Syllabus Appendix / Curriculum Book

Program: B. Pharm
Choice Based Credit System (CBSGS) 2012
Duration: 4 Years / 8 Semesters

VIVEKANANAD EDUCATION SOCIETY'S COLLEGE OF PHARMACY

Hashu Advani Memorial Complex, Behind Collectors Colony, Chembur(E),Mumbai-400074

Curriculum Book

Bachelor of Pharmacy

CBSGS

Duration 4 Years / 8 Semesters

CONTENTS

Abbreviations

Sr. No.	Abbreviations	Full form
1.	**MSE**	Mid Semester Exam
2.	**TSI**	Teacher - Student Interaction
3.	**ESE**	End Semester Examination
4.	**PPT**	Periodic Practical test
5.	**PTT**	Periodic Theory test

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Part I
First Year B. Pharm
Semester I

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<tr><td>Course assessment Methods:</td><td colspan="5">Continuous mode of assessment</td><td>Semester-end assessment</td></tr>
<tr><td>Assessment Tools:</td><td>MSE</td><td>Attendance</td><td>Quizzes</td><td colspan="2">TSI</td><td>ESE</td></tr>
<tr><td>Max. Marks:</td><td>15</td><td>5</td><td>5</td><td colspan="2">5</td><td>70</td></tr>
<tr><td>Pre-requisites :</td><td colspan="6">1. Basics organic chemistry till standard 12th.
2. The knowledge of bonding and basic mechanisms is useful in well understanding of this subject</td></tr>
<tr><td>Course objectives :</td><td colspan="6">1. To enhance the understanding of structures of organic compounds
2. To understand how structural properties decide reactivity and stability of organic compounds</td></tr>
<tr><td colspan="6">Course Outcomes:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="5">Learner will be able to understand the principles or theories, factors and basic concepts of organic chemistry, chemical kinetics, catalysis, charge transfer complex and Atomic and Molecular structures. Learner will be able to compare between various theories.</td><td>1,6</td></tr>
<tr><td>CO2</td><td colspan="5">Learner will be able to illustrate his understanding with suitable examples and construct molecular orbitals, compare and contrast between various structures and theories in Physical organic chemistry.</td><td>1,3</td></tr>
<tr><td>CO3</td><td colspan="5">Learner will be able to calculate half-life of reaction, percent completion at particular time, or time taken to complete the reaction, draw the resonating structures, predict stability of a molecular structure, draw Lewis structures and calculate formal charge.</td><td>1,3</td></tr>
<tr><td colspan="7">Topics covered :</td></tr>
<tr><td colspan="2">Unit I:</td><td colspan="4">Introduction to structure and models of bonding</td><td>Hours: 10</td></tr>
<tr><td colspan="7">Review of basic bonding concepts – quantum numbers, atomic orbitals, electron configuration, electronic diagrams, Lewis structures, formal charge, VSEPR,</td></tr>
</table>

hybridization involving s, p and d orbitals, polar covalent bonds, electronegativity, different scales of electronegativity, electrostatic potential surfaces, inductive effects, group electronegativities, hybridization effects, bond dipoles, molecular dipoles, and quadrupoles with examples, resonance, polarizability The teacher could try to relate some of these concepts to drug effects on macromolecular targets		
Unit II:	**Modern Theory of Organic Bonding**	**Hours: 12**
Molecular Orbital Theory, Strengths and drawbacks, Concept of Group orbitals, Qualitative Molecular Orbital Theory (QMOT), Rules of QMOT, Symmetry and Symmetry Operations, e.g. MH3 and MH3Y systems, M.Os of planar methyl, Walsh diagram – pyramidal methyl, bonding in planar and pyramidal forms of methyl, Consideration of NH3 and BH3, The orbitals of CH2 group, M.Os of MH2 group, molecular orbitals of H2O, Building larger molecules e.g. ethane, ethylene, formaldehyde, methyl chloride, allyl system, boranes, Orbitals of reactive intermediates – carbocations, carbenium ions, carbanions, radicals and carbine, Bonding in organometallics		
Unit III:	**Kinetics and Reaction Mechanisms.**	**Hours: 12**
Energy surfaces, reaction coordinate diagrams, activated complex/transition State, rate and rate constants, reaction order and rate laws, Transition state theory and its relationship to Arrhenius Rate law, Boltzmann distributions and dependence on temperature, methods of determination of activation parameters and Arrhenius parameters with some examples, Principles of Kinetic Analysis, Kinetic Experiments, First order kinetics, second order kinetics, pseudo-first order kinetics, equilibrium kinetics and initial-rate kinetics, some ideas about methods for following kinetics, Temperature dependence on Reaction rates, kinetic isotope effects, Hammond Postulate, reactivity vs selectivity, Curtin-Hammett Principle, microscopic reversibility, kinetic vs thermodynamic control		
Unit IV:	**Acid-Base Catalysis**	**Hours: 7**
General principles of catalysis, Forms of catalysis – electrophilic catalysis, acid-base catalysis, nucleophilic catalysis, covalent catalysis, phase transfer catalysis, Brønsted Acid-base catalysis, correlation of reaction rates with acidity functions.		
Unit V:	**Charge transfer complexes and reactions**	**Hours: 4**
Definition of complex, charge-transfer transition, donors and acceptors ground state charge-transfer contribution The teacher could try to relate these concepts to drugs effects on macromolecular targets		
Reference material:	1. Eric V Ansyln and Dennis A Dougherty, Modern Physical Organic Chemistry, John Wiley. (Main Book to be adopted for teaching this course). 2. Neil Isaacs, Physical Organic Chemistry, Pearson Education. 3. Louis P Hammett, Physical Organic Chemistry, McGraw Hill Education. 4. Edward M Kosower, an Introduction to Physical Organic Chemistry,	

	John Wiley and Sons, Inc 5. Atkins‟ Physical Chemistry, Peter Atkins and Julio De Paula, International Student Edition, Oxford University Press.

Course: Physical Pharmacy I (CBSGS)					
Course Code: DPH 01		**First Year B. Pharm**			**Semester: I**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Basic knowledge of Chemistry and Physics				
Course objectives :	To train the students for understanding the basic physicochemical principles applied in the development of pharmaceutical formulations.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Describe properties of various states of matter, the concepts of liquid crystalline phases, supercritical fluids, liquefaction of gases and discuss their importance in Pharmacy.	1
CO2	Understand basic physicochemical properties of substances such as refractive index, dipole moment, and optical rotation	1
CO3	Understand concept of thermodynamics and explain laws of thermodynamics and various thermodynamic quantities.	1
CO4	Explain theory of electrolytes and nonelectrolytes including colligative properties and process of distillation	1

Topics covered :		
Unit I:	**States of matter:**	**Hours: 12**
▪ The Gaseous state, The Liquid state, The Solid State. ▪ The Liquid Crystalline state, The Supercritical fluid state.		
Unit II:	**Physical properties of Drug Molecules**	**Hours: 6**
▪ Additive, constitutive and colligative properties with examples ▪ Dipole moment, Dielectric constant , concept of polarizability ▪ Refractive index and molar refraction ▪ Optical rotation, Specific rotation		
Unit III:	**Solutions of Non-electrolytes**	**Hours:12**

<table>
<tr><td colspan="3">

Units for expressing concentration
Ideal and real solutions, Raoult’s law
Distillation of binary mixtures and azeotropic distillation. Concept of steam distillation
Elevation of boiling point and determination of molecular weight (problems). Depression of freezing point and determination of molecular weight (problems)
Osmotic pressure

</td></tr>
<tr><td>Unit IV:</td><td>Thermodynamics</td><td>Hours:12</td></tr>
<tr><td colspan="3">

Definition, Applications and Limitations
Types of systems
Types of properties
Equilibrium and Non-equilibrium states,
Types of processes
First law of thermodynamics
Enthalpy, heat capacity
Work of expansion against constant pressure
Thermochemistry
Second law of thermodynamics
Carnot theorem, Efficiency of heat engine, Entropy
Third law of thermodynamics
Free energy and its applications
Chemical potential, Gibbs Helmholtz equation, Clausius Clapeyeron equation, van’t Hoff equation Problems

</td></tr>
<tr><td>Unit V:</td><td>Properties of solutions of Electrolytes</td><td>Hours: 6</td></tr>
<tr><td colspan="3">

Electrolysis
Faradays laws of electrolysis
Electrolytic conductance
Measurement of conductance
Variation of equivalent conductance with dilution
Arrhenius theory of electrolytic dissociation
Theory of strong electrolytes
Degree of dissociation
Kohlrausch’s law of independent migration of ions
Applications of conductivity

</td></tr>
<tr><td>Reference material:</td><td colspan="2">Books
1. P. J. Sinko, ‘Martin’s Physical Pharmacy and Pharmaceutical Sciences’ Fifth edition, Lippincott Williams and Wilkins, Indian Edition distributed by B.I.Publications Pvt Ltd, 2006.
2. Bahl and Tuli, ‘Essentials of Physical Chemistry’ S.Chand and Company Ltd. Ramnagar, New Delhi-110055.
3. U. B.Hadkar,’ A Textbook of Physical Pharmacy’, 9th Edition,</td></tr>
</table>

	Nirali Prakashan, Pune 2008. 4. U. B.Hadkar, T.N.Vasudevan and K.S. Laddha, 'Practical Physical Pharmacy', Yucca Publishing House, Dombivali, 1994 **5.** Findlay, 'Practical Physical Pharmacy' revised and edited by J.A. Kitchener, 8th Ed. Longmans, Green and company Ltd. 1967.

Course: Anatomy, Physiology and Pathophysiology – I (CBSGS)					
Course Code: DPL-01	**First Year B. Pharm**			**Semester: I**	
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**			**Semester-end assessment**	
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites:	• Basic knowledge of biology related to cell and systems of human body				
Course objective:	1. To introduce anatomy, physiology and pathophysiology to students. 2. To familiarize the students with scientific terminologies which are very crucial for communication with healthcare stakeholders 3. To provide fundamental knowledge related to structure and functions of cell membrane, tissues, blood, lymphatic system and muscles. 4. To give brief insight on the role of inflammation and the basic steps involved in inflammation				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Describe various transport mechanisms across cell membrane; Classify various tissues and describe their salient features	1, 3,4,7,8
CO2	Comprehend the structure and functions of the lymphatic system; explain the basics of immunity and the pathophysiological basis of few diseases of the human lymphatic system	1, 3,4,7,8
CO3	Describe the various components of blood and explain their role in health and disease; explain the events occurring in inflammation and justify the need of inflammation	1, 3,4,7,8
CO4	Compare the important features of different types of muscle tissue and muscle contractions, explain the physiology of	1, 3,4,7,8

	muscle contraction	
Topics covered		
Unit I:	**Brief introduction to human body and organization of human body**	**Hours:01**
Unit II :	**Structural and functional characteristics of following tissues**	**Hours:02**
1) Epithelial 2) Connective 3) Nervous 4) Muscle		
Unit III:	**Detailed structure of cell membrane and trans-membrane movement of substances**	**Hours:02**
Unit IV:	**Components and functions of lymphatic system**	**Hours:03**
Lymphatic organs and tissues • Organization of lymph vessels • Formation and flow of lymph		
Unit V:	**Pathophysiology of following diseases**	**Hours:02**
AIDS • Autoimmune diseases (Rheumatoid arthritis, Grave's disease, Myasthenia Gravis, Rheumatic fever) • Hypersensitivity and types of hypersensitivity reactions.		
Unit VI:	**Haematology**	**Hours:08**
Composition of blood • Functions of blood elements • Erythropoiesis and life cycle of RBC. • Synthesis of Haemoglobin • Leucopoiesis • Immunity: Basics and Types • Coagulation of blood • Blood groups		
Unit VII:	**Pathophysiology of following diseases**	**Hours:03**
Anaemias – Types of anaemias • Polycythemia : Physiological and polycythemia vera • Leucopenia • Leukocytosis • Thrombocytopenia • Leukemia		
Unit VIII:	**Basic mechanism involved in the process of inflammation and repair**	**Hours:05**
Alteration in vascular permeability and blood flow. • Migration of WBC • Acute and chronic inflammation • Brief outline of the process of repair		
Unit IX:	**Structure and properties of following muscles**	**Hours:09**
Cardiac muscles • Smooth muscles • Skeletal muscles • Neuromuscular transmission and contraction of skeletal muscle • Energy metabolism in the muscle • Types of muscle contractions • Muscle tone		
Reference material	**Latest editions of the following books can be referred:** 1. Ross & Wilson, Anatomy & Physiology in Health & Illness by Anne Waugh and Allison Grant, Published by Churchill Livingstone 2. Gerard J. Tortora & Bryan Derrickson, Principals of Anatomy & Physiology, Published by John Wiley and Sons, Inc 3. A.C. Guyton & J. E. Hall, Textbook of Medical Physiology, Published in India by Prism Books Ltd. on arrangement with W. B. Saunders Company, USA. 4. McNaught & Callander, Illustrated Physiology by B. R. Mackenna & R. Callander Published by Churchill Livingstone	

	5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques 6. Praful B. Godkar, Textbook of Medical Laboratory Technology, Published by Bhalani Publishing House, Mumbai, India 7. Harsh Mohan, Text book of Pathology, Published by Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi

Course: Environmental Science (CBSGS)					
Course Code: DAL01	**First Year B. Pharm**			**Semester: I**	
Type of course : Theory	**Contact Hours: 3 Hrs/week**				
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Quiz	Attendance	STI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Understanding of agents and factors that contribute to environmental changes. • Knowledge of structure and functioning of major physical and ecological components of the earth's systems				
Course objectives :	To access and analyze a complex literature addressing specific topics in environmental studies, and evaluate the usefulness and limitations of individual sources of information				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**
CO1	Understand the scope, significance, components and interdependence of the different components of the environment				2,6,8
CO2	Propose the causes, effects and control measures of all kinds of pollution and their effective management.				2,6,8
CO3	Acquire insights regarding issues such as consumerism, e-waste and chemical wastes				2,6,8
CO4	Implement the knowledge with respect to the need and scope of environmental legislation				2,6,8
Topics covered :					
Unit I:	**Multidisciplinary Nature of Environmental Studies:**				**Hours:5**
• Scope and Importance					

- Need for Public Awareness
- Depleting Nature of Environmental resources such as Soil, Water, Minerals, and Forests.
- Global Environmental Crisis related to Population, Water, Sanitation and Land.
- Ecosystem: Concept, Classification, Structure of Ecosystem, overview of Food chain, Food web and Ecological Pyramid

Unit II:	**Sustainable Development**	**Hours:5**

- Concept of sustainable development
- Social, Economical and Environmental aspect of sustainable development.
- Control Measures: 3R (Reuse, Recovery, Recycle), Appropriate Technology, Environmental education, Resource utilization as per the carrying capacity

Unit III:	**Environmental Pollution:**	**Hours:10**

- Air Pollution: Sources, Effects of air pollution with respect to Global Warming, Ozone layer Depletion, Acid Rain, Photochemical smog, Two Control Measures, Bag house Filter, Venturi scrubber. Case Study: Bhopal Gas Tragedy
- Water Pollution: Sources and Treatment, Concept of waste waters – Domestic & Industrial and treatment. Case Study: Minamata disease.
- Land Pollution: Solid waste, Solid waste Management by Land filling,Composting.
- Noise Pollution; Sources and Effects
- E-Pollution: Sources and Effects.

