectral and chemical,</p> <p>5.5 Applications of AAS.</p>	
<p><b>Course Outcomes: After completion of the course student should be able to-</b></p> <ol style="list-style-type: none"> <li>1. Explain the process of determination of carbohydrates proteins and fats in food material</li> <li>2. Explain Composition of food materials</li> <li>3. Illustrate green synthesis of various compounds.</li> <li>4. Explain principle of Atomic absorption spectroscopy.</li> </ol>		
<p><b>References :</b></p> <ol style="list-style-type: none"> <li>1. Vogel's. G.S 1996, 'Qualitative inorganic analysis', 7<sup>th</sup> edition, Longman publisher.</li> <li>2. Willard, Meritt, Dean Settle, 2004, 'Instrumental methods of analysis' 7<sup>th</sup> edition CBS Publisher</li> <li>3. Chatwal.A, 2011, 'Instrumental method of analysis' Himalayan publication house.</li> <li>4. Skoog &amp; D. M. Anand, 2022, 'Fundamentals of analytical chemistry' 10<sup>th</sup> edition.</li> <li>5. Khopkar, S. M, 2008, 'Basic concepts of analytical chemistry' 3<sup>rd</sup> edition, New age international pvt Ltd publisher.</li> <li>6. Kaur.H, 2021, 'Instrumental method of analysis' by Pragati prakashan.</li> </ol>		

<b>Credits 1</b>	<b>SEMESTER-V SEDCCCT 507- PAPER - I Basic numerical skill in Drug Chemistry</b>	<b>20</b>
	<b>Course Objectives: Student will be able to:</b> 1. Empower the tools of mathematics to solve different chemical problems. 2. Understand the key concept of computer operation and its importance.	<b>Lecture per unit</b>
<b>Unit I</b>	<b>Statistics</b>	<b>10</b>
	1.1 Fundamentals, mathematical functions 1.2 Mean, standard deviation, relative error. 1.3 Some Important Units of Measurement 1.4 Accuracy and Precision: 1.5 Determinate Errors 1.6 Indeterminate Errors 1.7 Significant Figures: 1.8 Standard Deviation 1.9 Projection of a Result 1.11 Linear Least Squares 1.12 Detection Limits 1.13 Statistics of Sampling 1.14 Numerical integration	
<b>Unit II</b>	<b>Computer programming :</b>	<b>10</b>
	2.1 Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. 2.2 Elements of the Basic language. 2.3 Basic keywords and commands. 2.4 Logical and relative operators. 2.5 Introduction of Excel, using digital tools to create graphical displays, graphing in excel, grade distribution graph, definition of bar graph, types of bar graph, uses, advantages and disadvantages, difference between bar graph and histogram, steps to draw bar graph, examples, area chart , bar chart, radar chart. 2.6 Use of Spreadsheets in Analytical Chemistry. 2.7 Using Spreadsheets for Plotting Calibration Curves	
	<b>Course outcome:- After completion of course student should be able to:</b>	

	<ol style="list-style-type: none"> <li>1. Understand the graphical representation and processing.</li> <li>2. Understand and uses the rules and differentiation and integration in chemical deviations.</li> <li>3. Understand importance and use of algorithm and flow chart drawing.</li> <li>4. Learn algorithm writing and flow chart drawing.</li> </ol>	
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Credits 1	SEMESTER-V SEDCCCP -510	
	<p><b>Course Objectives: Student will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Find out mean, standard deviation for the given set of the result.</li> <li>2. Determine errors in the analysis.</li> </ol>	<b>No. of Lectures per unit</b>
	<ol style="list-style-type: none"> <li>1. Find the mean, error, percent deviation and standard deviation for given sets of result (e.g. i to iii) <ol style="list-style-type: none"> <li>i] The boiling point of a liquid which has a theoretical value of 54<sup>0</sup> C, was measured by a student four times. Determine mean, for each measurement the error and percent deviation. Observed values are 54.9, 54.4, 54.1, 54.2</li> <li>ii] The student has measured the % of chlorine in an experiment a total of six times. The values are 18.92, 19.56, 19.75, 18.25, 19.60, and 18.70. Calculate the mean and standard deviation?</li> <li>iii] A student analyzing a sample for bromine makes five trials with the following results: 36.1, 35.9, 36.5, 35.9, and 36.3. The theoretical value is 36.2. Calculate the mean, error and percent deviation for each trial, the standard deviation.</li> </ol> </li> <li>2. Conversion of the given unit into other unit (e.g. I and ii) <ol style="list-style-type: none"> <li>i] The temperature outside is measured to be 95<sup>0</sup> F. Given that Fahrenheit and Celsius are linked by the equation: <math>C = \frac{5}{9} \times (F - 32)</math> and Celsius and Kelvin are linked by the equation: <math>K = C + 273</math> Calculate the outside temperature in Kelvin.</li> <li>ii] An industrial chemist produces <math>2.5 \times 10^5 \text{ dm}^3</math> of fertilizer in a reaction. How much is that in <math>\text{m}^3</math> ?</li> </ol> </li> <li>3. Calculate the pH of weak acid by using quadric equation. Formic acid is a weak acid with a</li> </ol>	



