

**SOPHIA COLLEGE (AUTONOMOUS)  
AFFILIATED TO THE UNIVERSITY OF MUMBAI**



**SYLLABUS FOR TYBSc CHEMISTRY (6/3\*UNITS)  
COURSE: APPLIED COMPONENT**

**With effect from the academic year 2020-21**

## SYLLABUS FOR APPROVAL

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1.</b>	<b>Title of course</b>	<b>TYBSc (6/3* Units) Applied Component</b>
<b>2.</b>	<b>Passing marks</b>	<b>40%</b>
<b>3.</b>	<b>Ordinance/Regulation (if any)</b>	
<b>4.</b>	<b>No. of Semester</b>	<b>Two</b>
<b>5.</b>	<b>Level</b>	<b>UG</b>
<b>6.</b>	<b>Pattern</b>	<b>Semester</b>
<b>7.</b>	<b>To be implemented from Academic year</b>	<b>2020-21</b>

**Date:**

**Dr. I. A. Mendes**  
BOS Chairperson

**Prof. Santosh Haram**  
Convener

**TYBSC CHEMISTRY APPLIED COMPONENT  
SEMESTER V**

<b>Course Code</b>	<b>Title of the Paper</b>	<b>Unit</b>	<b>Topic</b>	<b>Credits</b>	<b>L/Week</b>
<b>SBSAPC501</b>	<b>Pharmaceutical and Colour Chemistry</b>	I	1.1 General Introduction to Drugs 1.2 Routes of drug administration and dosage forms 1.3 Pharmacodynamic Agents	<b>2.5</b>	<b>4</b>
		II	2.1 Analgesics, Antipyretics and Anti-Inflammatory Drugs 2.2 Antihistaminic Drugs 2.3 Cardiovascular Drugs 2.4 Antidiabetic Agents 2.5 Antiparkinsonism Drugs 2.6 Drugs for Respiratory System		
		III	3.1 Introduction to the dye-stuff industry 3.2 Natural and Synthetic Dyes 3.3 Relation Between Colour and Chemical Constitution 3.4 Fluorescent Brightners 3.5 Pigments		
		IV	4.1 Classification of Dyes Based on Application 4.2 Types of Fibres and Dye Fibre attachment 4.3 Basic Operations Involved in Dyeing Process 4.4 Dyeing Method of Cotton Fibers 4.5 Some Important Reactions in Dye Synthesis 4.6 Preparation of Some Intermediates		
<b>Practical Semester V</b>					
<b>SBSAPCP501</b>	<b>Applied component Practical</b>	-	-	<b>1.5</b>	<b>4</b>

**TYBSC CHEMISTRY APPLIED COMPONENT  
SEMESTER VI**

<b>Course Code</b>	<b>Title of The Paper</b>	<b>Unit</b>	<b>Topic</b>	<b>Credits</b>	<b>L/Week</b>
<b>SBSAPC601</b>	<b>Pharmaceutical and Colour Chemistry</b>	I	1.1 Drug Discovery, Design And Development	<b>2.5</b>	<b>4</b>
		II	Chemotherapeutic Agents 2.1Antibiotics and Antivirals 2.2Antimalarials 2.3Antihelmintics and Antifungal Agents 2.4Antiamoebic Drugs 2.5Antitubercular and Antileprotic Drugs 2.6Anti-Neoplastic Drugs 2.7Anti-HIV Drugs 2.8Drug Intermediates - Synthesis and Uses 2.9Nano Particles in Medicinal Chemistry		
		III	3.1 Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes 3.2 Dyes Used in Food and Cosmetics		
		IV	4.1 Non-Textile Uses of Dyes 4.2 Chromic Materials 4.3 Health and Environmental Hazards of Synthetic Dyes and their remediation processes		
<b>Practical Semester V</b>					
<b>SBSAPCP601</b>	<b>Applied component Practical</b>	-		<b>1.5</b>	<b>4</b>