Unit IV:	**Environmental Legislation:**	**Hours: 5**

- Overview
- Ministry of Environment and Forests (MoE&F). Organizational structure of MoE&F.
- Functions and powers of Central Control Pollution Board.
- Functions and powers of State Control Pollution Board.
- Environmental Clearance, Consent and Authorization Mechanism.
- Environmental Protection Act
- Any two case studies pertaining to Environmental Legislation.

Unit V:	**Renewable sources of Energy:**	**Hours: 5**

- Limitations of conventional sources of Energy.
- Various renewable energy sources.
- Solar Energy: Principle, Working of Flat plate collector & Photovoltaic cell.
- Wind Energy: Principle, Wind Turbines.
- Hydel Energy: Principle, Hydropower generation.
- Geothermal Energy: Introduction, Steam Power Plant

Unit VI:	**Environment and Technology**	**Hours: 5**

- Role of Technology in Environment and health
- Concept of Green Buildings, Indoor air pollution
- Carbon Credit: Introduction, General concept.

• Disaster Management: Two Events: Tsunami, Earthquakes, Techniques of Disaster Management Case Study: Earthquake in Japan	
Reference material:	1. Hazardous Waste Incineration, Brunner R.C., McGraw Hill Inc 2. Global Biodiversity Assessment, Heywood V.H and Waston R.T., Cambridge Univ. Press 3. Environmental Science systems & Solutions, Mckinney M.L. and School R.M., Web enhanced edition. 4. Fundamentals of Ecology, Odum E.P., W.B. Saunders Co. USA. 5. Textbook of Environmental studies by Erach Bharucha, University Press. 6. Environmental Studies by R. Rajagopalan, Oxford University Press. 7. Essentials of Environmental Studies by Kurian Joseph & Nagendran, Pearson Education 8. Renewable Energy by Godfrey Boyle, Oxford Publications. 9. Perspective Of Environmental Studies, by Kaushik and Kaushik, New Age International 10. Environmental Studies by. Anandita Basak, Pearson Education 11. Textbook of Environmental Studies by Dave and Katewa, Cengage Learning 12. Environmental Studies by Benny Joseph, Tata McGraw Hill

Course: Communication Skills (CBSGS)					
Course Code: DAL 02	**First Year B. Pharm**				**Semester: I**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Basic English Language				
Course objectives :	To develop confidence in students for using English in various communication situations, both formal and informal.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Present their written and verbal communication skills effectively	3,4
CO2	Draft and explain scientific reports and projects in lucid manner	3,4
CO3	Execute their task effectively by professionally interacting with	3,4,5

	various stakeholders	
Topics covered :		
Unit I:	**Remedial study of grammar, Review of grammar and vocabulary.**	**Hours:10**
Conditionals/Tenses, relative clauses, subject–verb agreement, passive voice		
Unit II:	**Written Communication**	**Hours:07**
Discuss a topic of general interest, but related to science in about 300 words. Analyze, comment, argue, reflect, persuade, etc.) (can also be used for oral presentations by the students, followed by discussion).		
Unit III:	**Oral Communication**	**Hours:05**
Consulting a dictionary for correct pronunciation (familiarity with phonetics symbols and stress-marks only), Dialogue		
Unit IV:	**Scientific Writing**	**Hours:08**
Writing a Scientific Report on a project undertaken or an experiment conducted (theory + practice)		
Unit V:	**Soft Skills**	**Hours:10**
• Gestures/ postures – Body language, gesture, posture. • Group discussion – Giving up of PREP, REP Technique, how body language during group discussion. • Presentation skills: (i) How to make a Power Point presentation (ii) Body language during presentation; Resume writing: Cover letter, Career objectives, Resume writing (tailor made) • Mock Interview: Each student to face an interview and to demonstrate the above taught skills.		
Reference material:	**Latest editions of the following books to be adopted:** 1. English Grammar, Beaumont Digty and Colin Granger, An International reference practice book, London, Heinmann. 2. The right word at the right time A guide to the English language and how to use it, Elison John, The Reader‟s Digest 3. Study writing, Hamplyons Liz & Ben Heasley, Cambridge University Press. 4. Basic Business Communication, LesikerRaymond.V and Maire E Hatley, New York, Tata McGraw Hill	

Course: Physical Pharmacy I laboratory (CBSGS)		
Course Code: DPH 02	**First Year B. Pharm**	**Semester: I**
Type of course : Practical	**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**	**Semester-end assessment**

Assessment Tools:	MSE	Continuous Assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	Basic knowledge of chemistry and physics, handling of glassware, volumetric titrations		
Course objectives :	To train the students in determination of physicochemical properties of substances.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Determine physicochemical properties of substances such as refractive index, optical rotation, viscosity and partition coefficient.	1, 2
CO2	Apply theoretical knowledge in determining molecular weight of substances using colligative properties such as boiling point elevation, and freezing point depression.	1, 2
CO3	Apply concepts of thermochemistry and determine heat of solution.	1, 2
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2, 3

Topics covered :

Unit I:	**Refractive Index**	**Hours: 12**

- Determination of refractive index, molar refraction. Using water as a reference standard, to determine refractive index of two organic solvents and their mixtures and to determine composition of unknown. To determine RI of a solid (KCl) from two concentrations of solid solutions.

Unit II:	**Viscosity**	**Hours: 4**

- Viscosity: To determine the composition of the unknown binary mixture.

Unit III:	**Optical Activity**	**Hours: 4**

- Polarimetry: Different concentrations of sugar, determination of unknown concentration and specific rotation.

Unit IV:	**Colligative Property**	**Hours: 4**

- Determination of molecular weight by Rast camphor method.

Unit V:	**Solubility and heat of solution**	**Hours: 4**

- Determination of heat of solution of benzoic acid.

Unit VI:	**Partition Coefficient**	**Hours: 8**

- Partition coefficient of benzoic acid between benzene and water.

Unit VII:	**Demonstration**	**Hours: 4**

- Molecular weight determination with Landsberger method.

Reference material:	**Books** U.B. Hadkar, T.N.Vasudevan, K.S.Laddha, 'Practical Physical Pharmacy', Yucca Publishing House, Dombivali

Course: Anatomy, Physiology and Pathophysiology – Lab. I (CBSGS)			
Course Code: DPL02	**First Year B. Pharm**		**Semester: I**
Type of course : Practical	**Contact 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Prerequisites :	• Basic knowledge of biology i.e. name of different organ systems • Composition of blood, structure and functions of blood components, principle of blood grouping • Basic skills of using microscope		
Course objectives :	**1.** To give hands on training for performing basic procedures for determining important parameters of complete blood counts and an insight on various commonly used diagnostic tests **2.** To provide the student with a basic background in histology concerning the properties of cells and tissues **3.** To provide the student with a basic background of parts human skeletal system **4.** To enable students to communicate using technical terms, plan and work effectively as a team member		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Withdraw blood by pricking method, use microscopes skillfully; perform various blood counts; Interpret and draw basic conclusions of the results of complete blood counts (CBC) and understand the significance of abnormal counts	1,2,3,4,7,8
CO2	Identify and describe the salient features of said tissues and bones	1,3,4,7,8
CO3	State various routine diagnostic tests/procedures with their principles	1,3,4,7,8
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3,4,5,7,8

Topics covered :	
Unit I:	**Hematology**
1. Red Blood Cell (RBC) Count **2.** Total Leukocyte Count	

3. Differential Leukocyte (WBC) Count **4.** Hemoglobin content of blood **5.** Bleeding / Clotting Time **6.** Blood groups **7.** Erythrocyte Sedimentation Rate (ESR) / Hematocrit (Demonstration)	
Unit II:	**Study of human skeleton**
Unit III:	**Microscopic study of permanent slides**
• Tissues : **1.** Columnar, Cuboidal, Squamous, Ciliated Epithelium **2.** Cardiac / Skeletal / Smooth muscle **3.** Ovary, Testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein	
Unit IV:	**Measurement of blood pressure**
Unit V:	**Tutorial / Discussion on some common investigational procedures used in diagnosis of diseases with the help of charts / slides**
• **Name and Importance of following tests :** **1.** Electroencephalogram (EEG) in diagnosis of Epilepsy **2.** Use of Positron emission tomography (PET) Computed tomography scan (CT Scan), Single photon emission computed tomography (SPECT) in diagnosis. **3.** Use of flow cytometry as a diagnostic tool. **4.** Electrocardiogram (ECG) in diagnosis of cardiac arrhythmia **5.** Liver Function Tests: Serum Bilirubin, Serum glutamate oxaloacetate transaminase (SGOT), Serum glutamate pyruvate transaminese (SGPT), Urine Bilirubin, Urine Urobilinogen **6.** Kidney Function Tests: Serum Creatinine, Serum Urea, Uric Acid, Blood Urea Nitrogen (BUN) **7.** Blood Glucose **8.** Serum Cholesterol / Triglycerides **9.** Serum Alkaline phosphatase (ALT) **10.** Serum Acid phosphatase (APT) **11.** Serum Lipase **12.** Serum Amylase **13.** Serum Calcium **14.** Serum lactate dehydrogenase (LDH) **15.** Thyroid Function Tests – T3, T4 **16.** Prothrombin time (PT) **17.** Partial thromboplastin time (PTT) **18.** Activated partial thromboplastin time (APTT) **19.** Diagnostic tests for infectious diseases like Malaria, Tuberculosis, Dengue, H1N1 swine flu, Typhoid	

Reference material:	**Books** **1.** McNaught & Callander, Illustrated Physiology by B. R. Mackenna & R. Callander, Published by by Churchill Livingstone **2.** Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, Published by Elseviers Publications **3.** Praful B. Godkar, Textbook of Medical Laboratory Technology, Published by Bhalani Publishing House, Mumbai, India **4.** C. L. Ghai, Text book of Practical Physiology, Published by Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi

Course: Computer Lab (CBSGS)			
Course Code: DAL 03	**First Year B. Pharm**		**Semester: I**
Type of course : Practical	**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	Basic computer learning up to 12th Standard		
Course objectives :	Skills to develop and implement computer solutions that accomplish goals important to the industry, government or research area		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Basics of operating systems and programming languages	3
CO2	Apply knowledge of computing in various fields of pharmaceutical science.	6
CO3	Demonstrate computer graphics, operating skills and ability to plan the experimentation with proper time management	3,4,6

Topics covered :		
Unit I:	**Introduction to Computers.**	**Hours:02**
Unit II:	**History of Computer development and respective generation**	**Hours:03**

Abacus, Napier's Bones, Slide rule, Pascal's Calculator. General use of computers in everyday life. Computer Classification: Mainframe, Mini and Micro Computers, comparison of Analog & Digital Computers, Hardware and Software. Calculator and Computer

Unit III:	**Operating Systems**	**Hours:03**
Introduction to types of operating systems, UNIX, MS-DOS, etc. RAM, ROM, Virtual Memory etc. Students should learn on Windows and Linux OS based systems use of basic Windows and Linux commands		
Unit IV:	**Type of Languages**	**Hours:04**
Conventional languages; their advantages, limitations; C, Pascal, FORTRAN, Programming of these languages, Students should be taught some programming in BASIC and C		
Unit V:	**Introduction to Computer Networks**	**Hours:05**
Architecture of seven layers of communications, Students should be taken to a computer lab with has a network and shown the basic connections and operation of different types of networks.		
Unit VI:	**Introduction to Data Structure**	**Hours:09**
Like Queues, list, trees, Binary trees algorithms, Flow chart, Structured Systems, Analysis and development, Ingress-SQL, Gateways etc. Statistics, methodologies. Basic Language: Constants and Variables: Character set, constants, variables, Naming the variables getting data into memory, LET, INPUT, READ. DATA, Print Statement Expressions: Arithmetic expression, Hierarchy of operations, Rules of Arithmetic, Evaluation of expressions, Relational expressions, Logical operations, Library functions Printer Control: Comma and semicolon control, the TAB function, PRINT, LPRINT Functions and Subroutines: User defined functions, subroutines, subscripted variables. The above concepts should be introduced practically to students with examples, while working on a computer system.		
Unit VII:	**Computer Graphics**	**Hours:02**
Unit VIII:	**Computer applications in pharmaceutical area and in clinical studies**	**Hours:03**
Reference material:	**Latest editions of the following books to be adopted:** 1. Basic Electronics and Computer Applications, Rajiv Khanna, New Age International Publishers 2. Fundamentals of Computers, V. Rajaraman, Prentice Hall of India Pvt. Ltd. 3. Schaums Outline Series, Theory and Problems of Introduction to Computer Science, Francis Scheid, McGraw Hill Book Co.	

Semester II

Course: Pharmaceutical Chemistry I (CBSGS)					
Course Code:DPC02	**First Year B. Pharm**				**Semester: II**
Type of course : Theory	**Contact Hours: 3 Hrs/week**				
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Quiz	Attendance	STI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Definitions of all the categories of pharmaceuticals. • Background of molecular formulae of inorganic compounds				
Course objectives :	To learn all the inorganic compounds used in various ailments and disorders.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Acquire basic understanding of properties and uses of inorganic drugs and pharmaceuticals	1,2
CO2	Learn applications of such pharmaceuticals that are useful in treatment of various ailments and disorders.	1,2

Topics covered :		
Unit I:	Acids and Bases: Buffers, Water	**Hours:03**
Unit II:	Gastrointestinal Agents : Acidifying agents, Antacids, Protectives and Adsorbents, Cathartics	**Hours:04**
Unit III:	Major Intra-and Extra-cellular Electrolytes: Physiological ions. Electrolytes used for replacement therapy, acid-base balance and combination therapy	**Hours:04**
Unit IV:	Essential and Trace Elements: Transition elements and their compounds of pharmaceutical importance : Iron and haematinics, mineral supplements	**Hours:04**
Unit V:	Cationic and anionic components of inorganic drugs useful for systemic effects	**Hours:03**
Unit VI:	Topical Agents: Protectives, Astringents and Anti-infectives	**Hours:04**
Unit VII:	Gases and Vapours : Oxygen, Anesthetics and Respiratory stimulants	**Hours:03**

Unit VIII:	Dental Products: Dentifrice, Anti-caries agents	**Hours:03**
Unit IX:	Complexing and chelating agents used in therapy	**Hours:03**
Unit X:	Miscellaneous Agents: Sclerosing agents, expectorants, emetics, poisons and antidotes, sedatives etc. Pharmaceutical Aids Used in Pharmaceutical Industry. Anti-oxidants, preservatives, filter aids, adsorbents, diluents, excipients, suspending agents, colorants, etc	**Hours:05**
Unit XI:	Inorganic Radio Pharmaceuticals: Nuclear radio pharmaceuticals, Reactions, Nomenclature, Methods of obtaining their standards and units of activity,	**Hours:05**
Reference material:	**1.** Inorganic medicinal and pharmaceutical chemistry, J. H. Block, E. B. Roche, T. O. Soine, and C. O. **2.** Wilson. Lea & Febiger, Philadelphia, PA. **3.** Modern Inorganic Pharmaceutical Chemistry, Clarence A. Discher. Wiley, New York. **4.** Remington: the science and practice of pharmacy, Beringer, P. Lippincott Williams & Wilkins. **5.** Inorganic Pharmaceutical Chemistry, Bothara, K. G., Nirali Prakashan. **6.** Inorganic Pharmaceutical Chemistry, A. S. Dhake, H. P. Tipnis, Career Publication	

Course: Biochemistry I (CBSGS)					
Course Code: DPC 03	**First Year B. Pharm**				**Semester: II**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basics concepts and terminologies used in biology and chemistry				
Course objectives :	**1.** To learn chemistry of biomolecules and enzymes along with bioenergetics **2.** To prepare basics for understanding biological reactions				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**

CO1	Understand classification, structure, functions, digestion and absorption of basic biomolecules like Carbohydrates, proteins, lipids and vitamins	1,7
CO2	Acquire knowledge of enzymes with respect to classification,regulation, inhibition pattern and inhibitors as drug targets	1,7
CO3	Learn thermodynamic and bioenergetic aspects of biochemical reactions	1

Topics covered :

Unit I:	**Introduction to carbohydrates, proteins, lipids**	**Hours:18**

Introduction to common monosaccharides ranging from trioses to hexoses
Introduction to common disccharides sucrose, cellobiose, maltose, lactose
Introduction to common polysaccaharides starch and glycogen
Introduction to amino acids, their classification, three letter and one letter codes
Introduction to hierarchy of protein structures
Introduction to common saturated and unsaturated fatty acids
Introduction to triacyl glycerol, phospholipids, sphingolipids
Introduction to the concept of glycoproteins, proteoglycans, lipopolysaccharides, glycolipids, lipoproteins, proteolipids with examples.