dissociation constant  $K_a$  of  $1.8 \times 10^4$ . The  $K_a$  relates the concentration of the  $H^+$  ions denoted  $[H^+]$  and the amount of acid dissolved denoted  $N$  by the equation:  $K_a = [H^+]^2 / (N - [H^+])$  Given that there is 0.1 moles of formic acid dissolved, calculate the pH of the solution.

4. Application of numerical methods in finding root of volume (Vander waal's gas equation e.g. i- ii)
  - i] What is the volume of exactly one mole of oxygen gas at a pressure of 10.00 atm. and a temperature of 300.0 K.? For oxygen  $a$  is  $1.360 \text{ liter}^2 \text{ atm} / \text{mol}^2$  and  $b$  is  $0.003183 \text{ liter} / \text{mol}$ . Take  $R$  to be  $0.0820578 \text{ liter} \cdot \text{atm} / \text{mol} \cdot \text{K}$ .
    - ii] For benzene,  $a = 18.00 \text{ liter}^2 \text{ atm} / \text{mol}^2$  and  $b$  is  $0.1154 \text{ liter} / \text{mol}$ . Find the volume of 1.400 moles of benzene vapor at  $500^\circ\text{C}$  and a pressure of 40.00 atm.
5. Computer programs based on numerical methods for
  - i] Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
  - ii] Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid).
  - iii] Matrix operations. Application of Gauss-Siedel method in colorimetry.
  - iv] Simple exercises using molecular visualization software
6. Use the following set of stock prices (in dollars): 10, 7, 20, 12, 5, 15, 9, 18, 4, 12, 8, 14 Find the 10<sup>th</sup> percentile and the 50<sup>th</sup> percentile Solutions:
7. Find Population Mean and Sample Standard Deviation for the following data set: 5, 10, 15, 20

<b>Credits 2</b>	<b>SEMESTER-VI BDCT 601 Therapeutic areas and it's Drugs</b>	<b>45</b>
	<b>Course Objectives: Student will be to:</b> <ol style="list-style-type: none"> <li>1. Understand central nervous system.</li> <li>2. Learn different therapeutic areas.</li> <li>3. Know cardiovascular drugs.</li> <li>4. Understand severity of the diseases.</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Central Nervous system Drugs</b>	<b>9</b>
	1.1 Introduction to Central Nervous system, 1.2 Pharmacological actions, Concept of sedation, hypnosis, anesthesia, 1.3 Phenobarbitone(Barbiturates), 1.4 Phenytoin (Hydantoins), 1.5 Trimethadione (Oxazolidinediones), 1.6 Piracetam (Pyranones), 1.7 Midazolam, 1.8 Alprazolam (Benzodiazepines), 1.9 Methylphenidate, (Piperidines), 1.10 Chlorpromazine (Phenothiazines), 1.11 Fluoxetine (phenyl propyl amines), 1.12 Synthesis of Trimethadione; 1.13 Methylphenidate; Phenytoin. 1.14 Mode of action of Barbiturates as sedatives and hypnotics.	
<b>UNIT-II</b>	<b>Cardiovascular Drugs</b>	<b>9</b>
	2.1 Introduction to Cardiovascular system, 2.2 Diseases of Cardiovascular system, 2.3 Classification based on pharmacological actions, 2.4 Cardio tonic, 2.5 Antiarrythmic agents, 2.6 Enalapril, (alpha amino acids), 2.7 Isosorbide dinitrate(Nitrates), 2.8 Atenolol (Aryloxy propanol amines), 2.9 Nifedipine (pyridines), 2.10 Chlorthiazide (Thiazides), 2.11 Mode of action of Atenolol	
<b>UNIT-III</b>	<b>Drugs for respiratory system</b>	<b>9</b>