<b>SEMESTER V PHARMACEUTICAL AND COLOUR CHEMISTRY SBSAPC501</b>		
<b>UNIT</b>	<b>TOPIC</b>	<b>No of Lect</b>
<b>I</b>	<b>1.1 GENERAL INTRODUCTION TO DRUGS</b>	<b>7</b>
	<b>1.1.1</b> Definition, requirement and classification of drugs (based on Therapeutic action) <b>1.1.2</b> Nomenclature of drugs- generic, brand and systematic name. <b>1.1.3</b> Medicinal terms- Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD <sub>50</sub> , ED <sub>50</sub> , Therapeutic index. <b>1.1.4</b> Drug related terms- receptors, drug-receptor interaction, potency, bioavailability, toxicity, addiction, spurious and misbranded drugs, Adulterated drugs, Pharmacopoeia	
	<b>1.2 ROUTES OF DRUG ADMINISTRATION AND DOSAGE FORMS</b>	<b>5</b>
	<b>1.2.1</b> Oral and parenteral routes with advantages and disadvantages. <b>1.2.2</b> Formulations, different dosage forms (emphasis on sustained release formulations.) <b>1.2.3</b> Total Quality Management (TQM) – concept, Quality Control, Quality Assurance and their inter-relation; Food and Drug Administration (FDA) - concept, role and importance, classification; Pharmacopoeia - history, Drug act and schedules, components; Good Laboratory Practices (GLP), International Organization of Standardization (ISO), Good Manufacturing Practice (GMP), Drug Technical Advisory Board (DTAB).	
	<b>1.3 PHARMACODYNAMIC AGENTS - CNS Drugs- Classification based on pharmacological actions- CNS Depressants &amp; CNS Stimulants; i) Concept of sedation and hypnosis, anaesthesia ii) Phenytoin (Hydantoin) iii) Trimethadione (Oxazolidinediones) Alprazolam (Benzodiazepines) iv) Levetiracetam (Pyrrolidines) v) Amphetamine (Phenethylamine) (Asymmetric synthesis from phenyl acetic acid) vi) Chlorpromazine (Phenothiazines)</b> [*A brief introduction of the following pharmacodynamic agents and the study with respect to their chemical structure (memorizing the structure not expected) chemical class, therapeutic uses, and side effects]	<b>3</b>
<b>II</b>	<b>2.1 ANALGESICS, ANTIPYRETICS AND ANTI-INFLAMMATORY DRUGS</b>	<b>3</b>
	<b>2.1.1</b> Analgesics and Antipyretics – i) Morphine (Phenanthrene alkaloids) ii) Tramadol (Cyclohexanols) - Synthesis from salicylic acid iii) Aspirin (Salicylates) iv) Paracetamol (p-Amino phenol) <b>2.1.2</b> Anti-inflammatory Drugs - Mechanism and inflammatory conditions; i) Steroids: Prednisolone, Betamethasone ii) Sodium Diclofenac iii) Aceclofenac (N- Aryl anthranilic acid) - Synthesis from 2,6-dichlorodiphenyl amine	

2.2	<b>ANTI-HISTAMINIC DRUGS</b> - Histamine and histamine receptors - Synthesis and mechanism; i) Diphenhydramine (Ethanol amines) ii) Cetrizene (Piperazine) (Synthesis from 4- Chlorobenzhydryl chloride) iii) Chlorpheniramine maleate (Ethyl amines) iv) Pantoprazole (Benzimidazoles)	2
2.3	<b>CARDIOVASCULAR DRUGS</b> - Cardiovascular drugs - Classification based on pharmacological action; i) Isosorbidedinitrate (Nitrates) ii) Valsartan (Amino acids) (structure not expected) iii) Atenolol (Aryloxy propanol amines) - Synthesis from 3-Hydroxy phenyl acetamide iv) Amlodipine (Pyridines) v) Frusemide /Furosemide (Sulfamoyl benzoic acid) vi) Rosuvastatin (Pyrimidine)	3
2.4	<b>ANTIDIABETIC AGENTS</b> - Diabetes - General idea, types and Insulin therapy; i) Glibenclamide (Sulphonylureas) ii) Metformin (Biguanides) iii) Dapagliflozin (Pyranose) iv) Pioglitazone (Thiazolidinediones) – Synthesis from 2-(5-ethylpyridin-2-yl) ethanol	2
2.5	<b>ANTIPARKINSONISM DRUGS</b> - Parkinson's disease – general idea; i) Procyclidine hydrochloride (Pyrrolidines) ii) Ethopropazine hydrochloride (Phenothiazines) iii) Levodopa (Amino acids) - Synthesis from Vanillin	2
2.6	<b>DRUGS FOR RESPIRATORY SYSTEM</b> - Drugs for respiratory system - general idea, types - Expectorants, Mucolytes, Bronchodilators, Decongestants, Antitussives; i) Ambroxol (Cyclohexanol) - Synthesis from paracetamol ii) Salbutamol (Phenyl ethyl amines) iii) Codeine Phosphate (Opiates) iv) Formoterol (N-formamide) v) Theophylline (methylxanthines)	3
<b>III</b>	<b>INTRODUCTION TO THE DYE-STUFF INDUSTRY</b>	
3.1	Dyes – Definition, requirements of an ideal dye - Colour, Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability; Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R, B, K, L, C, S H, 6B, GK, 6GK ; Naming of dyes by colour index (two examples) used in dye industries	2
	<b>3.2 NATURAL AND SYNTHETIC DYES</b>	3
3.2.1	Natural Dyes- Definition, Examples, limitations and uses - Heena, Turmeric, Saffron, Indigo, Chlorophyll, Tyrian purple and cochineal; names of the chief dyeing material/s in each natural dye [structures not expected]	
3.2.2	Synthetic dyes- Definition, primaries and intermediates; Important milestones in the development of synthetic dyes – Emphasis on Name of the Scientist, dyes and the year of the discovery is required. (structure not expected)	