Unit II:	**Enzyme Kinetics**	**Hours:14**

Introduction to the factors affecting enzyme activity, concept of initial velocity, derivation of enzyme kinetic equation based on steady state assumptions, direct, Lineweaver Burk and Eadie Hofstee plots of enzyme kinetic data. Modulation of enzyme activity by reversible and irreversible inhibitors. Effects of these inhibitors on enzyme kinetic parameters and the detection of type of inhibitors through Lineweaver Burke and Eadie Hofstee plots. Introduction to the nomenclature of enzymes and names of enzymes that are important drug targets/have diagnostic value and the reactions they catalyze (structures included) (Thymidylate synthase, DHFR, ACE, Renin, HMGCoA reductase, cyclcooxygenase, MAO, COMT, 14-alpha demethylase, aromatase, squalene epoxidase, DNA polymerase, Reverse transcriptase, protease, carbonic anhydrase, proton pump ATPase, acetylcholinesterase, telomerase, SGOT, SGPT, LDH, HIV protease, HIV reverse transcriptase, DNA polymerase, cell wall synthesis enzymes.). Examples of drugs modulating enzyme activity (inhibitors) that are used as drugs with emphasis on the inhibition mechanism.
Endogenous regulation of enzyme activity (compartmentalization, positive and negative feedback, cascade systems (phospholipase based cascade as an example), repression/induction through repressor/promoter elements (the lac operon), post-translation modification to control enzyme activity (protein kinases).

Unit III:	**Vitamins**	**Hours:14**

Vitamins as co-enzymes and their significance. Metals as co-enzymes and their significance. Biochemical roles of all the vitamins with details of the mechanisms of

their functions. (riboflavin, thiamine, pyridoxal, nicotinamide, biotin, folic acid, ascorbic acid, pantothenic acid, cyanocobolamine, inositol, vitamins A, D, E, K)		
Unit IV:	**Biochemical Energetics**	**Hours:06**
Introduction to the concept of free energy, standard free energy, transformed free energy. Thermodynamically favorable or unfavorable reactions. Spontaneous versus thermodynamically favorable reactions. Oxidations as a source of energy in biological systems. ATP, NADH and FADH2 as energy carriers. Introduction to the concepts of anabolism and catabolism. Convergence of metabolic pathways and divergence of anabolic pathways		
Unit V:	**Digestion**	**Hours:03**
Digestion of food and absorption of food (carbohydrates, lipids and carbohydrates). Fate of absorbed nutrients and relationship with regard to immediate use, storage, release and interconversion. Role of liver, kidney, muscle, adipose tissue, brain and special features of rbcs.		
Reference material:	1. Lehninger, Principles of Biochemistry, Replika Press. 2. Stryer L, Biochemistry, W. H. Freeman & Co. 3. Harper's Biochemistry, Appleton and Lange, USA. 4. Conn E, Stumpf PK, Brueing G and Doi Roy H, Outlines of Biochemistry, Wiley Liss, USA. 5. Wilson and Gisvolds Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Willliams and Wilkins, USA 6. Foye's Principles of Medicinal Chemistry, Lippincott Williams and Wilkins, USA.	

Course: Pharmaceutics I (CBSGS)					
Course Code: DPH 02	**First Year B. Pharm**				**Semester: II**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Basic knowledge of Anatomy and Physiology, to understand various routes of administration of drug, as learnt in 12th standard.				
Course objectives :	To familiarize the student with the history of pharmacy and development unto the current stage.				

	To impart basic knowledge about various dosage forms particularly liquids and principles of GMP.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Describe various dosage forms and routes of administration	1
CO2	Calculate strengths, quantities required in formulations	1
CO3	Explain and prepare monophasic liquid formulations, pharmaceutical powders	1
CO4	Explain the importance of rheology, GMP, complexes, diffusion & dissolution	1
Topics covered :		
Unit I:	a) Historical back ground of the Profession of Pharmacy in India in brief b) Brief overview of status of Pharmaceutical Industry in India	**Hours: 1**
Unit II:	Introduction to Pharmacopoeias:	**Hours: 2**
Development of Indian Pharmacopoeia and other compendia including B.P,U.S.P-NF, Ph. Eur, International Pharmacopoeia		
Unit III:	a) Definition of drug and concept of dosage form & formulation-Scope of Pharmaceutics. b) Introduction to route of administration and physiological considerations c) Classification of dosage form and their applications	**Hours: 4**
Unit IV:	Drug Administration:	**Hours: 3**
Introduction to absorption, distribution and fate of drug. Introduction to Bioavailability and Biopharmaceutics. Concept of drug efficiency and dose response.		
Unit V:	Pharmaceutical calculations:	**Hours: 2**
Reduction and enlargement of formulae, formula by weight(w/v, w/w, v/v), in parts		
Unit VI:	Introduction to Good Manufacturing Practices and Quality Assurance	**Hours: 2**
Unit VII:	Introduction to alternate systems of medicine:	**Hours: 1**
Ayurveda, Homeopathy, Unnani and Siddha		
Unit VIII:	Rheology	**Hours: 3**
Definition and concept, types of flow, and measurement of flow properties		
Unit IX:	Concept of Monophasic liquid dosage forms:- Preformulation and Formulation Aspects:	**Hours: 15**
a) Organoleptic properties, Purity, Solubility and solubilisation technique,		

<table>
<tr><td colspan="3">Dissociation and Partition coefficient, Polymorphism, Stability and Interaction with excipients.
b) General consideration of liquid dosage form design & manufacture: Selection of vehicle, stabilizing and organoleptic additives, large scale manufacturing including unit operations like liquid mixing, filtration and clarification concept and equipments, filling operations, packaging and quality control tests.
c) Brief coverage of various monophasic liquid dosage forms: Solutions, Aromatic waters, Syrups, Elixirs, Linctuses, Nasal and Ear drops, Paints, Sprays, Lotions & Liniments.
d) Packaging of Pharmaceuticals-General concepts: Package and its components, containers and types of containers, closures and types of closures, packaging material- glass, plastic, metal, rubber and paper, quality control tests</td></tr>
<tr><td>Unit X:</td><td>Micromeritics & Powder Technology</td><td>Hours:10</td></tr>
<tr><td colspan="3">a) Fundamental and derived properties of powders and their measurement
b) Size Reduction
c) Size separation
d) Formulation, Large scale manufacturing (including powder mixing), Packaging and Quality Control of powders.
e) Brief coverage of following powders : Dusting powders, Oral Rehydration powders, Dry Syrup formulations</td></tr>
<tr><td>Unit XI:</td><td>Complexation :</td><td>Hours:2</td></tr>
<tr><td colspan="3">Classification of complexes, Pharmaceutical applications of complexation and Analysis of Complexes</td></tr>
<tr><td>Unit XII:</td><td>Diffusion & Dissolution</td><td>Hours:3</td></tr>
<tr><td colspan="3">a) Fick’s laws and steady state diffusion, measurement of diffusion
b) Dissolution rate, Noyes – Whitney equation, Factors affecting dissolution, Intrinsic Dissolution Rate, Hixson – Crowell Law</td></tr>
<tr><td>Reference material:</td><td colspan="2">1. Lachman Leon, Lieberman Herbert A, Kanig Joseph L., “The Theory and Practice of Industrial Pharmacy, Varghese Publishing House, Mumbai.
2. Lieberman Herbert A., Rieger, “Pharmaceutical Dosage Forms – Dispersed Systems”, Volume 1/2/3, Marcel Dekker Inc, New York.
3. Remington, The Science and Practice of Pharmacy, Vol I & II, B.L. Publications Pvt. Ltd.
4. Martin A., Physical Pharmacy, 4th Edition, Lea & Febiger, Philadelphia, London.
5. M.E. Aulton, Ed, Pharmaceutics-The Science of Dosage Form Design, Churchill Livingstone Medical Division Of Longman</td></tr>
</table>

	Group, UK Ltd. 6. Rawlings, Bentley's Text Book of Pharmaceutics, Bailliere Tindall, London. 7. Atmaram Pawar, "Introduction to Pharmaceutics", Career Publications, Nashik.

Course: Physical Pharmacy II (CBSGS)					
Course Code: DPH 04	**First Year B. Pharm**				**Semester: II**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Basic knowledge of Physical Chemistry and Physical Pharmacy I				
Course objectives :	To train the students for understanding the basic physicochemical principles applied in the development of pharmaceutical formulations.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Explain concepts of acids and bases, buffer system and tonicity and perform calculations involving pH and buffered solutions.	1
CO2	Describe solute solvent interactions and factors governing solid-liquid, liquid-liquid, and gas-liquid solubility and explain the concept of phase equilibria, phase rule and partition coefficient.	1
CO3	Understand and explain the concepts of chemical kinetics, define order of reaction, molecularity, rate constants, activation energy, accelerated stability studies and their applications	1
CO4	Understand and explain concepts of interfacial tension, adsorption, surfactants, HLB system and wetting phenomena, and also about colloidal systems, their properties, methods for stabilization and destabilization of colloidal systems.	1
CO5	Understand Nernst equation, electromotive force and different types of electrodes.	1

Topics covered :		
Unit I:	**Ionic equilibria and buffers**	**Hours: 5**
▪ Arrhenius Theory, Bronsted – Lowry Theory, Lewis Electronic Theory ▪ Sorensens pH scale, calculation of pH, effect of pH on ionization of weak acids and bases, calculation of fraction unionized ▪ Buffers in pharmaceutical and biological systems, concept of tonicity		
Unit II:	**Solubility and distribution phenomenon**	**Hours: 6**
▪ Solvent – solute interactions ▪ Solubility of gases in liquids ▪ Solubility of liquids in liquids, miscible and partially miscible liquids ▪ Phase equilibria and Phase rule ▪ Solubility of solids in liquids ▪ Partition phenomenon		
Unit III:	**Chemical kinetics**	**Hours: 8**
▪ Molecularity, order of a reaction and specific rate constant ▪ Zero order, First order and Second order reaction ▪ Methods to determine order of a reaction ▪ Energy of activation, Arrhenius equation ▪ Collision theory and transition state theory ▪ Accelerated stability studies		
Unit IV:	**Interfacial phenomena**	**Hours: 8**
▪ Surface tension, Interfacial tension, Surface free energy, Pressure differences across curved interfaces, Measurement of surface and interfacial tension ▪ Spreading of liquids, Spreading coefficient, Hydrophilic-Lipophilic balance ▪ Types of monolayers at liquid interfaces ▪ Adsorption at solid interfaces, Adsorption isotherms ▪ Wetting angle and contact angle		
Unit V:	**Electromotive force**	**Hours: 4**
▪ Electrochemical cell ▪ Types of electrodes ▪ Nernst equation and cell emf ▪ pH meter and measurement of pH ▪ Ion sensitive electrodes ▪ Oxidation reduction indicators ▪ Concentration cells		
Unit VI:	**Colloids**	**Hours:**

		5
▪ Classification, ▪ Preparation, colloid properties such as optical, kinetic and electrical ▪ Gold number ▪ Protective colloid ▪ Schultz Hardy rule		
Reference material:	**Books** 1. P. J. Sinko, 'Martin's Physical Pharmacy and Pharmaceutical Sciences' Fifth edition, Lippincott Williams and Wilkins, Indian Edition distributed by B.I.Publications Pvt Ltd, 2006. 2. Bahl and Tuli, 'Essentials of Physical Chemistry' S.Chand and Company Ltd. Ramnagar, New Delhi-110055. 3. U. B.Hadkar,' A Textbook of Physical Pharmacy', 9th Edition, Nirali Prakashan, Pune 2008. 4. U. B.Hadkar, T.N.Vasudevan and K.S. Laddha, 'Practical Physical Pharmacy', Yucca Publishing House, Dombivali, 1994 5. Findlay, 'Practical Physical Pharmacy' revised and edited by J.A. Kitchener, 8th Ed. Longmans, Green and company Ltd. 1967.	

Course: Anatomy, Physiology and Pathophysiology – II (CBSGS)					
Course Code: DPL03	**First Year B. Pharm**				**Semester: II**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basic knowledge of biology, commonly used terminologies in anatomy, physiology and pathophysiology. • Concepts of homeostasis, feedback mechanisms, mitosis and meosis, dietary constituents, and transport across cell membrane.				
Course objectives :	1. To give understanding of mechanisms of cell injury and adaptations to aid in understanding changes that occur in diseases/disorders. 2. To provide basic understanding of anatomy and physiology of nervous system, sense organs, endocrine system and respiratory system.				