	<p>3.1 Respiratory system anatomy and working mechanism, 3.2 Disease of respiratory system, 3.3 General idea of Expectorants; Mucolytes; 3.4 Bronchodilators; Decongestants and Antitussives, \ 3.5 Bromohexine( phenyl methyl amines), 3.6 Salbutamol, 3.7 Pseudo-epuedrine ( Phenyl eth amines) , 3.8 Oxymetazoline( Imidazolines) , Codeine Phosphate(Opiates), 3.9 Synthesis of Salbutamol.</p>	
<b>UNIT- IV</b>	<b>Anti-Neoplastic and Anti-HIV Drugs</b>	<b>9</b>
	<p><b>Anti-Neoplastic Drugs</b>  4.1 Malignancy; Causes of cancer, brief idea of Immuno Stimulants, Immuno supressants,  4.2 Lomoustine (Nitrosoureas),  4.3 Fluorouracil (Pyrimidines),  4.4 Estrogen( steroidal hormones),  4.5 Mitomycin C (Antibiotics),  4.6 Vincristine; vinblatine; Vindesine (Vica alkaloids- no structures)  4.7 Cisplatin  4.8 Synthesis of 5 fluorouracil from urea.  <b>4.9 Anti HIV Drugs</b> Idea of HIV pathogenicity; 4.8 Symptoms of AIDS AZT,  4.10 Lamivudinr, Stavidine (Pyrimidines),  4.11 DDI (Purines).</p>	
<b>UNIT- V</b>	<b>Drugs Acting on Gastrointestinal Tract</b>	<b>9</b>
	<p>5.1 Introduction to Gastrointestinal tract,  5.2 Diseases of GIT,  5.3 Classification,  5.4 Pharmacological actions,  5.5 Dose,  5.6 Indications and contraindications of</p> <ul style="list-style-type: none"> <li>• Antiulcer drugs</li> <li>• Antiemetic's drugs</li> <li>• Laxatives &amp; Purgatives</li> <li>• Antidiarrheal drugs</li> </ul>	

**Course Outcomes: After completion of the course student should be able to:**

1. Explain Central Nervous System and drugs acting on it.
2. Explain the synthesis of Salbutamol.
3. Explain mode of action of cardiovascular drugs.
4. Illustrate the term Malignancy.

**References:**

1. Dr. N.Murugesh Sathya, 2021,'Human Anatomy and Physiology' by Sathya Publishers.
2. Chatterjee. K, Eric J Topol 2013 Cardiac Drugs Jaypee Brothers Medical Publisher. pvt. Ltd 1st edition.
3. Branton. L.L, Bjorn. H. D. knollmann. C, 2017 'The pharmacological basis of therapeutics by Goodman and Gilmans
4. Guyton. A. C, Hall. J. E, 1990 'Textbook of medical physiology sounders.

<b>Credits 2</b>	<b>SEMESTER-V BDCT 602 Heterocyclic Drugs</b>	<b>45</b>
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Know the heterocyclic chemistry ( 3-6 membered)</li> <li>2. Understand preparation methods for 5 &amp; 6 membered heterocycles.</li> <li>3. Learn mode of action of heterocyclic drugs.</li> <li>4. Role of Spiro and bridged compounds in activities of drug.</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Heterocyclic Chemistry</b>	<b>10</b>
	1.1 Introduction, 1.2 Classification of heterocyclic compounds, 1.3 Aliphatic heterocyclic compounds, 1.4 Aromatic heterocyclic compounds and 3-6 membered heterocyclic compounds condensed or fused hetero cyclic compounds, 1.5 Applications of heterocyclic compounds.	
<b>UNIT-II</b>	<b>Five &amp; Six Membered Heterocyclic Compounds</b>	<b>11</b>
	2.1 Drugs with 5 &6 membered heterocyclic compounds with one and two hetero atoms (03 each), 2.2 Synthesis, 2.3 Mode of action and its applications/uses.	
<b>UNIT-III</b>	<b>Condensed Heterocyclic Compounds</b>	<b>11</b>
	3.1 Drugs with condensed five membered heterocycles, 3.2 Synthesis and applications of Benzoxazole, 3.3 Benzthiazole, 3.4 Benzimidazole, 3.5 Condensed six membered heterocycles synthesis 3.6 Applications of Benzofuran, Indole and Quinoline.	
<b>UNIT- IV</b>	<b>Bridged and Spiro heterocycles</b>	<b>13</b>
	Synthesis and applications of (06) bridged heterocyclic drugs: 4.1 Zoipidem, 4.2 Necopidem, 4.3 Aldpiodem, 4.4 Minodronic acid, 4.5 Cephalexin and quinine. 4.6 spiro hetrocycles- (5)	

	<p><b>Course Outcomes: After completion of the course student should be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand heterocyclic chemistry</li> <li>2. Explain mode of action of drug.</li> <li>3. Understood the applications of different drugs</li> <li>4. Analyze structurally different types of drugs</li> </ol>	
	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Heterocyclic Chemistry by R. K. Bansal.</li> <li>2. Heterocyclic Chemistry by T. Gilchrist.</li> <li>3. The essence of Heterocyclic chemistry by A. R. Parikh, Hansa Parikh, Rajan Khunt.</li> <li>4. Heterocyclic Chemistry by R. R. Gupta, M. Kumar, V. Gupta, Springer publications.</li> </ol> <p>Principles of modern Heterocyclic Chemistry by A. Paquette.</p>	