	<b>3.3 RELATION BETWEEN COLOUR AND CHEMICAL CONSTITUTION</b>	<b>5</b>
<b>3.3.1</b>	Absorption of visible light, Colour of wavelength absorbed, Complementary colours.	
<b>3.3.2</b>	Armstrong theory (quinonoid theory) and its limitations	
<b>3.3.3</b>	Witt's Theory; Recapitulation - Chromophore, Auxochrome, Bathochromic and Hypsochromic Shift, Hypochromic and Hyperchromic effect	
<b>3.3.4</b>	Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes – i) Benzene ii) Nitrobenzene iii) Nitroanilines iv) Nitrophenols v) Benzoquinones vi) Azo vii) Triphenyl methane viii) Anthraquinones.	
<b>3.3.5</b>	Molecular Orbital approach to colour – structure relationship	
<b>3.4</b>	<b>FLUORESCENT BRIGHTENERS</b> Fluorescent brightens – General idea, important characteristics and applications one example with structure of each of the following classes - i) Stilbene ii) Coumarin iii) Hetrocyclic vinylene derivative iv) Naphthalimide	<b>3</b>
<b>3.5</b>	<b>PIGMENTS</b> - Characteristics, Classification, Difference between a dye and a pigment, applications - toners and lakes	<b>2</b>
<b>IV</b>	<b>CLASSIFICATION OF DYES BASED ON APPLICATION</b>	
<b>4.1</b>	<b>Dyes</b> - Definition, fastness properties and applicability of substrates, examples with structures - i) Acid Dyes- Orange II ii) Basic Dyes-methyl violet iii) Direct cotton Dyes- Benzofast Yellow 5GL iv) Azoic Dyes – a) Diazo components- Fast yellow G, Fast orange R b) Coupling components- Naphthol AS, Naphthol ASG v) Mordant Dyes-Eriochrome Black A, Alizarin vi) Vat Dyes- Indanthrene brown RRD vii) Sulphur Dyes- Sulphur Black T (no structure) viii) Disperse Dyes-Celliton Fast brown 3R ix) Reactive Dyes- Cibacron Brilliant Red B.	<b>6</b>
	<b>4.2 TYPES OF FIBRES AND DYE FIBRE ATTACHMENT</b>	<b>2</b>
<b>4.2.1</b>	Introduction to the structure of fibres and corresponding classes of dyes applicable to these fibres – a) Natural: Cotton, wool, silk b) Synthetic: polyester, polyamides	
<b>4.2.2</b>	Binding forces of dyes on substrate- ionic forces, covalent linkages, hydrogen bonding, Van der Waals forces	
<b>4.3</b>	<b>BASIC OPERATIONS INVOLVED IN DYEING PROCESS</b> - Preparation of Fibers and Dye bath, Application of dyes and Finishing	<b>1</b>
<b>4.4</b>	<b>DYEING METHODS OF COTTON FIBERS</b> - Dyeing methods - Direct, Mordant, Vat and Disperse	<b>1</b>
<b>4.5</b>	<b>IMPORTANT REACTIONS IN SYNTHESIS OF DYES</b> - i) Nitration ii) sulfonation iii) halogenations iv) diazotization, v) ammonolysis vi) reduction - definition, reagents and examples of each type of reaction (mechanism not expected)	<b>2</b>