	3. To provide basic understanding of pathophysiology of few diseases related to the given systems.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Explain various causes and mechanisms involved in cell injury and cellular adaptations; Outline the pathophysiological mechanisms involved in malignant transformation of cells and differentiate between benign and malignant tumors.	1,3,4,7,8
CO2	Comprehend the structure and functions of various organs of the respiratory system and explain the pathophysiological basis of few diseases of the human respiratory system.	1,3,4,7,8
CO3	Comprehend the structure and functions of various endocrine glands and explain the pathophysiological basis of few diseases of the human endocrine system.	1,3,4,7,8
CO4	Comprehend the structure and functions of various parts of the nervous system and explain the pathophysiological basis of few diseases of the human nervous system.	1,3,4,7,8
Topics covered :		
Unit I:	**Principles of cell injury and adaptation**	**Hours: 3**
• Causes of cell injury • Pathogenesis and morphology of cell injury. • Cellular adaptation • Cellular atrophy and hypertrophy.		
Unit II:	**Disturbances of growth of cells**	**Hours: 3**
• Differences between benign and malignant tumor • Classification of malignant tumors • Etiology and pathogenesis of cancer- Invasion, metastasis and patterns of spread of cancer.		
Unit III:	**Biological effects of radiation**	**Hours: 2**
Nuclear radiation, U.V. radiation, X-ray and other radiations		
Unit IV:	**Anatomy and Physiology of Respiratory System**	**Hours: 4**
• Exchange of gases • External and internal respiration • Mechanism and regulation of respiration • Lung volumes and lung capacities		
Unit V:	**Pathophysiology of following diseases**	**Hours: 2**
Asthma, Pneumonia, Bronchitis, Emphysema, Respiratory Acidosis and Alkosis		
Unit VI:	**Endocrine System**	**Hours: 9**
Anatomy and physiology of following endocrine glands : • Pituitary		

<table>
<tr><td colspan="3">• Thyroid & Parathyroid
• Adrenal
• Pancreas</td></tr>
<tr><td>Unit VII:</td><td>Pathophysiology of hypo and hyper secretion of above endocrine glands and related diseases</td><td>Hours: 4</td></tr>
<tr><td>Unit VIII:</td><td>Nervous System</td><td>Hours: 9</td></tr>
<tr><td colspan="3">• Neurons, Neurotransmitter and neurotransmission
• Anatomy and physiology of :
• Central Nervous System (CNS)
- Autonomic Nervous System (ANS)
- Cranial and spinal nerves
- Sensory and Motor pathways</td></tr>
<tr><td>Unit IX:</td><td>Pathophysiology of following diseases</td><td>Hours: 3</td></tr>
<tr><td colspan="3">Epilepsy, Parkinsonism, Alzheimer‟s Disease, Cerebral Hypoxia, Stroke (Cerebrovascular disease), Anxiety & Depression, Mania and Schizophrenia</td></tr>
<tr><td>Unit IX:</td><td>Structure and Function of following sensory organs</td><td>Hours: 6</td></tr>
<tr><td colspan="3">Eye, Ear, Tongue, Nose, Skin</td></tr>
<tr><td>Reference material:</td><td colspan="2">Latest editions of the following books can be referred:
1. Ross & Wilson, Anatomy & Physiology in Health & Illness by Anne Waugh and Allison Grant, Published by Churchill Livingstone
2. Gerard J. Tortora & Bryan Derrickson, Principals of Anatomy & Physiology, Published by John Wiley and Sons, Inc.
3. A.C. Guyton & J. E. Hall, Textbook of Medical Physiology, Published in India by Prism Books Ltd. on arrangement with W. B. Saunders Company, USA.
4. McNaught & Callander, Illustrated Physiology by B. R. Mackenna & R. Callander, Published by Churchill Livingstone
5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques
6. Praful B. Godkar, Textbook of Medical Laboratory Technology, Published by Bhalani Publishing House, Mumbai, India
7. Harsh Mohan, Text book of Pathology, Published by Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi</td></tr>
</table>

Course: Pharmaceutical Chemistry Lab-I (CBSGS)		
Course Code: DPC-04	**First Year B. Pharm**	**Semester: II**

Type of course: Practical		Contact Hours: 4Hrs/week	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	End semester Examination
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• **Basic knowledge of ions, properties and separation techniques.**		
Course objectives :	To make them understand detection of the pharmacopoeial Inorganic substances by limit tests. To make them aware separation & identification of Cations 7 Anions of inorganic mixtures.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand and detect the pharmacopoeial Inorganic substances by limit tests.	1,2
CO2	Separate and identify cations and anions of inorganic mixtures by applying the principle of separation technique.	1,2
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management.	1,2,3

Topics covered :

Unit I:	**Practicals**	**Hours: 40 hrs**

1. The background and systematic qualitative analysis of inorganic mixtures of up to four radicals.
2. Six mixtures to be analyzed, preferably by semi-micro methods.
3. Identification tests for pharmacopoeial inorganic pharmaceuticals and qualitative tests for cations and anions should be covered.

Reference material:	Inorganic Pharmaceutical Practical by Dr. D.P. Belsare, Dr. A.S. Dhake.

Course: Pharmaceutics Lab I (CBSGS)		
Course Code: DPH 05	**First Year B. Pharm**	**Semester: II**
Type of course : Practical	**Contact Hours: 4 Hrs/week**	
Course	**Continuous mode of assessment**	**Semester-end**

assessment Methods:			**assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	Basic Knowledge of various dosage forms and routes of administration, fundamental and derived properties of powders as learnt in theory. Basic knowlegde of handling certain laboratory apparatus/instruments.		
Course objectives:	To train the students for understanding the basic development of liquid oral dosage forms and powders.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Select ingredients and formulate various liquid dosage forms like aromatic waters, Syrups, Linctus, Elixirs, drops, Glycerites, Solutions	1,2
CO2	Select ingredients and formulate powder dosage forms like ORS powder and determine its derived properties like bulk density, tapped density etc	1,2
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	3

Topics covered :		
Unit I:	**Aromatic waters** Chloroform water I.P.'66. Concentrated Dill water I.P.'66. Concentrated Anise water B.P.C. '73. Gripe water.	**Hours: 6**
Unit II:	**Syrups** Syrup I.P.'66 Artificial syrup Cough syrup-Codeine phosphate syrup B.P.C.	**Hours: 6**
Unit III:	**Linctus** Simple linctus B.P.C.	**Hours: 2**
Unit IV:	**Elixirs** Piperazine citrate elixir B.P.C	**Hours: 2**
Unit V:	**Ear drops** Chloramphenicol ear drops B.P.C.	**Hours: 1**
Unit VI:	**Nasal drops** Ephedrine sulphate nasal drops B.P.C.	**Hours: 1**

Unit VII:	**Glycerites** Glycerine of starch I.P.'55 Glycerine of boric acid I.P.'55 Glycerine of tannic acid I.P.'66	**Hours: 7**
Unit VIII:	**Solutions** Aqueous iodine solution I.P.'66 Paracetamol solubilised paediatric drops Cresol with soap solution I.P. Magnesium citrate oral solution NF XIV. Chlorinated soda solution, surgical B.P.C. Iodine paint compound B.P. C.'68.	**Hours:10**
Unit IX:	**Powders** Oral rehydration salt (ORS) Evaluation of a)liquids for specific gravity and viscosity and b) powders for bulk density, flow rate and angle of Repose	**Hours: 5**

Course: Physical Pharmacy Lab II (CBSGS)			
Course Code: DPH 06	**First Year B. Pharm**		**Semester: II**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous Assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	Basic knowledge of chemistry and physics, handling of glassware, volumetric titrations		
Course objectives :	To train the students for determination of the basic physical properties of substances and chemical kinetics.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Determine relative strength of acids, order of reaction.	1,2
CO2	Determine surface tension, and critical solution temperature.	1,2
CO3	Find critical micellar concentration of surfactants, determine molecular weight of polymers from viscosity determination,	1,2

	and find surface area of solids by studying solid-liquid adsorption.	
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3
Topics covered :		
Unit I:	**Kinetics**	**Hours: 4**
1. Relative strength: Hydrochloric acid/Sulphuric acid		
Unit II:	**Kinetics**	**Hours: 4**
2. Second order reaction (saponification)		
Unit III:	**Kinetics**	**Hours: 4**
▪ Determination of order by equal fraction method (first order reaction)		
Unit IV:	**Kinetics**	**Hours: 4**
▪ Ostwald's isolation method to determine order		
Unit V:	Surface tension	**Hours: 8**
▪ Determination of surface tension of water, toluene, n – hexane, parachor and critical solution temperature determination. ▪ Determination of CMC		
Unit VI:	**Solubility of Partially miscible liquids**	**Hours: 4**
▪ Phenol water – Critical solution temperature and composition		
Unit VII:	**Viscosity**	**Hours: 4**
▪ Determination of molecular weight of a polymer from solution viscosity		
Unit VIII:	Adsorption	**Hours: 4**
▪ Adsorption – Surface area determination		
Unit IX:	**Demonstrations**	**Hours: 4**
1. HLB of a surfactant 2. Potentiometry – Titration and Determination of buffer capacity		
Reference material:	**Books** U.B. Hadkar, T.N.Vasudevan, K.S.Laddha, 'Practical Physical Pharmacy', Yucca Publishing House, Dombivali	

Second Year B. Pharm:
Semester III

<table>
<tr><td colspan="6">Course: Organic Chemistry I (CBSGS)</td></tr>
<tr><td>Course Code: DPC05</td><td colspan="4">Second Year B. Pharm</td><td>Semester: III</td></tr>
<tr><td colspan="2">Type of course : Theory</td><td colspan="4">Contact Hours: 4 Hrs/week</td></tr>
<tr><td>Course assessment Methods:</td><td colspan="3">Continuous mode of assessment</td><td colspan="2">Semester-end assessment</td></tr>
<tr><td>Assessment Tools:</td><td>MSE</td><td>Quiz</td><td>Attendance</td><td>STI</td><td>ESE</td></tr>
<tr><td>Max. Marks:</td><td>15</td><td>5</td><td>5</td><td>5</td><td>70</td></tr>
<tr><td>Pre-requisites :</td><td colspan="5">• Classification of organic compounds and its different types of reaction.
• Also they must be aware of hybridization patterns and basic rules of nomenclature.</td></tr>
<tr><td>Course objectives :</td><td colspan="5">1. To learn the fundamentals of organic chemistry.
2. To illustrate applications of organic chemistry.</td></tr>
<tr><td colspan="5">Course Outcomes: After the completion of course learner will be able to:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="4">Understand fundamental concepts of atomic and molecular structure, nomenclature and aromaticity of organic compounds</td><td>1,2</td></tr>
<tr><td>CO2</td><td colspan="4">Predict and explain the products considering the mechanisms and their stereochemical aspects.</td><td>1,2</td></tr>
<tr><td colspan="6">Topics covered :</td></tr>
<tr><td>Unit I:</td><td colspan="4">Basic concepts</td><td>Hours:11</td></tr>
<tr><td colspan="6">1. Electronegativity, Inductive effect, Dipole moment, Polarizability
2. Resonance in aliphatic and aromatic systems: Rules of resonance, Stability of the resonating structures
3. Tautomerism (including types of tautomerism), Hyperconjugation
4. Reactive Intermediates in Organic Chemistry: Electrophiles and Nucleophiles (including charged and neutral species), Carbocations, Carbanions, Carbenes and Carbon radicals: Geometry, stability and properties. Concept of leaving groups, alkyl shift, migratory aptitude.
5. Acidity and Basicity (Excluding discussion of acidity and basicity of heterocyclic compounds).
6. Basics of mechanism writing using curved arrows-Homolytic, Heterolytic, Homogenic, Heterogenic.</td></tr>
</table>

Unit II:	Nomenclature of multifunctional organic compounds.	Hours: 6

1. Writing common names of some common compounds.
2. Writing IUPAC nomenclature of compounds containing multiple functional groups, use of priority charts.
3. Writing structures of compounds containing multiple functional groups given the Nomenclature.
4. Nomenclature of stereo isomers including cis/trans, D/L, E/Z and R/S designations.

Unit III:	Stereochemistry	Hours: 9

1. Concept of configuration and chirality, axis of symmetry, plane of symmetry, centre of symmetry, representation of molecules by the use of projection formulae: Fischer, Wedge, Sawhorse and Newman.
2. Geometric isomerism: Methods of determination of configuration of geometric isomers, Optical isomerism: Enantiomers and diastereoisomers, Resolution of a racemic mixture, Atropisomerism in biphenyls.
3. Stereospecificity and stereoselectivity in organic reactions: SN_1, SN_2, E_1, E_2 and E_1cb reactions, syn and anti additions of H_2 to alkynes, addition of halogens (X_2), Halogens in water (X_2 and H_2O), $KMnO_4$, OsO_4 and alkaline H_2O_2 to alkenes, Hydroboration - Oxidation, Oxymercuration - Demercuration of alkenes.

Unit IV:	Benzene and aromaticity	Hours: 6

1. Concept of aromaticity: Huckel's rule for aromaticity, identification of aromatic, non-aromatic and anti aromatic systems based on planarity, conjugation and Huckel's rule.
2. Electrophilic Aromatic Substitution: Reactions of benzene (with mechanism and structures of intermediate/s involved) like nitration, sulphonation, protonation, halogenation, Friedel-Crafts alkylation and acylation. Classification and influence of substituent groups on orientation and reactivity, orientation in disubstituted benzenes.
3. Nucleophilic Aromatic Substitution: Bimolecular displacement mechanism with evidence, reactivity and orientation in nucleophilic aromatic substitution, Elimination-Addition mechanism.

Unit V:	Functional group Chemistry	Hours:16

Discussion of the following classes of compounds in brief, with regard to sources, methods of preparation, general reactions with mechanism.

1. Alkanes: Physical properties, Preparation of alkanes: Hydrolysis of Grignard reagent, reduction of alkyl halides by metal and acid, Corey House reaction, Wurtz reaction; Reactions: halogenation of alkanes (Mechanism and orientation)
2. Alkenes: Physical properties, Preparation of Alkenes: Dehydrohalogenation of Alkyl halides (Mechanism and orientation of E_1 and E_2), dehydration of alcohols, dehalogenation of vicinal dihalides, conversion of aldehydes and ketones to

alkenes (Wittig reaction, Peterson reaction, Shapiro reaction). Reactions: Addition of H_2, HX (Markovnikov and Anti-Markovnikov), H_2SO_4, H_2O, free radicals, alkenes (dimerization), alkanes (Alkylation), ozonolysis, Michael addition, Simmons-Smith reaction, epoxidation, halogenation by allylic substitution. 3. Dienes: Resonance in conjugated dienes, electrophilic addition to conjugated dienes: 1,2 and 1,4 additions. 4. Alkynes: Physical properties, Preparation of alkynes: dehydrohalogenation of alkyl dihalides, reaction of metal acetylides with primary alkyl halides; Addition reactions: Addition of X_2, addition of HX, addition of H_2O (Hydration), formation of metal acetylides. 5. Alkyl halides: Physical Properties, Preparation: Hunsdieker reaction (other methods are covered under reactions of other functional groups). Reactions: Nucleophilic Aliphatic Substitution reaction (Mechanism, Factors affecting SN_1 and SN_2 reactions to be discussed in detail), SNi reaction.	
Reference material:	1. Organic Chemistry by R.T. Morrison and R.N. Boyd, 6th edition,Prentice Hall Publications 2. Organic Chemistry by Pine, Stanley H.; Hendrickson, James B.; Cram, Donald J.; Hammond, George S., 4th edition. The Macgraw hill publications 3. Organic Chemistry by I.L. Finar, Vol 1 & 2, 6th edition, Pearson education 4. Advanced Organic Chemistry: Reactions, Mechanisms, Structures by Jerry March, John Wiley and sons 5. Organic Chemistry, Part A: Structures and Mechanism, Part B: Reactions and Synthesis, Francis and Carry, Richard J Sundberg. Springer publications 6. A Guidebook to Mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson Education 7. Peter Sykes, Essentials of Organic chemistry by Paul M Dewick, Wiley, Pine 8. Essentials of Organic chemistry by Paul M Dewick, Wiley 9. Eliel, Kalsi, Organic Chemistry by L.G.Wade, Jr., Maya Shankar Singh, Pearson Education, 6th Ed, Organic Chemistry, 2nd Ed., Thomas Sorrell, University Science Books 10. Stereochemistry: Conformation and Mechanism, b) Organic Reactions And Their Mechanisms. By P. S. Kalsi. New age International 11. Organic Chemistry through Solved Problems, Goutam Brahmachari. Edition, Morgan & Claypool 12. Organic Name Reactions: A Unified Approach. Goutam Brahmachari. Alpha Science publications