Credits 4	SEMESTER-VI BDCP 608 Lab XVIII	No. of Lectures per unit
	<p><b>Preparation of intermediates</b></p> <ol style="list-style-type: none"> <li>1. 1,3 Pyrazole</li> <li>2. 1,3 Oxazole</li> <li>3. Synthesis of Barbiturates</li> <li>4. Preparation of Dihydro pyrimidine</li> <li>5. Preparation of Triphenyl imidazole</li> <li>6. Synthesis of Sulpha drugs</li> <li>7. Preparation of Paracetamol</li> <li>8. Synthesis of five membered heterocyclic ring containing drug.(02)</li> <li>9. Synthesis of Quinolone from aniline (Skraup synthesis)</li> <li>10. Estimation of an aspirin.</li> </ol> <p><b>Note- Any other relevant practical may be added.</b></p>	

Credits 2	SEMESTER-VI BDCT 603 Herbal Drug Technology	45
	<p><b>Course Objectives: Student will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand raw material as a source of herbal drugs from cultivation to herbal drug product.</li> <li>2. Know the herbal cosmetics, nutraceuticals.</li> <li>3. Know the WHO &amp; ICH guidelines for evaluation of herbal drugs.</li> <li>4. Appreciate patenting of herbal drugs.</li> </ol>	<b>No. of lectures per unit</b>
<b>UNIT - I</b>	<b>Herbs as raw materials</b>	<b>8</b>
	<p>1.1 Definition of herb, 1.2 Herbal medicine, 1.3 Herbal medicinal product, 1.4 Herbal drug preparation, 1.5 Source of Herbs, Selection, identification and authentication of herbal materials, 1.6 Processing of herbal raw material <b>1.7 Biodynamic Agriculture</b> Good agricultural practices in cultivation of medicinal plants including Organic farming. 1.8 Pest and Pest management in medicinal plants: Bio pesticides/ Bio insecticides.</p>	
<b>UNIT-II</b>	<b>Nutraceuticals</b>	<b>10</b>
	<p>2.1 General aspects, Market, growth, scope and types of products available in the market. 2.2 Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. 2.3 Study of following herbs as health food: <i>Alfa alfa</i>, Chicory, Ginger, Fenugreek, Garlic, Honey, Alma, Ginseng, Ashwagandha, Spirulina <b>2.4 Herbal-Drug and Herb-Food Interactions:</b> General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper &amp; Ephedra</p>	
<b>UNIT-III</b>	<b>Herbal Cosmetics</b>	<b>10</b>

	<p>3.1 Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colors, perfumes, protective agents, bleaching agents, antioxidants in products such as skincare, hair care and oral hygiene products.</p> <p>3.2 <b>Herbal excipients:</b> Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors &amp; perfumes.</p> <p>3.3 <b>Herbal formulations:</b> Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes.</p>	
<b>UNIT- IV</b>	<b>Evaluation of Drugs</b>	<b>08</b>
	<p>4.1 WHO &amp; ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.</p> <p><b>Patenting and Regulatory requirements of natural products:</b></p> <p>4.2 a) Definition of the terms: Patent, IPR, Farmers right, Breeder’s right, Bio prospecting and Bio piracy</p> <p>4.3 b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma &amp; Neem.</p> <p>4.4 <b>Regulatory Issues</b> - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs &amp; Cosmetics Act for ASU drugs.</p>	
<b>UNIT- V</b>	<b>General Introduction to Herbal Industry</b>	<b>07</b>
	<p>5.1 Herbal drugs industry: Present scope and future prospects.</p> <p>5.2 A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.</p> <p>5.3 Schedule T– Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule –T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment's, standard operating procedures, health and hygiene, documentation and records.</p>	
	<p><b>Course Outcomes: After completion of the course student should be able to:</b></p> <ol style="list-style-type: none"> <li>1. Explain herbal drugs and nutraceuticals.</li> <li>2. Explain bio prospecting and bio piracy</li> <li>3. Explain side effects and interactions of different drugs.</li> </ol>	



**References:**

1. Evans.W. C.s 2009, 'Textbook of pharmacognocoy 16th edition Elsevier Health Science,
2. Rangari V. D. 2009,; Pharmacognocoy & phytochemistry' 2nd edition Career Publication.
3. Pharmacopeial standards for ayurvedic formulations (Council of research in Indian medicine and homeopathy) revised edition.