<b>4.6</b>	<b>PREPARATION OF DYE INTERMEDIATES</b> Benzene derivatives – i) Sulphanilic acid ii) o-m,p-nitroanilines iii) o-m-p-chloronitrobenzene iv) m-dinitrobenzene ; Naphthalene Derivatives – i) Naphthionic acid ii) H-Acid ; Anthraquinone derivatives- i) Benzanthrone	<b>3</b>
	<b>PRACTICALS</b>	<b>24</b>
	<b>SYNTHESIS OF DYES: (Any Three)</b> 1. Preparation of Fluorescein from resorcinol and phthalic anhydride 2. Preparation of eosin from fluorescein 3. Preparation Orange II from sulphanilic acid 4. Preparation of Indigo from o-nitrobenzaldehyde <b>ESTIMATION OF DRUGS: (Any three)</b> 1. Estimation of Ibuprofen (Back titration) 2. Estimation of acid neutralizing capacity of a drug 3. Estimation of Iodine in Tincture Iodine 4. Assay of Riboflavin in a given drug <b>PROJECT WORK:</b> Dyeing of Fabric (silk, cotton, polyester) using Orange II/Indigo	
	<b>SEMESTER VI PHARMACEUTICAL AND COLOUR CHEMISTRY SBSAPC601</b>	
<b>UNIT</b>	<b>TOPIC</b>	<b>No of Lect</b>
<b>I</b>	<b>1.1 DRUG DISCOVERY, DESIGN AND DEVELOPMENT</b>	<b>15</b>
<b>1.1.1</b>	Discovery of a lead compound - Screening, drug metabolism studies and clinical observation, Lipinski's rule of 5	
<b>1.1.2</b>	Medicinal properties of compounds from Natural Sources - Anti-infective and anticancer properties of Turmeric (Curcumin)	
<b>1.1.3</b>	Development of drug - The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides).	
<b>1.1.4</b>	Structure modification to increase potency - Homologation, Chain branching and extension of the structure	
<b>1.1.5</b>	Computer assisted drug design	
<b>1.1.6</b>	Drug Metabolism - Introduction, Absorption, Distribution, Biotransformation, Excretion; Different types of chemical transformation of drugs with specific examples	
<b>II</b>	<b>CHEMOTHERAPEUTIC AGENTS</b>	
<b>2.1</b>	<b>Antibiotics and antivirals</b> - Definition; i) Amoxicillin ( $\beta$ - lactum antibiotics) ii) Cefpodoxime (Cephalosporins) iii) Doxycycline (Tetracyclines) iv) Levofloxacin (Quinolones) (Synthesis from 2,3,4 – Trifluoro -1-nitrobenzene) v) Aciclovir/Acylovir (Purines)	<b>2</b>
<b>2.2</b>	<b>Antimalarials</b> - Types and Symptoms of malaria; Pathological detection during window period (Life cycle of the parasites not to be discussed) ; i) Chloroquine (3-Amino quinolones) ii) Artemether(Benzodioxepins)	<b>1</b>