<table>
<tr><td colspan="6">Course: Biochemistry II (CBSGS)</td></tr>
<tr><td>Course Code: DPC 06</td><td colspan="4">Second Year B. Pharm</td><td>Semester:III</td></tr>
<tr><td colspan="3">Type of course : Theory</td><td colspan="3">Contact Hours: 4 Hrs/week</td></tr>
<tr><td>Course assessment Methods:</td><td colspan="4">Continuous mode of assessment</td><td>Semester-end assessment</td></tr>
<tr><td>Assessment Tools:</td><td>MSE</td><td>Attendance</td><td>Quizzes</td><td>TSI</td><td>ESE</td></tr>
<tr><td>Max. Marks:</td><td>15</td><td>5</td><td>5</td><td>5</td><td>70</td></tr>
<tr><td>Pre-requisites :</td><td colspan="5">• Biochemistry I
• Basics of the biomolecules existing in the body and the primary role of these biomolecules</td></tr>
<tr><td>Course objectives :</td><td colspan="5">1. To make student understand basic reactions happening inside body like metabolism and biosynthesis of biomolecules
2. To learn central paradigm of biochemistry which will form base for understanding advanced application subjects like biotechnology</td></tr>
<tr><td colspan="5">Course Outcomes: After the completion of course learner will be able to:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="4">Understand biosynthesis and metabolism of biomolecules including bioenergetics involved theirin.</td><td>1</td></tr>
<tr><td>CO2</td><td colspan="4">Reproduce names, structures,products and enzymes involved in all metabolic processes.</td><td>1</td></tr>
<tr><td>CO3</td><td colspan="4">Learn three cornered central paradigm of biochemistry i. e. replication, transcription and translation.</td><td>1,7</td></tr>
<tr><td>CO4</td><td colspan="4">Relate basic understanding to learn applications like DNA sequencing DNA polymorphism,Peptide sequencing and Protein synthesis</td><td>1,7</td></tr>
<tr><td colspan="6">Topics covered :</td></tr>
<tr><td>Unit I:</td><td colspan="4">Carbohydrate metabolism discussed with respect to the structures of intermediates, enzymes and cofactors, energy yield/requirements and regulation. Examples of drugs modulating carbohydrate metabolism</td><td>Hours:12</td></tr>
<tr><td colspan="5">• Glycolysis (Embden Meyerhoff Pathway), TCA cycle (Kreb’s Cycle, Citric acid Cycle) and glyoxalate shunt. Entry of sugars other than glucose into glycolytic pathway. Discussion of shuttle systems to transfer NADH to the mitochondria.</td><td></td></tr>
</table>

• Electron Transport Chain discussed with respect to the components of the ETC, explanation of oxidative phosphorylation vs substrate level phosphorylation. Discussion of proton motive force and generation of ATP using proton gradients. Discussion of uncouplers of oxidative phosphorylation. • Discussion of pentose phosphate pathway, glycogenesis, glycogenoysis, gluconeogenesis and other systems involved in carbohydrate metabolism		
Unit II:	**Lipid metabolism discussed with respect to the structures of intermediates, enzymes and cofactors involved, energy yield/requirements and regulation.**	**Hours: 8**
• Beta oxidation pathway for catabolism of saturated and unsaturated even number fatty acids, catabolism of odd number carbon containing fatty acids, formation of ketone bodies, • Acetate mevalonate pathway to cholesterol biosynthesis • Biosynthesis of fatty acids and phospholipids • Examples of drugs modulating lipid/cholesterol metabolism		
Unit III:	**Nucleic Acid Metabolism discussed with respect to the structures of intermediates, enzymes and cofactors, energy yield/requirements and regulation**	**Hours: 8**
• Discussion of biosynthesis of purines • Discussion of biosynthesis of pyrimidines • Salvage pathways for nucleic acid metabolism. Examples of drugs modulating purine/pyrimidine biosynthesis		
Unit IV:	**DNA replication**	**Hours: 8**
• Details of DNA replication, differences between prokaryotes/eukaryotes. Brief description of telomeres and telomerase activity. DNA polymorphisms and SNPs. Examples of drugs modulating these pathways (polymerase inhibitors, telomerase inhibitors, topoisomerase inhibitors) and polymorphisms involved in disease states • Discussion of solid phase DNA synthesis, DNA synthesizers and comparison between biosynthesis and chemical synthesis • Discussion of DNA sequencing (Sanger dideoxy method)		
Unit V:	**Protein biosynthesis**	**Hours: 10**
• Details of DNA transcription and RNA translation. Transcriptional and translational differences in prokaryotes and eukaryotes especially with respect to post-transcriptional and post-translational modifications. Examples of drugs modulating these pathways with emphasis on protein synthesis inhibitors used as drugs • Discussion of solid phase peptide synthesis, peptide synthesizers and comparison		

between biosynthesis and chemical synthesis • Discussion of peptide sequencing (Edman method and its automation). Utility of peptidases and chemical agents to cleave proteins in preparation for sequencing	
Reference material:	**Books** 1. Lehninger, Principles of Biochemistry, Replika Press. 2. Stryer L, Biochemistry, W. H. Freeman & Co. 3. Harper's Biochemistry, Appleton and Lange, USA. 4. Conn E, Stumpf PK, Brueing G and Doi Roy H, Outlines of Biochemistry, Wiley Liss, USA. 5. Wilson and Gisvolds Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Willliams and Wilkins, USA 6. Foye's Principles of Medicinal Chemistry, Lippincott Williams and Wilkins, USA.

Course: Dispensing Pharmacy (CBSGS)					
Course Code: DPH 07	**Second Year B. Pharm**				**Semester: III**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Prior knowledge of physical pharmacy encompassing micromeritics, physico-chemical properties of drug molecules and excipients and prior knowledge of Pharmaceutics including definition, properties and advantages of various pharmaceutical dosage forms like biphasic dispersed systems, semisolid and suppositories.				
Course objectives :	The student shall be given orientations to know the prescription, posology, dispensing procedure of medicines, pharmaceutical calculations and interpretations of incompatibilities.				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**
CO1	Understand the structure of a prescription; record keeping; labeling and packaging, Latin terms and abbreviations.				1,3,4
CO2	Apply accurate and standardized information on extemporaneous compounding and dispense a safe and				1,2,3

	effective pharmaceutical products	
CO3	Identify physical and chemical incompatibilities among active and inactive pharmaceutical ingredients of a formulation; recommend and follow approaches to avoid incompatibilities and unwanted interactions.	1,2,3
CO4	Calculate and measure the correct quantity of active and inactive pharmaceutical ingredients using appropriate laboratory measuring equipment and follow good manufacturing procedures to obtain the desired quantity of formulation.	1,2

Topics covered :

Unit I:	**Introduction.**	**Hours: 6**

Introduction to compounding and dispensing.
Prescription and its parts.
Types of prescriptions.
Pricing and recording of prescriptions.
Types of dispensed preparations.
Weights and measures including imperial weights (Apothecary

Unit II:	**General dispensing.**	**Hours: 6**

Fundamentals of compounding and dispensing including good practices.
Formulation of dispensed products.
Containers and closures/packaging for dispensed products.
Storage and stability of dispensed products.
Labeling of dispensed preparations.
Latin Terms and abbreviations.
Preparation of stock solutions.
Dispensing of proprietary medicines.

Unit III:	**Calculations.**	**Hours: 4**

Calculations based on expressions of concentration and dilution (percentage, parts, alligation), proof strength.
Calculations based on Isotonicity.
HLB calculations.
Posology.

Unit IV:	**Solutions.**	**Hours:2**

Solutions taken orally.
Solutions used in body cavities.
Solutions for external use.

Unit V:	**Suspensions.**	**Hours: 3**

Suspensions containing diffusible solids.
Suspensions containing indiffusible solids.
Suspensions containing poorly wettable solids.

Suspensions containing precipitate forming liquids. Dispersion of oil in inhalation. Suspensions produced by chemical reaction.		
Unit VI:	**Emulsions**	**Hours: 3**
Types of Emulsions. Emulsifying agents. Compounding and preservation of Emulsions. Emulsions for external use (Creams).		
Unit VII:	**Ointments, Pastes and Gels.**	**Hours: 3**
Types of Ointment bases. Preparation Of Ointments. Pastes and Poultices. Gels.		
Unit VIII:	**Dispensed Oral Solid Dosage forms.**	**Hours: 4**
Powders, Granules, Tablet Triturates, Pills, Lozenges and Pastilles, Capsules.		
Unit IX:	**Suppositories and Pessaries.**	**Hours: 2**
Types of Suppository base, Compounding of Suppositories		
Unit X:	**Incompatibilities.**	**Hours: 3**
Physical Incompatibilities, Chemical Incompatibilities.		
Reference material:	1. Cooper and Gunns Dispensing for Pharmaceutical Students, Edns. 11 and 12; Edited by S.J.Carter, Indian Edition, CBS Publishers, Delhi. 2. Pharmaceutical Practice; Edited by D.M.Collet and M.E.Aulton; Churchill Livingstone, ELBS Edition, 1991. 3. Pharmaceutical Practice Edited by A.J.Winfield and R.M.E. Richards, Second Edition, Churchill Livingstone, 1998. 4. Pharmaceutical Practice; Edited by A.J. Winfild and R.M.E. Richards, Third Edition, Churchill Livingstone, 2004. 5. Husa's Pharmaceutical Dispensing, Edited by Eric Martin, Sixth Edition, Mack Publishing Company, 1996. 6. Pharmaceutical Calculations, A.C. Ansel and M.J.Stoklosa, Lippincott Williams and Wilkins, 2006. 7 Pharmaceutical Calculations – Bradley, Gustafson and Stoklosa, Third Edition, Lea and	

Course: Pharmaceutical Engineering (CBSGS)					
Course Code: DAL04	**Second Year B. Pharm**				**Semester: III**
Type of course : Theory			**Contact Hours: Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basic Knowledge of Physics and Chemistry of Standard 12th • Knowledge of State of matter, Thermodynamics, Solubility and Distribution Phenomena learned in Physical Pharmacy **I** and **II.**				
Course objectives :	1. To know various unit operations and equipments based on same. 2. To know types of corrosion and construction materials. 3. To know safety guidelines in work environment.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand theoretical aspects of unit operations based on Heat and Mass transfer and measurement parameter.	1
CO2	Grasp knowledge of Construction and Working of different Equipments and Accessories for Unit Operation, required for bulk drug production.	1,2
CO3	Know types of Corrosion and various materials for design of Equipment.	1,2
CO4	Apply safety guidelines for better work conditions.	8

Topics covered :		
Unit I:	**Fluid flow**	**Hours: 3**
Mention fluid properties such as viscosity, compressibility and surface tension of fluids. Hydrostatics influencing fluid flow. Fluid dynamics- Bernoulli's theorem, flow of fluids in pipes, laminar and turbulent flow		
Unit II:	**Fluid and pressure measurements**	**Hours: 4**
• Measurement of flow- Classification of flow meters, venturi meter, orifice meter, pitot tube, rotameter and current flow meters. • Pressure measurement- Classification of manometers, simple manometer, U tube manometer and modifications, Bourdon gauge.		
Unit III:	**Pumps:**	**Hours: 2**

• Positive displacement pumps-reciprocating pumps, rotary pumps. Centrifugal pumps.		
Unit IV:	**Heat and Mass transfer**	**Hours: 4**
• Modes of heat transfer- conduction, convection and radiation, Heat exchangers- tubular and plate, Temperature measurement-basic principles and devices Mass transfer in turbulent and laminar flow • Concept of interfacial mass transfer		
Unit V:	**Conveying of solids**	**Hours: 1**
Belt conveyor, Bucket conveyor, Screw conveyor and Pneumatic conveyor.		
Unit VI:	**Crystallization**	**Hours: 6**
• Crystal forms and crystal habits, Theory of crystallization- Supersaturation- Mier's theory of supersaturation, Nucleation, Crystal growth. • Crystallizers- Classification, Tank crystallizers, Agitated tank crystallizers, Swenson Walker crystallizer, Vacuum crystallizer and its modifications, Krystal or Oslo crystallizer • Factors affecting crystallization and Caking of crystals		
Unit VII:	**Evaporation:**	**Hours: 4**
• Introduction, factors influencing rate of evaporation, including scale formation, Evaporators classification- Pan evaporators, Tubular evaporators (Horizontal tube evaporator, Vertical tube evaporators- short tube vertical evaporator, Multiple effect evaporator, Long tube evaporators -Climbing film evaporator, Falling film evaporator, Forced circulation evaporator,) Wiped film evaporator , Centrifugal rotary evaporator. • Evaporator accessories- condensers, vacuum pumps, expansion and bucket traps, entrainment separators		
Unit VIII:	**Distillation**	**Hours: 6**
• Revision of Vapour-liquid equilibrium, Distillation methods- Equilibrium distillation, Simple distillation. • Fractional distillation- Theory of batch fractionation, Columns (only construction and working) Bubble cap, sieve plate columns, packed columns. Concept of plate efficiency and HETP (no detailed theories and Derivations). • Distillation under reduced pressure- Theory of molecular distillation and equipments. Falling film and centrifugal molecular distillation still, applications. Azeotropic and Extractive distillation- Theory and applications. Steam distillation- Theory and applications.		
Unit IX:	**Refrigeration:**	**Hours: 1**
Refrigeration –equipment and concept of refrigeration load, concepts of brine systems and absorption systems.		
Unit X:	**Materials of construction and Corrosion**	**Hours:5**
• Classification into metals and non-metals. Ferrous and its alloys-cast iron, mild		

<table>
<tr><td colspan="3">steel and stainless steel. Copper and its alloys. Nickel and its alloys. Aluminium and its alloys. Plastics- Classification into thermoplastics and thermosetting plastics, properties and applications of polyvinyl chloride, polyethylene, polyporopylene, polystyrene, polyester, ABS, phenolic and epoxy plastics, fluorocarbon plastics, chlorinated plastics and polycarbonated plastics.
• Corrosion: Mechanism and types of corrosion. Factors influencing rate of corrosion. Methods of combating corrosion.</td></tr>
<tr><td>Unit XI:</td><td>Industrial Hazards and safety regulations.</td><td>Hours: 2</td></tr>
<tr><td colspan="3">• Mechanical hazards and prevention
• Electrical hazards and prevention
• Chemical hazards and prevention
• Fire hazards and extinguishers.</td></tr>
<tr><td>Reference material:</td><td colspan="2">Latest editions of all books to be referred:
1. K. Sambamurthy, Pharmaceutical Engineering, New age international (P) Limited Publishers, 1998.
2. Dr. A. R. Paradkar, Introduction to Pharmaceutical Engineering, 10th Edition, Nirali Parakashan, 2007.
3. James Swarbrick & James C. Boylon, Encyclopedia of Pharmaceutical Technology, Marcel Dekker, INC, New York, 1994.
4. Walter I. Badger & Julius T. Bancher, Introduction to Chemical Engineering, Mc Graw Hill Inc, 1995.
5. M. E. Aulton, Ed, Pharmaceutics-The Science of Dosage Form Design, Churchill Livingstone Medical Division Of Longman Group UK Ltd, 2002.
6. S. J. Carter, Cooper and Gunn’s Tutorial Pharmacy, 6th Edition, CBS Publishers & Distributors, New Delhi, 2005.
7. Robert H. Perry, Don W. Green, Perry’s Chemical Engineers Handbook,7th Edition, Don W. Green, James O. Maloney, McGraw Hill,1997.
8. G. K. Jani, Pharmaceutical Engineering, Vallabh Prakashan.</td></tr>
</table>

Course: Anatomy, Physiology and Pathophysiology III (CBSGS)		
Course Code: DPL04	**Second Year B. Pharm**	**Semester: III**
Type of course : Theory	**Contact Hours: 3 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**	**Semester end assessment**

Assessment Tools:	MSE	Attendance	Quizzes	Teacher Student interaction	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**

Prerequisites :	• Basic knowledge of biology, commonly used terminologies in anatomy, physiology and pathophysiology. • Concepts of homeostasis, feedback mechanisms, dietary constituents, and transport across cell membrane.
Course objectives :	1. To provide basic understanding of anatomy and physiology of reproductive system, the cardiovascular system, urinary system and digestive system. 2. To provide basic understanding of pathophysiology of few diseases related to the given systems.