Credits 2	SEMESTER-VI BDCT 604 Industrial Chemistry (Elective)	45
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand aspects of small scale industries.</li> <li>2. Learn Basic concepts of entrepreneurship development and management</li> <li>3. Learn concepts of sugar industries.</li> <li>4. Familiar about manufacturing industrial chemicals.</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Small scale Industries</b>	<b>11</b>
	<ol style="list-style-type: none"> <li>1.1 Introduction and aspects of small scale industries,</li> <li>1.2 safety matches,</li> <li>1.3 Agarbatties,</li> <li>1.4 Naphthalene balls,</li> <li>1.5 Wax candles,</li> <li>1.6 Shoe polishes,</li> <li>1.7 Gum paste,</li> <li>1.8 Writing and fountain pain ink,</li> <li>1.9 Plaster of Paris,</li> <li>1.10 Silicon carbide crucibles,</li> <li>1.11 How to remove stains</li> </ol>	
<b>UNIT-II</b>	<b>Entrepreneurship Development and Management</b>	<b>12</b>
	<ol style="list-style-type: none"> <li>2.1 Entrepreneurship, Concept/Meaning,</li> <li>2.2 Need , Competencies/qualities of an entrepreneur,</li> <li>2.3 Entrepreneurial Support System, District Industry Centers (DICs) Commercial Banks State Financial Corporations,</li> <li>2.4 Small Industries Service Institutes (SISIs),</li> <li>2.5 Small Industries Development Bank of India (SIDBI),</li> <li>2.6 National Bank for Agriculture and Rural Development (NABARD),</li> <li>2.7 National Small Industries Corporation (NSIC) and other relevant institutions/ organizations at State level</li> </ol>	
<b>UNIT-III</b>	<b>Sugar Industry</b>	<b>07</b>

	<p>3.1 Introduction Manufacture of cane sugar in India :</p> <p>3.2 Extraction of juice,</p> <p>3.3 Clarification,</p> <p>3.4 Concentration,</p> <p>3.5 Crystallization, centrifugation and other details of industrial process By products of sugar industry</p> <p>Manufacture of Ethyl Alcohol from Molasses.</p> <p>3.6 Introduction,</p> <p>3.7 Preparation of wash,</p> <p>3.8 Fermentation and Distillation.</p>	
<b>UNIT- IV</b>	<b>Manufacture of Industrial Heavy Chemicals</b>	<b>08</b>
	<p>Introduction,</p> <p>4.1 Manufacture of Ammonia by Haber's process; (NH<sub>3</sub>): i] Physico - chemical principles, ii] Plant and process.</p> <p>4.2 Manufacture of Sulphuric acid by Contact process; (H<sub>2</sub> SO<sub>4</sub>): i] Physico - chemical principles, ii] Plant and process.</p> <p>4.3 Manufacture of Nitric acid by Ostwald's (Ammonia oxidation process) ;( HNO<sub>3</sub>): i] Physico - chemical principles, ii] Plant and process.</p> <p>4.4 Manufacture of Sodium carbonate (Washing soda) by Solvay process. (Na<sub>2</sub>CO<sub>3</sub>): i] Physico - chemical principles, ii] Plant and process.</p>	
<b>UNIT- V</b>	<b>Electroplating</b>	<b>07</b>
	<p>5.1 Electrolysis,</p> <p>5.2 Faraday's laws,</p> <p>5.3 Cathode current efficiency; Basic principles of electroplating,</p> <p>5.4 Ceaning of articles; Electroplating of Nickel and Chromium; Anodizing.</p>	
	<p><b>Course Outcomes: After completion of the course student should be able to:</b></p> <ol style="list-style-type: none"> <li>1. Explain preparation methods of small scale products</li> <li>2. Find financial support system for entrepreneurship development.</li> <li>3. Explain manufacturing process of sugar in detail</li> <li>4. Explain schematic process of manufacturing of different heavy chemicals.</li> </ol>	

	<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Shrama. B. K, 2014.'Industrial chemistry', Gel publishing house Krishan Prakashan</li> <li>2. Shreve. N.S, Joseph. 'Chemical process industries', sMcGraw-Hill Publication</li> <li>3. Kent. J. 2010, Handbook of Industrial chemistry&amp; Biotechnology.</li> <li>4. Das. R. K.1967, Industrial chemistry Part II Asia publisher house</li> </ol>	
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<b>Credits</b> 4	<b>SEMESTER-VI</b> <b>BDCP 609</b> <b>Lab XIX</b>	<b>No. of Lectures per unit</b>
	<ol style="list-style-type: none"> <li>1. Determination of Aldehyde content in herb.</li> <li>2. Determination of alcohol content of Asava and Arista.</li> <li>3. Preparation of herbal face pack.</li> <li>4. Preparation of herbal Hair care products. (2)</li> <li>5. Determination of Phenol contents in herbs.</li> <li>6. Estimation of sucrose</li> <li>7. Preparation of Aloe Vera gel.</li> <li>8. Estimation of Oxalic acid from cane sugar.</li> <li>9. Methyl orange, Aniline yellow dye preparation.</li> </ol> <p><b>pH – metry:</b></p> <ol style="list-style-type: none"> <li>10. To determine the dissociation constant of monobasic acid (Acetic acid).</li> <li>11. To determine the pH values of various mixtures of sodium acetate and acetic acid in aqueous solutions and hence find out the dissociation constant of the acid.</li> </ol> <p><b>Note- Any other relevant practical may be added.</b></p>	