	Following combination to be discussed - Atremether-Lumefantrine (structure not expected)	
<b>2.3</b>	<b>Antihelmintics and Antifungal agents</b> - Drugs effective in the treatment of Nematodes and Cestodes infestations; i) Diethyl carbamazine (Piperazines) ii) Albendazole (Benzimidazoles) (Synthesis from 2- Nitroaniline) iii) Clotrimazole (Imidazole) iv) Fluconazole (Triazole) (Synthesis from 1- Bromo – 2,4-difluorobenzene)	<b>2</b>
<b>2.4</b>	<b>Antiamoebic Drugs</b> - Types of Amoebiasis - Metronidazole, Ornidazole, Tinidazole (Imidazole); Synthesis of Metronidazole from glyoxal by Debus Radziszewski imidazole route Following combination therapy to be discussed – CiprofloxacinTinidazole	<b>1</b>
<b>2.5</b>	<b>Antitubercular and Antileprotic Drugs</b> - Tuberculosis and leprosy – Types, Symptoms and diagnosis; General idea of Antibiotics used in their treatment; i) PAS (Amino salicylates) ii) Isoniazide (Hydrazides) iii) Pyrazinamide (Pyrazines) iv) (+) Ethambutol (Aliphatic diamines)(Synthesis from 1- Nitropropane) v) Dapsone(Sulphonamides) vi) Clofazimine (Phenazines) vii) Bedaquiline (Quinolines) Following combination therapy to be discussed - (a) Rifampin + Ethambutol + Pyrazinamide (b) Rifampin + Isoniazide + Pyrazinamide	<b>2</b>
<b>2.6</b>	<b>Antineoplastic Drugs</b> - Causes of cancer - malignancy; Brief idea of Immuno Stimulants and depressants; i) Lomoustine (Nitrosoureas) ii) Anastrozole(Triazoles) [Synthesis from 3,5-bis (bromomethyl) toluene] iii) Cisplatin (Chloroplatinum) iv) Vinca alkaloids - Vincristine, Vinblastine, Vindesine (structure not expected)	<b>2</b>
<b>2.7</b>	<b>Anti-HIV Drugs</b> - Idea of HIV pathogenicity, Symptoms of AIDS; i) AZT/Zidovudine ii) Lamivudine iii) DDI (Purines) iv) Nevirapine (dipyridodiazepinone)	<b>1</b>
<b>2.8</b>	<b>Drug Intermediates-</b> Synthesis and uses; i) p-[2'-(5-Chloro-2-methoxy benzamido) ethyl]-benzenesulphonamide from Methyl-5-chloro-2- methoxybenzene ii) 3-(p-Chlorophenyl)-3- hydroxypiperidine from 3-Chloroacetophenone iii) Epichlorohydrine from propene	<b>1</b>
<b>2.9</b>	<b>Nano particles in Medicinal Chemistry-</b> Introduction; Nano based drug delivery systems- drug delivery process and mechanism; i) Cellulose ii) Dendrimers iii) liposomes iv) polymeric micelle	<b>3</b>
	*Study of the above <b>chemotherapeutic agents</b> with respect to their chemical structure (not expected) chemical class, therapeutic uses, side effects and introduction to MDR wherever applicable.	

<b>III</b>	<b>CLASSIFICATION AND SYNTHESIS OF SELECTED DYES BASED ON CHEMICAL CONSTITUTION</b>	
<b>3.1</b>	<p>a) Nitro Dye – i) Naphthol Yellow S</p> <p>b) uiAzo dyes – i) Monoazo dyes- Orange IV *(from sulphanilic acid) and Eriochrome Black T* (from <math>\beta</math>- naphthol) ii) Bisazo dyes- Congo Red* (from nitrobenzene) iii) Trisazo Dye- Direct Deep Black EW* (from benzidine)</p> <p>c) Diphenylmethane dye- i) Auramine O* (from N,N-dimethyl aniline)</p> <p>d) Triphenylmethane dye- i) Diamine series- Malachite Green* (from benzaldehyde) ii) Triamine series- Acid Magenta iii) Phenol series- Rosolic acid</p> <p>e) Heterocyclic Dye – i) Thiazine dyes- Methylene Blue ii) Azine dyes - Safranin T iii) Xanthene Dyes- Eosin* (from phthalic anhydride) iv) Acridine Dyes- Acriflavine</p> <p>f) Quinone Dyes- i) Naphthaquinone- Naphthazarin ii) Anthraquinone Dyes- Indanthrene Blue* (from anthraquinone)</p> <p>g) Indigoid Dyes- i) Indigo* (from aniline + monochloroacetic acid)</p> <p>h) Phthalocyanine Dyes- i) Monastral Fast Blue B</p> <p>(*synthesis of the dyes is expected)</p>	<b>10</b>
<b>3.2</b>	<b>DYES USED IN FOOD AND COSMETICS</b> - Properties of dyes used in food and cosmetics; Introduction to FDA and FSSAI; Commonly used food colours and their limits; Characteristics of dyes used in nail lacquers and lipsticks with some examples; Hair Dyes - Oxidative Hair coloration and non-oxidative Hair Dyes.	<b>5</b>
<b>IV</b>	<b>4.1 NON-TEXTILE USES OF DYES</b>	<b>8</b>
<b>4.1.1</b>	Biomedical uses of dyes - a) Dyes used in formulations (Tablets, capsules, syrups etc) – i) Indigo carmine ii) Sunset yellow iii) Tartrazine	
	b) Biological staining agents – i) Methylene blue ii) Crystal violet iii) Safranin T	
	c) Fluorescent stains – i) Lucifer Yellow CH/VS	
	d) DNA markers – i) Bromophenol blue ii) Orange G iii) Cresol red	
	e) Dyes as therapeutics – i) Mercurochrome ii) Acriflavine iii) Crystal Violet	
	iv) Prontosil	
<b>4.1.2</b>	Colour photography - Additive and subtractive processes, dye transfer and synthesis	
<b>4.1.3</b>	Paper and leather dyes -Structural features and examples	
<b>4.1.4</b>	Miscellaneous dyes- Laser Dyes, Indicators, Security Inks, Coloured smokes and Camouflage colours	
<b>4.2</b>	<b>CHROMIC MATERIALS</b> - Thermochromism , Photochromism, electrochromism	<b>2</b>
	<b>4.3 SYNTHETIC DYES - HEALTH AND ENVIRONMENTAL HAZARDS, REMEDIATION PROCESSES</b>	<b>5</b>
<b>4.3.1</b>	Impact of the textile and leather dye industry on the environment with special emphasis on water pollution.	
<b>4.3.2</b>	Toxicity of dyes with respect to food colours	
<b>4.3.3</b>	Effluent Treatment - Brief introduction to effluent treatment plants (ETP); Primary Remediation processes – Physical Processes- i) Sedimentation ii) Aeration iii) Sorption - activated charcoal, fly ash; Secondary Remediation processes – a) Biological Remediation – i) Biosorption ii) Biodegradation; b) Chemical Remediation processes - i) Oxidation Process (Chlorination) ii) Coagulation-flocculation-Precipitation	