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Comprehend the structure and functions of various organs of the reproductive system and explain the pathophysiological basis of few diseases of the human reproductive system.	1,3,4,7,8
CO2	Comprehend the structure and functions of the cardiovascular system; explain the pathophysiological basis of few diseases of the human cardiovascular system.	1,3,4,7,8
CO3	Comprehend the structure and functions of various organs of urinary system; explain the pathophysiological basis of few diseases of the human urinary system.	1,3,4,7,8
CO4	Comprehend the structure and functions of various organs of the digestive system; explain the pathophysiological basis of few diseases of the human digestive system.	1,3,4,7,8

Topics covered :

Unit I:	**Reproductive system**	**Hours: 4**

- Anatomical and Physiological considerations of male and female reproductive system
- Reproductive and endocrine functions of testes and ovaries
- Menstrual cycle

Unit II:	**Pathophysiology of following diseases**	**Hours: 2**

Infertility, Sexually transmitted diseases (STD), Dysmenorrhea

Unit III:	**Cardiovascular System**	**Hours: 8**

- Functional anatomy of heart
- Conducting system of heart
- Cardiac cycle, Electrocardiogram (ECG)

<table>
<tr><td colspan="3">• Physiology of blood circulation
• Functional anatomy of blood vessels
• Blood pressure and factors regulating blood pressure
• Baroreceptors, chemoreceptors, vasomotor center
• Humoral and neuronal control of blood pressure and circulation</td></tr>
<tr><td>Unit IV:</td><td>Pathophysiology of following diseases</td><td>Hours: 4</td></tr>
<tr><td colspan="3">Hypertension, Congestive Cardiac Failure, Cardiac Arrhythmia, Angina Pectoris, Ischemic Heart Disease, Arteriosclerosis/Atherosclerosis</td></tr>
<tr><td>Unit V:</td><td>Urinary system</td><td>Hours: 5</td></tr>
<tr><td colspan="3">• Anatomy and Physiology of Urinary System
• Formation of urine
• Water balance, electrolyte balance & acid – base balance</td></tr>
<tr><td>Unit VI:</td><td>Formation of body fluids and fluid compartments.</td><td>Hours: 3</td></tr>
<tr><td>Unit VII:</td><td>Pathophysiology of following diseases</td><td>Hours: 3</td></tr>
<tr><td colspan="3">Renal failure, Glomerulonephritis, Renal calculi / kidney stones, Urinary Tract Infections (UTI)</td></tr>
<tr><td>Unit VIII:</td><td>Digestive System</td><td>Hours: 6</td></tr>
<tr><td colspan="3">• Anatomy and physiology of digestive system
• Digestion and absorption of carbohydrates, proteins and fats</td></tr>
<tr><td>Unit IX:</td><td>Pathophysiology of following diseases</td><td>Hours: 3</td></tr>
<tr><td colspan="3">Peptic ulceration, Zollinger – Ellison’s Syndrome, Inflammatory Bowel Disease (Ulcerative colitis, Crohn’s disease), Cholecystitis & Cholelithiasis, Jaundice, Hepatitis, Pancreatitis, Achalasia, Reflux esophagitis</td></tr>
<tr><td>Reference material:</td><td colspan="2">Books Latest editions of the following books to be referred:
1. Ross & Wilson, Anatomy & Physiology in Health & Illness by Anne Waugh and Allison Grant, Published by Churchill Livingstone
2. Gerard J. Tortora & Bryan Derrickson, Principals of Anatomy & Physiology, Published by John Wiley and Sons, Inc.
3. A.C. Guyton & J. E. Hall, Textbook of Medical Physiology, Published in India by Prism Books Ltd. on arrangement with W. B. Saunders Company, USA.
4. McNaught & Callander, Illustrated Physiology by B. R. Mackenna & R. Callander, Published by Churchill Livingstone
5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques
6. Praful B. Godkar, Textbook of Medical Laboratory Technology, Published by Bhalani Publishing House, Mumbai, India
7. Harsh Mohan, Text book of Pathology, Published by Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi</td></tr>
</table>

Course: Mathematics (CBSGS)					
Course Code: DAL05	**Second Year B. Pharm**				**Semester: III**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basic mathematics and calculus covered in higher secondary school.				
Course objectives :	• To familiarize students with different techniques involved in calculations, including calculus, differential equations, matrices and numerical methods				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Solve problems involving differential and integral calculus.	1
CO2	Solve problems involving differential equations.	1
CO3	Solve problems involving matrices and determinants.	1
CO4	Use numerical methods for solving complex mathematical problems.	1

Topics covered :		
Unit I:	**Differential Calculus**	**Hours: 05**
1) Successive Derivatives, 2) Lebnitz's Rule fourth derivative, 3) Lagrange's and Rolle's Mean Value Theorems (Statements only), 4) Taylors and Maclaurins Series (No proof) with application		
Unit II:	**Partial Differentiation**	**Hours: 05**
1) Functions of two or three variables, 2) Change of variables, 3) Application to errors, maxima and minima		
Unit III:	**Integral Calculus**	**Hours: 07**
1) Integration by parts, 2) Properties of definite integrals and reduction formulae, 3) Determination of the length of the curve, are and volume		
Unit IV:	**Differential Equations**	**Hours: 07**
1) Formation of differential equations, 2) Solution of first-order and first-degree equations, 3) Linear differential equations of higher order with constant coefficients, 4) Simple applications to chemical reactions and biopharmaceutics		

Unit V:	**Determinants and Matrices**	**Hours: 07**
1) Properties of determinants and applications, 2) Solution of simultaneous equations with three variables by Cramers method, 3) Types of matrices, inverse of matrix, rank of a matrix, eigen value and eigen vectors, 4) Caley Hamilton Theorem		
Unit VI:	**Numerical Methods**	**Hours: 06**
1) Finite difference operators (delta and E), 2) Interpolation of equal and unequal intervals – Newtons method and Lagrange method, 3) Numerical integration – Trapezoidal rule, Simpsons 1/3rd and 3/8th rules		
Reference material:	1. Mathematics for Pharmacy Students (Vol. 1), Gujar, K. N., Bhavale Ashok, Career Publications. 2. Differential Calculaus; Nareyan, S., S. Chand Publication 3. Applied Mathematics – I, Baphana R. M., Techmax Publication. 4. Textbook of Applied Mathematics, Vols. I and II, Wartikar, P. N. Pune Vidyarthi Griha Prakashan. 5. Integral Calculus, Shanti Narayan, S. Chand Publication. **6.** A Textbook of Matrices, Shantinarayan, S. Chand Publication	

Course: Organic Chemistry Lab – I (CBSGS)			
Course Code: DPC 07	**Second Year B. Pharm**		**Semester: III**
Type of course : Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	End semester Examination
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Handling different sets of laboratory apparatus. • Basics of safety aspects while working in chemistry lab.		
Course objectives :	1. To make students understand different techniques involved in identification of organic compounds. 2. To develop practical approach and disciplinary planning behaviour for performance of experiment. It also includes boosting self-confidence and effective communication.		
Course Outcomes: After the completion of course learner will be able to:			**PO Mapped**
CO1	Perform solubility nature, elemental analysis, functional group detection and physical constant of test compound.		1

CO2	Correlate theoretical concepts for identification of compounds by performing various qualitative tests.	1
CO3	Summarize the findings in systematic way verbally and in written communication.	3

Topics covered :	
Unit I:	Laboratory safety measures to be taken for: a. Fire and burns b. Spillage c. Inhalation of toxic fumes d. Dress code in a laboratory e. First aid measures to be taken in cases of accidents f. Use of fume hood, eye shower, body shower. **Hours:**
Unit II:	Organic spotting
	Minimum eight samples of mono-functional groups and two samples of bifunctional groups to be taken.
Unit III:	Theoretical aspects of physical constant determination, and detection of functional groups.
Reference material:	**Following books can be referred.** 1. A laboratory hand book of Organic qualitative analysis and separations, V.S. Kulkarni, S.P.Pathak, D. Ramchandra & Co., Pune 2. Text book of organic practical chemistry, V.S. Kulkarni, S.P.Pathak, D. Ramchandra & Co., Pune. 3. R. L. Shriner, R. C. Fuson and D. Y. Curtin, The systematic Identification of Organic compounds, 6th Ed., Wiley, New York, 1980 4. A. I. Vogel, A textbook of practical organic chemistry, 4th edition, Wiely New York, 1978 5. Comprehensive Practical Organic Chemistry: Qualitative Analysis, V.K. Ahluwalia, S. Dhingra, Universities Press (India) Limited, 2000 6. Comprehensive Practical Organic Chemistry: Preparation and Quantitative analysis, V.K.Ahluwalia, Renu Aggarwal, Universitites Press (India) Limited, 2000

Course: Biochemistry Lab (CBSGS)			
Course Code: DPC 08	**Second Year B. Pharm**		**Semester: III**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE

Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Basics chemical properties of all biomolecules, enzyme kinetics as well as factors affecting enzyme activity		
Course objectives :	1. To develop skills of qualitative and quantitative analysis of biomolecules 2. Learn to apply knowledge acquired in theory to interpret results		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Able to perform Qualitative and quantitative analysis of various samples of carbohydrate, protein, lipids and enzymes	1
CO2	Correlate findings with theoretical concepts and conclude the results based on confirmatory tests and calculations	1
CO3	Demonstrate oral and written communication and ability to plan experiment with proper time management.	3

Topics covered :	
Unit I:	Qualitative tests for carbohydrates and confirmatory tests by ozasone formation
Unit II:	Qualitative test and simple color reactions for amino acids and proteins. Precipitation reactions of proteins.
Unit III:	Chromatographic separation of amino acids.
Unit IV:	Quantitative estimation of glucose (Willstaters and Lane & Eynon's methods). Estimation of sucrose. Colorimetric estimation of glucose.
Unit V:	Quantitative estimation of proteins by Biuret method and Folin method (one titrimetry and one by colorimetry)
Unit VI:	Estimation of enzyme activity – ptyline (amylase) in saliva and alkaline phosphatase (including plotting of data to determine Km and Vmax for any one of these enzymes
Unit VII:	Quantitative estimation of properties of lipids – acid value, iodine value, saponification
Unit IX:	Demonstrations of estimation of blood glucose, SGOT or SGPT using commercial kits (suggest that students should volunteer for fasting and post prandial glucose determinations)
Unit X	Demonstration of isolation of DNA.
Reference material:	**Books** 1. An Introduction to Practical Biochemistry – Plummer D.T., Tata Mcgraw Hill, N Delhi, India 2. Laboratory Manual In Biochemisty, Jayaraman J, Wiley Easter, N Delhi. India

Course: Dispensing Lab (CBSGS)			
Course Code: DPH 08	**Second Year B. Pharm**		**Semester: III**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	Prior knowledge of compounding liquid and solid dosage forms formulations and their labeling.		
Course objectives :	To train the students for compounding, labelling and dispensing extemporaneous formulations.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Compound, label and dispense extemporaneous formulations	1,2, 8
CO2	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3

Topics covered :		
Unit I:	**SOLUTIONS:** 1. Potassium Permanganate Solution 2. Zinc Chloride and Zinc sulphate Mouthwash BPC 1973 3. Sodium Bicarbonate Ear Drops BP 4. Paediatric Ferrous Sulphate Oral Solution BP 1988	**Hours: 4**
Unit II:	**SUSPENSIONS** 1. Menthol and Eucalyptus oil inhalation 2. Paediatric Chalk Mixture BP 1988 3. Kaolin Mixture BP 1988	**Hours: 4**
Unit III:	**EMULSIONS AND CREAMS** 1. Arachis Oil Emulsion 2. Calciferol Emulsion 3. Aqueous Calamine cream IP 2010 4. Medicated cream 5. Buffered Cream BP 1988	**Hours: 4**
Unit IV:	**OINTMENT** Zinc and Castor Oil Ointment BP 1988 / Calamine	**Hours: 2**

	Ointment IP 2010	
Unit V:	**GEL** Lubricating Jelly	**Hours: 2**
Unit VI:	**PASTE** 1. Compound Zinc Paste BP 1988/ Zinc and Salicylic Acid paste BP 1988 2. Kaolin Poultice BP 1988	**Hours: 2**
Unit VII:	**POWDER** 1. Bulk Powder : Compound Magnesium trisilicate Oral Powder BP 1988 / Zinc, Starch and Talc Dusting Powder BPC 1973 2. Divided Powder : Hyoscine Hydrobromide Powder 3. Siedlitz Powder	**Hours: 2**
Unit VIII:	**GRANULES** 1. Isapguhl Granules 2. Effervescent Granules	**Hours: 4**
Unit IX:	**TABLET TRITURATE** 1. Boric acid / Riboflavin tablet triturate	**Hours: 2**
Unit X:	**CAPSULE** 1. Chlordiazepoxide capsules BP	**Hours: 2**
Unit XI:	**PILLS** 1. Compound Rhubarb Pills BPC 1960 / Potassium Permanganate Pills	**Hours: 2**
Unit X:	**PASTILLES** 1. Medicated Pastille	**Hours: 2**
Unit XI:	**LOZENGE** 1. Brompton Cough Lozenge BPC 1973 / Compound Bismuth Carbonate Lozenge BPC 1973	**Hours: 2**
Unit XII:	**SUPPOSITORY** 1. Compound Bismuth Subgallate Suppositories BP 1980	**Hours: 4**
Unit XIII:	**INCOMPATABILITY** 1. Eutectic Mixture	**Hours: 2**
Reference material:	1. Relevant editions of IP, BP, BPC 2. Cooper and Gunns Dispensing for Pharmaceutical Students, Edns. 11 and 12; Edited by S.J.Carter, Indian Edition, CBS Publishers, Delhi. 3. Pharmaceutical Practice; Edited by D.M.Collet and M.E.Aulton; Churchill Livingstone, ELBS Edition, 1991. 4. Pharmaceutical Practice Edited by A.J.Winfield and R.M.E. Richards, Second Edition (1998),	

	Third Edition (2004) Churchill Livingstone.

Semester IV

<table>
<tr><td colspan="6">Course: Organic Chemistry – II (CBSGS)</td></tr>
<tr><td colspan="2">Course Code: DPC 09</td><td colspan="3">Second Year B. Pharm</td><td>Semester: IV</td></tr>
<tr><td colspan="3">Type of course : Theory</td><td colspan="3">Contact Hours: 3 Hrs/week</td></tr>
<tr><td>Course assessment Methods:</td><td colspan="4">Continuous mode of assessment</td><td>Semester-end assessment</td></tr>
<tr><td>Assessment Tool:</td><td>Periodic Theory test</td><td>Attendance</td><td>Quizzes</td><td>Teacher - Student interaction</td><td>End semester Examination</td></tr>
<tr><td>Max. Marks:</td><td>15</td><td>5</td><td>5</td><td>5</td><td>70</td></tr>
<tr><td>Pre-requisites :</td><td colspan="5">• Handling different sets of laboratory apparatus.
• Basics of safety aspects while working in chemistry lab.</td></tr>
<tr><td>Course objectives :</td><td colspan="5">1. To make students understand basic chemistry of functional groups including various methods of preparation, reactions, and reagents involved.
2. To make students aware about stereochemistry of some organic molecules.
3. To provide information of polycyclic compounds.</td></tr>
<tr><td colspan="5">Course Outcomes: After the completion of course learner will be able to:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="4">Understand and express basic chemistry and preparation of various functional groups and polycyclic compounds.</td><td>1</td></tr>
<tr><td>CO2</td><td colspan="4">Acquire knowledge of stereochemistry of organic molecules and interpret stability pattern of stereoisomers.</td><td>1</td></tr>
<tr><td>CO3</td><td colspan="4">Recognize the reaction from experimental conditions, deduce the mechanism and transform one functional group to other.</td><td>1,7</td></tr>
<tr><td colspan="6">Topics covered :</td></tr>
<tr><td>Unit I:</td><td colspan="4">Functional group chemistry and molecular rearrangements.</td><td>Hours: 25</td></tr>
<tr><td colspan="6">1.1 Aldehydes and Ketones Methods of preparation :Dry distillation of anhydrides, Oxidation of primary and secondary alcohol, Oxidation of methylbenzene, Reduction of acid chlorides, from Reaction of acid chloride with organocopper. Oxidation with Ag(NH3)2, KMnO4, K2Cr2O7, NaOH/I2, Reduction with H2/Pt or Ni or Pd, LiAlH4, NaBH4, Clemmesons & Wolf Kishner Reduction, reduction. Nucleophilic additions like Cyanohydrin, Acetal formation, Grignard, Derivatives of ammonia,</td></tr>
</table>

NaHSO3, organolithium compounds. Condensations with discussion of mechanism of aldol (Acid and Base catalyzed), Mixed aldol, crossed aldol, nitroaldol, retroaldol, Claisen-Schmidt, Halogenation of ketones, Perkin, Knovengeal, Dobener-Knovengeal, Reformatsky, Micheal, Benzillic acid alkylations, Dakin oxidation, Benzoin Condensation, Wittig with Ph3P, Wolff, Bayer-Villiger Oxidation, Diazomethane reaction, Stobbes, Willgerodt, Favorskii, Cannizzaro reduction. Problems related to above reactions.