Credits 2	SEMESTER-VI BDCT 605 Industrial Chemistry (Elective)	45
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand aspects of small scale industries.</li> <li>2. Learn Basic concepts of entrepreneurship development and management</li> <li>3. Learn concepts of soil chemistry.</li> <li>5. Know principles of leather Chemistry</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Small scale Industries</b>	<b>11</b>
	1.1 Introduction and aspects of small scale industries, 1.2 safety matches, 1.3 Agarbatties, naphthalene balls, 1.4 Wax candles, Shoe polishes, 1.5 Gum paste, writing and fountain pain ink, 1.6 Plaster of Paris, 1.7 Silicon carbide crucibles, 1.8 How to remove stains	
<b>UNIT-II</b>	<b>Entrepreneurship Development and Management</b>	<b>12</b>
	2.1 Entrepreneurship, 2.2 Concept/Meaning, 2.3 Need, Competencies/qualities of an entrepreneur, 2.4 Entrepreneurial Support System, 2.5 District Industry Centers (DICs) Commercial Banks State Financial Corporations, 2.6 Small Industries Service Institutes (SISIs), 2.7 Small Industries Development Bank of India (SIDBI), 2.8 National Bank for Agriculture and Rural Development (NABARD), 2.9 National Small Industries Corporation (NSIC) and other relevant institutions/ organizations at State level	
<b>UNIT-III</b>	<b>Dairy Chemistry</b>	<b>07</b>
	3.1 Definition and structure of milk, 3.2 Factors affecting composition of milk, 3.3 Nomenclature and classification of milk proteins, Casein : Isolation, fractionation and chemical composition, physico-chemical properties of casein, 3.4 Whey proteins: Preparation of total whey proteins:	
<b>UNIT- IV</b>	<b>Soil chemistry</b>	<b>08</b>

	<p>4.1 Chemical(elemental)composition of the earth's crust and soils ,</p> <p>4.2 Elements of equilibrium thermodynamics,</p> <p>4.3 Chemical equilibria,</p> <p>4.4 Electrochemistry and chemical kinetics,</p> <p>4.5 Soil colloids: inorganic and organic colloids- origin of charge,</p> <p>4.6 Concept of point of zero-charge (PZC) and its dependence on variable-charge soil components</p> <p>4.7 surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability,</p> <p>4.8 Coagulation/ flocculation and peptization of soil colloids;</p> <p>4.9 Electrometric properties of soil colloids; adsorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions.</p>	
<b>UNIT- V</b>	<b>Leather Chemistry</b>	<b>07</b>
	<p>Principles of pre tannagep:</p> <p>5.1. Curing:-Definition; necessity; principles and different state of cured hides and skins.</p> <p>5.2. Soaking: -Physico-Chemical explanation of wetting; objectives and different controls in soaking operation.</p> <p>5.3. Liming: - Chemistry of unhairing; unhairing by different methods; objectives of liming; effects of liming on collagen; controls in liming operation to achieve different physical properties of leather.</p> <p>5.4. Deliming and Drenching: - Objectives, principles and controls of deliming and drenching.</p> <p>5.5. Bating: - Chemistry of Proteolytic enzymes used for bating; necessity of bating; its preparation and controls for desired properties of leather.</p> <p>5.6. Pickling:-Acid binding capacity of collagen; use of organic acids or salts in pickling; its necessity and controls; concept of Depickling.</p> <p>5.7. Degreasing:- Objectives and necessity of degreasing; different degreasing systems and method.</p>	

**References:**

1. Shrama. B. K, 2014.'Industrial chemistry', Gel publishing house Krishan Prakashan
2. Shreve. N.S, Joseph. 'Chemical process industries',McGraw-Hill Publication
3. Kent. J. 2010, Handbook of Industrial chemistry& Biotechnology.
4. . Das. R. K.1967, Industrial chemistry Part II Asia publisher house.
5. De Sukumar, Outline of Dairy Technology - Oxford University press
6. Vaidya. V. G, Sahashtra Buddhe K.R. Introduction to Agronomy and soil, water management, (Continental Prakashan).