	<b>PRACTICALS</b>	<b>24</b>
	<p><b>Preparation of Drugs: (any three)</b></p> <ol style="list-style-type: none"> <li>1. p-nitroacetanilide from acetanilide</li> <li>2. p-nitroaniline from p-nitroacetanilide</li> <li>3. Benzocaine from 4-aminobenzoic acid</li> <li>4. o-chlorobenzoic acid from anthranilic acid</li> </ol> <p><b>Estimation and separation of Dyes: (any three)</b></p> <ol style="list-style-type: none"> <li>1. Estimation of primary aromatic amine by diazotation</li> <li>2. Estimation of coupling component by diazonium salt solution (any one)               <ol style="list-style-type: none"> <li>a. <math>\beta</math>-Naphthol</li> <li>b. Resorcinol</li> </ol> </li> <li>3. Colorimetric estimation of Methyl Orange</li> <li>4. Separation of a mixture of dyes using TLC</li> <li>5. Separation of Azo, Basic and Vat dyes by chemical method (Two Mixtures)</li> </ol> <p><b>Project work</b>            Monograph of a Drug and its assay or Case Study  <b>Industrial Visit Compulsory to a pharmaceutical / dye industry.</b></p>	
	<p><b>References</b></p> <ol style="list-style-type: none"> <li>1. Chemistry of Synthetic Dyes, Vol I – VIII, Venkatraman K., Academic Press 1972</li> <li>2. Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY 1995</li> <li>3. Colour Chemistry, Heinrich Zollinger</li> <li>4. Colour Chemistry, Allen</li> <li>5. Colour Chemistry, Robert M Christie, 2<sup>nd</sup> Edition, Royal Society of Chemistry, 2015</li> <li>6. Synthetic dyes, Gurdeep R. Chatwal</li> <li>7. Chemistry of Dyes and Principles of Dyeing, V.A. Shenai; Sevak Publication, Bombay</li> <li>8. Natural and Synthetic Organic Chemistry, O.P.Agrawal</li> <li>9. An introduction to drugs, Singh and Rangnekar</li> <li>10. British Pharmacopeia</li> <li>11. Indian Pharmacopeia</li> <li>12. Pharmacology and pharmacotherapeutics, Iswariah and Guruswamy, 7<sup>th</sup> Edition, Vikas Publishers</li> <li>13. Practical Organic Chemistry, A.I. Vogel</li> </ol>	

**Exam Paper Pattern for T.Y.B.Sc. Applied Component****Total Marks: 75**

- Q1. Unit I: Answer any three of the following (3 out of 5) (15 marks)
- Q2. Unit II: Answer any three of the following (3 out of 5) (15 marks)
- Q3. Unit III: Answer any three of the following (3 out of 5) (15 marks)
- Q4. Unit IV: Answer any three of the following (3 out of 5) (15 marks)
- Q5. Do as directed: (objective type) (15 marks)
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- A] Unit I: (4 out of 6) (4 marks)
- B] Unit II: (4 out of 6) (4 marks)
- C] Unit III: (4 out of 6) (4 marks)
- D] Unit IV: (3 out of 5) (3 marks)