1.2 Amines Methods of preparation : From alkyl halides, Reduction of nitro compounds with Metal/HCl and Na2S2/NH4S6, Reduction of amides, Reduction of cyanides, Reduction of oximes, Reductive amination, Leukart method, Gabriel-pthalimide method, discussion and Mechanism of Curtius, Lossen, Scmidt rearrangement. Discussion on physical properties Reactions of amines : With acid, with alkyl halides, conversion to amides, Schotten- Baumann technique, ring substitution in aromatic amines, Hoffman elimination from alkylation ammonium, salts. Mechanism of Steven & Sommelet alkylations, Diazotization with mechanism and its application including Sandmeyer reaction mechanism and Gomberg reaction mechanism Problems related to above reactions.

1.3 Carboxylic acids Methods of alkylation: Oxidation of alcohols, Oxidation of alkylbenzene, from alkylation reagent, hydrolysis of nitriles, malonic ester synthesis of carboxylic acid with alkylation Reactions with Base, with SOCl2, PCl3.PCl5 SO2Cl2, with alcohol, Conversions to amides, Reduction, Hell-Volhard-Zelinsky reaction Condensation reactions like Dieckmann condensation with mechanism. Problems related to all reactions

1.4 Amides Methods of preparation of amides, imides Reactions of amides: Hoffmann and Beckmann alkylations and its mechanism including transformations. Identification test like diazotization after acidic hydrolysis

1.5 Esters Methods of preparation Reactions: Basic and acidic hydrolysis of esters with mechanism, conversions to amides, transesterification, reaction with Grignard & organolithium, catalytic hydrogenation of esters, reduction with LiAlH4, Claisen condensation, mixed Claisen, crossed Claisen Problems related to above reactions.

1.6 Physical Properties, Preparation of alcohols using Grignard synthesis, Aldol Condensation, Reduction of acids, esters carbonyl compounds. Reactions: HX, PX3, with metal, esterification, oxidation, Pinacol-Pinacolone rearrangement. Problems related to above reactions.

1.7 Phenols Physical Properties. Preparation of Phenols: Hydrolysis of diazonium salts, from aryl sulphonates. Reactions: Ester formation, Electrophilic substitution reaction-Nitration, sulponation, alkylations, Freidel-crafts alkylation, nitrosation, Fries rearrangement, Kolbe-Schimdt reaction, Reimmer-Tiemman reaction, Schotten- Baumann reaction

1.8 Ethers Physical Properties, Preparation Willimason’s synthesis, alkoxymercuration- demercuration, Industrial sources of ethers. Reaction with HX

and Wittig reaction		
Unit II:	**Polycyclic aromatic compounds: Naphthalene, Anthreacene, Phenanathrene**	**Hours: 3**
(Reactions of derivatives not included) Methods of preparation of polycyclic aromatic compounds- : Fittig reaction, Friedel-Crafts reaction, Elbs reaction, Pschorr synthesis, Haworth synthesis for naphthalene and phenanthrene, Stobbe condensation, Bardhan- Sengupta synthesis, Bogert-Cook synthesis, resonance and nomenclature, Reactions of naphthalene- oxidation		
Unit III:	**Stereochemistry**	**Hours: 6**
Conformation of ethane, Butane, Cyclohexane Types of strains: Angle strain, Transannular strain, Bayer strain, Pitzer strain stability, optical activity and conformational analysis of mono and disubstituted cyclohexanes (1,2/1,3/1,4 disubstituted with –OH, -X, t-butyl, -COOH like groups)		
Unit IV:	**Redox reactions**	**Hours: 4**
Reagents used in Oxidation : perbenzoic acid, CF3CO3H, V2O5, lead tetracetate, Al-isopropoxide and reactions using these reagents. Reagents used in Reduction : NaBH4, LiAlH4, SnCl2, Na/alcohol, Na/Liq. NH3, Raney Ni, Na dithionate and reactions using these reagents, Birch reduction		
Reference material:	List of reference books: 1.Organic Chemistry by R.T. Morrison and R.N.Boyd, 6th edition,Prentice Hall Publications 2. Organic Chemistry by Pine, Stanley H.; Hendrickson, James B.; Cram, Donald J.; Hammond, George S., 4th edition. The Macgraw hill publications 3. Organic Chemistry by I.L. Finar, Vol 1& 2, 6th edition, Pearson Education 4. Advanced Organic Chemistry: Reactions, Mechanisms, Structures by Jerry March, John Wiley and Sons 5. Organic Chemistry, Part A: Structures and Mechanism, Part B: Reactions and Synthesis, Francis and Carry, Richard J Sundberg. Springer publications 6. A Guidebook to Mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson Education 7. Name Reactions: A Collection of Detailed Reaction Mechanisms. Jie Jack LiJi Jack Lee, Springer Publications 8. Organic Chemistry, 9th Ed, T. W. Graham Solomons, Craig Fryhle. John Wiley & Sons 9. a) Stereochemistry: Conformation and Mechanism, b) Organic Reactions And Their Mechanisms. P.S. Kalsi. New age International 10. Organic Chemistry through Solved Problems, Goutam Brahmachari. Edition, Morgan & Claypool	

	11. Organic Name Reactions: A Unified Approach. Goutam Brahmachari. Alpha Science publications

Course: Pharmaceutical Analysis I (CBSGS)					
Course Code: DPC 10	**Second Year B. Pharm**				**Semester:**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Basic chemical concepts relevant to the chemical analysis. Knowledge and understanding of some basic quality control aspects				
Course objectives :	• To make students understand basic of different types of titrimetric analytical chemistry including various methods of preparation, reactions and reagents involved. • To make students aware about role of reagents in different titrimetric analysis.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the principles of different types of titrations for analysis of various compounds	1,6
CO2	Correlate the role and procedure for standardization and assays of important chemicals	1,2,6
CO3	Apply suitable analytical methods for different pharmaceuticals	2,6

Topics covered :

Unit I:	**Introduction to Pharmaceutical Analysis**	**Hours: 4**

1. Scope of Pharmaceutical Analysis, Classification of Quantitative Analytical techniques (Instrumental and Non-Instrumental).
2. **Introduction to pharmacopoeial monograph** - Drug and formulation (As API-Aspirin, Calcium gluconate and Dried aluminium hydroxide gel. formulation-Soluble Aspirin tablets and Calcium gluconate injection).
3. **Types Of Errors –** Determinate and indeterminate: Causes of errors and ways to minimize them.
4. **Concept and numerical of –**Mean, Median, Standard deviation, relative standard

deviation, Absolute and relative errors, precision, accuracy, significant figures.

Unit II:	**Aqueous acid-base titrations.**	**Hours: 7**

1. **Theoretical terms*:*** Titrimetric analysis, Titrant, Titrand, Theoretical end point or equivalence point, end point of titration, Titration error, Conditions for titrimetric analysis, Classification of reactions for titrimetric analysis, *Expression of concentration of Standard solutions*-Molarity-(Analytical and equilibrium molarity), Molality, percent concentration, ppm, ppb, Normality, Primary and Secondary standards.
2. Law Of Mass Action, Equilibrium Constant, Application Of Law of Mass Action to solutions Of Weak Electrolytes, pH, pKa, pKb, hydrolysis of salts (weak base-strong acid, weak acid-strong base, weak acid, weak base), Buffer solutions, Buffer Capacity.
3. **Neutralisation curves-**(strong acid by strong base, weak acid by strong base, weak base by strong acid, and weak acid by weak base).
4. **Neutralisation indicators-**different theories (Ostwald's theory, Resonance theory), Mixed indicators, concept of range of indicators, Choice of indicators.
5. **Methods of titration –**Direct titration, back titration and need, blank determination use, significance (One Example for each type) and concepts of factor calculation for assay.
6. **Problems related to calculation of**- pH and its numericals with respect to neutralisation curve, Strength of Electrolytes (molarity, normality, and milliequivalence), and assay.
7. Applications.

Unit III:	**Non-aqueous titrations**	**Hours: 2**

1. **Theoretical considerations-**Need, Types of non-aqueous solvents (aprotic, protophilic, protogenic, amphiprotic), Characteristics of solvents for non-aqueous titrations (acid-base character, dielectric constant, leveling and differentiating effect), Indicators for non-aqueous titrations, Determination of Bases and Acids (solvent, titrants and indicator used).
2. **Applications**.

Unit IV:	**Complexometric titrations**	**Hours: 3**

1. **Terms-**Complex, complexing agents (Complexones), Chelate, Ligand, Dentate and types, Co-ordination number, Chelating agent, Sequestering agent, Metal – Ligand complex.
2. **Aspects in complex formation with respect to Disodium Edetate-** Dissociation constant, pH, Stability, colouration, titrability of polyvalent metal ions, pM indicators, presence of auxiliary complexing agent, and general structure of complexes formed with di-, tri-, and tetravalent metal ions.
3. **Complexometric titrations:** Direct method, back titration, Replacement titration, Titration of mixture of metal ions, masking agent (auxiliary ligand) and demasking agents, and Titration curve w. r. t Disodium Edetate.

4. **Applications:** Determination of individual cations (aluminium by back titration, nickel by direct titration), determination of mixture of lead, zinc and magnesium in a sample, and assay of calcium gluconate injection.

Unit V:	**Oxidation – Reduction Titrations**	**Hours: 6**

1. **Terms:** Oxidation –Reduction, Oxidising and reducing Agents, Standard Reduction Potential, Nernst Equation, redox titration curve and Equivalence point potential
2. Theory, indicators, and titrants for : Permaganatometry and Cerrimetry, Applications- Assay of hydrogen peroxide solution (Permaganometry), Assay of Ascorbic acid tablets/ Dried Ferrous sulphate, Paracetamol (Cerrimetry).
3. Theory, indicators, and titrants for : Iodometry, Iodimetry, Potassium dichromate, potassium iodate titrations, and Potassium bromate titrations.
4. **Applications-**Assay of hydrogen peroxide solution, Assay of Ascorbic acid API
5. (Iodimetry), Assay of KMnO4 (Back Iodometry), Assay of Potassium iodide (Iodate titration).
6. **Balancing Of Redox Equation-**half cell reaction and net reaction

Unit VI:	**Precipitation Titration**	**Hours: 3**

1. **Theoretical considerations-**Common Ion Effect, Solubilty Product, Factors affecting solubility of precipitates, Fractional precipitation.
2. **Types** Of Precipitation Titration (Argentometric, Non– Argentometric), Argentometric
3. Titration methods -Mohr's method, Volhard's Method and Adsorption Indicator Method.
4. **Applications:** Standardisation of silver nitrate, Assay of NaCl and KCl.

Unit VII:	**Gravimetry**	**Hours: 3**

1. **Theory** mass as measurement signal and precipitation equilibria, **Unit operations** in gravimetric analysis, Organic and inorganic **precipitants,** precipitation from homogeneous solution.
2. **Problems** associated with gravimetric analysis and methods to overcome (coprecipitation and reprecipitation, Ostwald's ripening, degree of supersaturation or von Weimarn ratio, solubility of precipitate, peptisation).
3. **Applications**-Assay of Nickel by dimethylglyoxime, Assay of aluminium by oxine reagent, Assay of Ba+2 as BaSO4.
4. **Numerical related to gravimetric factor.**

Unit VIII:	**Miscellaneous methods**	**Hours: 2**

1. **Oxygen flask combustion method-**technique, apparatus, principle and determination of organically bound halogens, sulphur and phosphorus, **Application**- Diloxanide furoate.
2. **Nitrite titrations-** Concept of external indicator and application- Assay of Sulphacetamide sodium
3. **Determination of nitrogen (Kjeldahl method)-**Technique (direct and indirect

method), reagents & apparatus used, reaction & factor calculation and numerical for estimation of nitrogen.

4. **Application-Assay of Urea (API)**

Unit IX:	**Electro Analytical Techniques:**	**Hours: 6**

1. **Polarography-**
   Apparatus-Construction and working of Dropping mercury electrode (DME), advantages and disadvantages of DME.
   Theory-Current-Voltage curve (Polarogram), supporting electrolyte, Oxygen wave, polarographic maxima, Ilkovic equation, factors affecting limiting current, half wave potential.
   Applications-In brief.
   Pulse polarography-Normal pulse polarography and Differential pulse polarography and square wave polarography)**.**
2. **Amperometry-**DME cell, four types of end points in amperometric titrations, advantages, general applications and Biamperometric titrations**.**
3. **Aquametry by Karl Fischer titration:** principle, composition and stability of KFR, standardization of KFR as per I.P, determination of water in a sample-e.g.Amoxycillin trihydrate.
4. **Coulometry and High Frequency Titration-**Faraday's first law of electrolysis, Current vs Time plot, Cells for coulometric titration and generation of titrant, Types of coulometric methods (potentiostatic and amperostatic), primary and secondary coulometric titrations, advantages of coulometric titrations, and applications in brief
5. **Electrogravimetry-** Theory of electrolysis – constant current electrolysis and constant potential electrolysis, theory of electrogravimetry- Ohm's Law, Faraday's second law of electrolysis, Terminology: polarization, overvoltage, current density, current efficiency, decomposition potential, polarized electrode, types of polarizationconcentration and kinetic, apparatus for electrogravimetric determinations, characteristics of the deposit, factors affecting physical properties of the deposit, applications in brief.

Unit X:	**Liquid-Liquid Extraction**	**Hours: 2**

1. **Terms:** Nernst Distribution law and partition coefficient, Distribution coefficient, Distribution Ratio, Percent extraction or extraction efficiency, Separability factor.
2. **Types-**Single extraction (Batch), Multiple extractions, Countercurrent Distribution and Continuous.
3. **Factors** influencing solvent extraction, Emulsion formation problem in extraction and ways to minimise.
4. Applications.
5. Problems based on distribution coefficient.