Credits 2	SEMESTER-VI BDCT 606 Industrial Chemistry (Elective)	45
	<b>Course Objectives: Student will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand aspects of small scale industries.</li> <li>2. Learn Basic concepts of entrepreneurship development and management</li> <li>3. Learn concepts of Synthetic polymer.</li> <li>4. Know principles of glass industry</li> </ol>	<b>No. of Lectures per unit</b>
<b>UNIT - I</b>	<b>Small scale Industries</b>	<b>11</b>
	<ol style="list-style-type: none"> <li>1.1 Introduction and aspects of small scale industries</li> <li>1.2 Safety matches,</li> <li>1.3 Agarbatties,</li> <li>1.4 Naphthalene balls,</li> <li>1.5 Wax candles,</li> <li>1.6 Shoe polishes,</li> <li>1.7 Gum paste</li> <li>1.8 Writing and fountain pain ink,</li> <li>1.9 Plaster of Paris</li> <li>1.10 Silicon carbide crucibles,</li> <li>1.11 How to remove stains</li> </ol>	
<b>UNIT-II</b>	<b>Entrepreneurship Development and Management</b>	<b>12</b>
	<ol style="list-style-type: none"> <li>2.1 Entrepreneurship,</li> <li>2.2 Concept/Meaning,</li> <li>2.3 Need ,</li> <li>2.4 Competencies/qualities of an entrepreneur,</li> <li>2.5 Entrepreneurial Support System,</li> <li>2.6 District Industry Centers (DICs) Commercial Banks State Financial Corporations,</li> <li>2.7 Small Industries Service Institutes (SISIs),</li> <li>2.8 Small Industries Development Bank of India (SIDBI),</li> <li>2.9 National Bank for Agriculture and Rural Development (NABARD),</li> <li>2.10 National Small Industries Corporation (NSIC) and other relevant institutions/ organizations at State level</li> </ol>	
<b>UNIT-III</b>	<b>Synthetic Polymer</b>	<b>08</b>



	<p>3.1 Introduction, Classification: Based on origin;  3.2 Based on composition-organic, inorganic polymers;  3.3 Based on method of preparation; Based on general physical properties;  3.4 Based on structure. Addition Polymerization: Free radical addition and ionic addition polymerization, Ziegler-Natta polymerization,  3.5 Method of preparation and applications of some organic polymers: Polyethylene, polystyrene, polyvinyl chloride,  3.6 Phenol-formaldehyde resin, conducting organic polymers: Synthesis and properties of Polyaniline, polypyrrol.  3.7 Applications of conducting organic polymers</p>	
<b>UNIT- IV</b>	<b>Glass Industry</b>	<b>06</b>
	<p>4.1 Glassy state and its properties,  4.2 Classification (silicate and non-silicate glasses).  4.3 Manufacture and processing of glass.  4.4 Composition and properties of the following types of glasses: i] Soda lime glass, ii] lead glass, iii] armored glass, iv] safety glass, v] borosilicate glass, vi) fluoro silicate, vii) colored glass, viii) photosensitive glass.</p>	
<b>UNIT- V</b>	<b>Batteries</b>	<b>07</b>
	<p>5.1 Primary and secondary batteries, battery components and their role,  5.2 Characteristics of Battery Working of following batteries: Pb acid, Li-Battery,  5.3 Solid state electrolyte battery.  5.4 Fuel cells,  5.4 Solar cell and polymer cell.</p>	

**References:**

1. Shrama. B. K, 2014.'Industrial chemistry', Gel publishing house Krishan Prakashan
2. Shreve. N.S, Joseph. 'Chemical process industries', McGraw-Hill Publication.
3. Kent. J. 2010, Handbook of Industrial chemistry & Biotechnology.
4. Industrial chemistry—Rogers
5. Das. R. K. 1967, Industrial chemistry Part II Asia publisher house.
6. De Sukumar, Outline of Dairy Technology - Oxford University press
7. Vaidya. V. G, Sahashtra Buddhe K.R. Introduction to Agronomy and soil, water management, (Continental Prakashan).

<b>Credits 1</b>	<b>Semester VI SEDCCT 607- Entrepreneurship Development in Drug Chemistry</b>	<b>45</b>
	<b>Course Objectives: Student will be able to:</b> 1. Understand Characteristics of entrepreneur. 2. Learn Enterprise management.	<b>No. of lecture per unit</b>
<b>Unit I</b>	<b>Entrepreneurship, Creativity &amp; Opportunities</b>	<b>6</b>
	1.1 Concept, Classification & Characteristics of Entrepreneur, 1.2 Creativity and Risk taking, Risk Situation, Types of risk & risk takers, Business Reforms, 1.3 Process of Liberalization, 1.4 Reform Policies, Impact of Liberalization, 1.5 Emerging high growth areas, 1.6 Business Idea Methods and techniques to generate business idea, 1.7 Transforming Ideas into opportunities transformation involves, 1.8 Assessment of idea & Feasibility of opportunity SWOT Analysis Information and Support Systems. 1.9 Information needed and Their Sources: Information related to project, 1.10 Information related to support system. 1.11 Information related to procedures and formalities, 1.12 Support Systems Small Scale Business Planning, 1.13 Requirements, Govt. & Institutional Agencies. 1.14 Formalities Statutory Requirements and Agencies. 1.15 Market Assessment Marketing: Concept and Importance Market Identification, 1.16 Survey Key components Market Assessment.	
<b>Unit II</b>	<b>Business Finance &amp; Accounts</b>	<b>05</b>
	2.1 Business Finance: Cost of Project Sources of Finance Assessment of working capital Product costing Profitability Break Even Analysis Financial Ratios and Significance Business Account: 2.2 Accounting Principles, 2.3 Methodology Book Keeping Financial Statements Concept of Audit. 2.4 Business Plan: Business plan steps involved from concept to commissioning,	

	2.5 Activity Recourses, Time, Cost. Project Report: Meaning and Importance, 2.6 Components of project report/profile (Give list), 2.7 Project Appraisal: 1] Meaning and definition. 2] Technical, Economic easibility. 3] Cost benefit Analysis	
<b>Unit III</b>	<b>Enterprise Management and Modern Trends</b>	<b>05</b>
	3.1 Enterprise Management: Essential roles of Entrepreneur in managing enterprise. 3.2 Product Cycle: Concept and importance Probable Causes of Sickness. 3.3 Quality Assurance: Importance of Quality. 3.4 Importance of testing E - Commerce :Concept and Process	
<b>Unit IV</b>	<b>Chemistry Entrepreneur</b>	<b>04</b>
	4.1 Current challenges and opportunities for the chemistry – using industries, 4.2 Assess your self are you an entrepreneur? Prepare project report for Chemistry and study its feasibility.	
	<b>Course Outcomes: Student should be able to</b> 1.Perform SWOT analysis. 2. Illustrate current challenges and opportunities in chemical industries	

<b>Credits 1</b>	<b>SEMESTER-VI</b> <b>SECCCP 607- Entrepreneurship Development in Drug Chemistry</b>	
	15 Days internship program and report writing. Visit to Chemical industry Internship Report writing Presentation	

**EVALUATION PATTERN****FIFTH SEMESTER----- NO. OF PAPERS- 4**

<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Marks</b>
Paper XXIX	BDCT - 501	Drug Design and Early Development	30
Paper XXX	BDCT - 502	Reaction Mechanisms Reagents & Name Reactions	30
Paper XXXI	BDCT- 503	Natural Products	30
Paper XXXII (Elective)	BDCT- 504	Industrial Pharmacy	30
Paper XXXII (Elective)	BDCT- 505	Analytical Chemistry	30
Paper XXXII (Elective)	BDCT- 506	Analytical Chemistry	30
Paper SECC Paper I	SECCT - 507	Basic Numerical Skills in Drug Chemistry	20
Practical Course Lab XV	BDCP- 508	Drug Design and Early Development <b>And</b> Reaction Mechanisms Reagents & Name Reactions	50
Practical Course Lab XVI	BDCP- 509	Natural Products & Industrial Pharmacy	50
Practical SECC Paper I	SECCP- 510	Basic Numerical Skills in Drug Chemistry Practical	30
Internal Examination (ISE I, Mid semester, ISE II) <b>will be conducted for 20 Marks for each paper.</b>			

**EVALUATION PATTERN****SIXTH SEMESTER ----- (NO. OF PAPERS 4)**

<b>Course Category</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Marks</b>
Paper XXXIII	BDCT - 601	Therapeutic Areas & its Drugs	30
Paper XXXIV	BDCT - 602	Heterocyclic Drugs	30
Paper XXXV	BDCT- 603	Herbal drug Technology	30
Paper XXXVI <b>(Elective)</b>	BDCT- 604	Industrial Chemistry	30
Paper XXXVI <b>(Elective)</b>	BDCT- 605	Industrial Chemistry	30
Paper XXXVI <b>(Elective)</b>	BDCT- 606	Industrial Chemistry	30
Paper SECC <b>Paper I</b>	SECCT - 607	Entrepreneurship Development in Drug Chemistry	20
<b>Practical Course Lab XVII</b>	BDCP- 608	Therapeutic Areas & its Drugs & Heterocyclic Drugs	50
<b>Practical Course Lab XVIII</b>	BDCP- 609	Herbal drug Technology & Industrial Chemistry	50
<b>Practical SECC Paper I</b>	SECCP- 610	Entrepreneurship Development in Drug Chemistry	30

Internal Examination (ISE I, ISE II) **will be conducted for 20 Marks for each paper.**