Reference material:	1. Practical Pharmaceutical Chemistry by Beckett, A H & Stenlake, J B, 2005, 4th edition, Part I and II, CBS Publishers

	and Distributors, India. 2. A Textbook of Pharmaceutical Analysis by Kenneth A Connors, 2002, 3rd edition, John Wiley and Sons, Canada. 3. Principles of Instrumental Analysis by Douglas A. Skoog, F.James Holler, 1992, 5th edition, Saunders College Publishing, USA. 4. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, 1991, 7th edition, Saunders College Publishing, USA. 5. Analytical Chemistry by Gary D. Christian, 6th edition, John Wiley & Sons, Singapore. 6. Vogel's textbook of quantitative chemical analysis by Mendham J, R.C. Denney, J.D. Barnes, M.Thomas, 2002, th edition, Pearson Education Ltd. 7. Pharmaceutical Drug Analysis by Ashutosh Kar, 2005, 2nd edition, New Age International (P) Ltd Publishers,India. 8. Instrumental Methods of Analysis by Dr. Supriya S. Mahajan, 2010, 1st edition, Popular Prakashan Pvt Ltd, India. 9. Instrumental methods of chemical analysis (Analytical Chemistry) by Gurudeep R. Chatwal and Sham.K.Anand, 2008, 5th revised and enlarged edition, Himalaya Publishing House Pvt Ltd. 10. Indian Pharmacopoeia 11. Instrumental Method of Analysis by Willard H.H.L. L. Merrit & John A. Dean, 1986, 6th edition, CBS Publishers & Distributors, New Delhi. 12. Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists by David G Watson, second edition, Pub: Elsevier, Churchill Livingstone 13. Undergraduate instrumental analysis by J.W. Robinson, E.M. Skelly Frame and G.M. Frame II, Pub. Marcel Deker, 2009 14. Analytical Chemistry, A modern approach to analytical science, second edition, R. Kellnar, J.M.Mermet, M.Otto, M. Valcarcel, H.M.Widner, Pub: WILEY-VCH 15. Analytical chemistry by Open learning Pub: John Wiley and sons: Classical methods Vol. 1 by and Chris Doran Classical methods Vol.2 by John Mendham and Derek Cooper Principles of electroanalytical methods by Tom Riley and Colin Tomlinson Polarography and other voltammetric methods by Tom Riley

	and Arthur Watson

Course: Pharmaceutics – II (CBSGS)					
Course Code: DPH 09	**Second Year B. Pharm**				**Semester: IV**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Prior knowledge of anatomy and physiology, preformulation, physical pharmacy, dispensing pharmacy and basic pharmaceutics. • Have basic understanding of unit processes like drying, mixing, refrigeration covered under the subject of pharmaceutical engineering.				
Course objectives :	To train the learner about various aspects of manufacturing and evaluating disperse systems, semi-solid dosage forms, suppositories, blood products, sutures and ligatures.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the theory, formulation considerations, packaging, quality control and large scale manufacturing of disperse systems like suspensions and emulsions	1,2,4
CO2	Understand the theory, formulation aspects, quality control, packaging, and large scale manufacturing of semi solid dosage forms and suppositories	1,2,4
CO3	Understand the need, problems, procedure and quality control associated with the manufacturing of blood products and sutures and ligatures	1,2,4

Topics covered :		
Unit I:	Disperse Systems: Suspensions and Emulsions	**Hours: 15**

1. Introduction and Physicochemical principles, (Revision) surface & interfacial tension, surface free energy, Gibb's equation , concepts of thermodynamic &

kinetic stability of disperse systems and challenges to formulator, Classification of disperse systems

2. A)Suspensions:- Definition, advantages and disadvantages, desirable features and pharmaceutical applications
   B) Emulsions:-
3. Definition, advantages and disadvantages, pharmaceutical applications Theoretical aspects of Suspensions:-Wetting phenomenon, particle-particle interactions, DLVO theory, flocculated and deflocculated systems, Schulze Hardy rule, Sedimentation in suspensions, Ostwald ripening and crystal factors, Rheology
4. Theoretical aspects of Emulsions:-Need for emulsifier Emulsifiers- mechanisms, droplet stabilization, classification, Selection of emulsifiers-HLB method, Davies method, PIT method, Cloud point method Preparation of suspensions:- Precipitation methods and dispersion method.
5. Formulation additives
6. Preparation of Emulsions-Other formulation additives, rheological aspects, physical stability of emulsions, symptoms of instability
7. Large scale manufacture of emulsions & suspensions, with layout of manufacturing area and equipments for each step Quality control tests for emulsions & suspensions- including stress testing. Examples of official formulations.

Unit II:	Factors influencing skin penetration-physiological and Physicochemical factors, vehicles and penetration enhancers, methods to evaluate skin.	**Hours: 6**

1. Raw materials for semisolids, types of vehicles, ointment bases, pastes, gels, poultice, Formulation additives.
2. Large scale manufacture with equipments involved in each step and layout, Quality control tests.
3. Examples of official formulations.

Unit III:	Suppositories:	**Hours: 7**

1. Introduction, definition, advantages and disadvantages, desirable features of suppositories, factors affecting rectal absorption
2. Suppository bases- specifications and desired features, classification and selection of suppository bases, special bases.
3. Formulation and specific problems involved in formulating suppositories, large scale manufacture with equipments involved in each step, packaging
4. Quality control tests, Examples of official formulations

Unit IV:	Blood products:	**Hours: 6**

1. Need, problems/hazards, blood banking procedures
2. Whole human blood, Red cell concentrate, Platelet concentrate, Plasmapheresis, plasma, serum. Fractionation of plasma, study of some fractions-clotting factors

like fibrinogen, AHF, factor IX complex, prothrombin, albumin preparations, γ globulin preparations. Quality control aspects of blood products 3. Plasma substitutes (plasma volume expanders)- need, desired properties, examples- hydrolyzed gelatin based products, HETA starch, Dextran (in detail – source, preparation, official injections)		
Unit V:	Sutures/ligatures:	**Hours: 4**
1. Definition, classification, cat gut manufacturing and processing, other absorbable sutures-natural & synthetic 2. Nonabsorbable sutures- silk, linen, polyamides, polyesters, polyolefins, and metallic wires. 3. Quality control tests for sutures/ligatures		
Reference material:	1. Lachman Leon, Liberman Herbert A., Kaing Joseph L., "Theory and practice of Industrial Pharmacy" 3rd edition, 1987, Varghese Publishing house, Mumbai. 2. Liberman Herbert A., Rieger, "Pharmaceutical dosage Forms-Disperse Systems", Vol 1/2/3, 2nd Edition,2005, Marcel Dekker Inc., New York. 3. Allen, Loyd V.Jr, "Remingtons- the Science and Practice of Pharmacy, Vol 1/2, 22nd Edition, Pharmaceutical Press 4. Patrik Sinko Ed."Martin's Physical Pharmacy and Pharmaceutical Sciences", 6th Edition, 2010, Lippincott Williams and Wilkins. 5. M.E. Aulton Ed.,"Pharmaceutics-The Science of Dosage Form Design" 3rd Edition, 2007, Churchill Livingstone Elsevier Ltd., UK. 6. E.A. Rawlins Ed., "Bentley's Textbook of Pharmaceutics", 2010, Elsevier Publications. 7. S.J. Carter Ed., "Tutorial Pharmacy-Cooper & Gunn", 6th Edition,1986, CBS Publishers & Distributors, India. 8. Pharmacopeias-IP, BP, USP-latest editions.	

Course: Microbiology (CBSGS)					
Course Code: DAL 06	**Second Year B. Pharm**				**Semester: IV**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE

Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basics concepts in biology like cell, Prokaryotes, Eukaryotes				
Course objectives :	1. To understand various microorganisms with respect to morphology, cultivation which are involved in various infectious diseases 2. Develop foundation to understand advance subjects which deals with various infectious diseases and their drug targets				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Describe salient features and uses of different types of microscopy techniques	1
CO2	Understand morphology, cultivation and reproduction of various classes of microorganisms including bacteria, fungi and viruses, algae, protozoa, chlamydia and rickettsia etc and give overview of some common microbial diseases	1,4
CO3	Explain significance of control of microorganisms; describe the death pattern of microorgansms; principles underlying various techniques of sterilization and apply the knowledge in selecting the most appropriate sterilization technique for commonly used laboratory materials.	1,2

Topics covered :

Unit I:	**Introduction to Microbiology**	**Hours: 2**

1. Brief history, Scope of Microbiology-Basic & Applied, Relevance and Applications in Pharmaceutical Industry

2. Classification of Microorganisms, Procaryotic and eukaryotic microorganisms, Microbes and the environment

Unit II:	**Microscopy**	**Hours: 3**

1. Simple microscope, Compound microscope, resolving power, magnification, angular aperture, numerical aperture, oil immersion objective
2. Dark field microscopy, phase contrast microscopy, fluorescent microscopy, electron microscopy..

Unit III:	**Techniques to study and characterize microorganisms**	**Hours: 2**

1. Staining of microorganisms-Monochrome stain; Negative staining; Differential staining (Gram staining & Acid fast staining), Capsule, Flagella, Cell wall, Spore staining; Study of motility by hanging drop technique
2. Information used to characterize and identify microorganisms (in brief) - morphological, cultural, metabolic, antigenic, pathogenic, genetic

Unit IV:	Bacteria	Hours: 9
1. Morphology, Cell characteristics, Habitat, Nutritional requirements, Cultivation of bacteria, Culture media- Cultivation & Storage media, 2. Enrichment media, Differential media, Assay media, Cultivation of aerobes and anaerobes. 3. Pure culture, Methods to isolate pure cultures, Preservation of cultures 4. Reproduction of bacteria, Growth phases, Measurement of growth, factors affecting growth, continuous cultivation, enumeration of bacteria. 5. Overview of bacterial diseases and the pathogens causing them- Mycobacterium sp., Salmonella sp., Shigella sp., Staphylococci sp., Pseudomonas sp., Klebsiella sp., Clostridium sp		
Unit V:	**Viruses & related microorganisms**	**Hours: 3**
1. Morphological characteristics, Nutritional aspects, Cultivation and reproduction, HIV and Oncogenic viruses. 2. Rickettsiae and Chlamydiae- Morphological characteristics, Cultivation, Rickettsial & Chlamydial diseases.		
Unit VI:	**Major groups of Eucaryotic microorganisms**	**Hours: 7**
1. Fungi-Morphological characteristics, Classification, Reproduction of fungi, Cultivation of fungi, Culture media 2. Study of some important fungi-Penicillium, Aspergillus, Candida, Saccharomyces. Fungal infections-Mycoses 3. Algae - Classification, Morphological characteristics, reproduction, economic significance of algae. 4. Protozoa- Morphological characteristics and classification, reproduction, pathogenic protozoa like Amoeba, Paramecium, Trichomonas, Plasmodium		
Unit VII:	**Control of Micro-organisms**	**Hours: 10**
1. Fundamentals of Microbial Control - Pattern of Death in a Microbial population, Conditions affecting Antimicrobial activity, Mechanisms of microbial cell damage, Survivor curves and concepts of D - value and Z- value. Sterility assurance and Inactivation factor. 2. Sterilization methods & Equipments- Heat Sterilization methods (Moist heat, dry heat, low temperature sterilization methods), Radiation Sterilization (Ionizing and non-ionizing radiations), Filtration Sterilization, Gaseous Sterilization 3. Chemical agents used for control of microorganisms- Terminology of Chemical agents, Ideal properties, Major groups of disinfectants and antiseptics (with mechanisms and applications), Chemical sterilants, Evaluation of potency- Tube dilution & Agar plate methods, Phenol Coefficient technique 4. Introduction to Aseptic techniques (no equipments), Sterilization control and sterility assurance- Various types of sterilization indicators, Test for sterility		

Reference material:	Books: (Latest editions should be referred) 1. M.J. Pelzer Jr., E.C.S. Chan and N.R. Krieg "Microbiology Concepts and Applications" McGrawill, Inc., USA, 1993. 2. M.Frobisher, R.D. Hinsdill, K.T. Crabtree and C.R. Goodheart "Fundamentals of microbiology", 9th Edn. Saunders College Publishing, Philadelphia 1968. 3. W. B. Hugo and A. D. Russel "Pharmaceutical Microbiology" 6th Edn. Blackwell science Ltd. UK, 2003. 4. R. Ananthianarayan and Ck. J. Paniker "Text Book of Microbiology", 7th edn. Orierit Longman Pvt. Ltd. Hydrabad, 2005.

Course: Pharmacology – I (CBSGS)					
Course Code: DPL-05	**Second Year B. Pharm**				**Semester: IV**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	Teacher Student interaction	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Prerequisites :	• Structure of plasma membrane, knowledge of transport mechanisms across membrane • Anatomy and physiology of nervous tissue, central nervous system, autonomic nervous division, cardiovascular system, urinary system and their related diseases. • Physiology of skeletal and smooth muscle contraction, components of neuromuscular junction and physiology of transmission at neuromuscular junction.				
Course objectives :	1. To provide broad understanding of fundamental principles of pharmacodynamics and pharmacokinetics. 2. To give specific insight into the principal pharmacological actions and clinical uses of the drugs acting on autonomic nervous system, cardiovascular system and kidneys.				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**

CO1	Describe the fundamental concepts of pharmacokinetics and pharmacodynamics, explain factors modifying drug action and categorize adverse drug effects	1,3,4,7,8
CO2	Classify major drugs acting on autonomic nervous division into correct therapeutic categories; apply the basics of ANS and explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs	1,3,4,7,8
CO3	Classify major drugs acting on cardiovascular division including diuretics into correct therapeutic categories; correlate the pathophysiology of few common cardiovascular disease to their pharmacotherapy; discuss and explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs	1,3,4,7,8

Topics covered :

Unit I:	**General Principles of Pharmacology**	**Hours: 6**

- Introduction to Pharmacology
- Routes of drug administration with special reference to their advantages and disadvantages.
- Drug Absorption, Distribution, Metabolism & Excretion (ADME)

Unit II:	**Mechanisms of drug action**	**Hours: 4**

- Brief introduction to physiological receptors
- Structural and functional families of receptors
- Mechanisms of drug action:
    - Drug receptor interaction
    - Dose response curve (DRC)
    - Drug antagonism

Unit III:	**Factors modifying actions of drugs**	**Hours: 1**
Unit IV:	**Toxic effects of drugs on different organs and systems.**	**Hours: 2**
Unit V:	**Autonomic nervous system**	**Hours: 12**

- Autonomic neurotransmission
- Parasympathomimetics
- Parasympatholytics
- Sympathomimetics
- Sympatholytics
- Drugs acting on autonomic ganglia
- Skeletal muscle relaxants

Unit VI:	**Cardiovascular system**	**Hours: 10**

- Drugs used in the treatment of:
    - Congestive cardiac failure

o Hypertension o Cardiac arrhythmia o Angina pectoris o Hyperlipoproteinemia		
Unit VII:	**Diuretics**	**Hours: 3**
Reference material:	**Latest edition of following books to be referred:** **1.** Goodman & Gilmans Pharmacological Basis of Therapeutics; Joel. G, Hardmon Lee, E. Limbird, Alfred Goodman Gilman; 11th Ed.; The Mcgraw-Hill Companies, Inc; 2011. **2.** Pharmacology and Pharmaco therapeutics; R.S. Satoskar, S.D. Bhandarkar, Nirmala N. Rege; 20th Ed.; Popular Prakashan; 2007. **3.** Pharmacology; Rang and Dale; 7th Ed.; Churchil Livingstone; 2012. **4.** Lippincott's illustrated reviews: Pharmacology, Lippincott-Raven; 3rd Ed.; Howland & . **5.** Nycets Publishers, N.Y.; 2006. 5. Lewis Pharmacology; Crossland; 5th Ed. Churchill Livingstone. **6.** Clinical Pharmacology- Lawrence, D.R and Bennet- 9th Ed.; Elsevier, N.Y. 2006. 7. **7.** Clinical Pharmacology- B.G. Katzung; 11th Ed.; Appleton & Lange Publications. 2009. **8.** Pharmacology; George M. Brenner, Craig W. Stevens; 2nd Ed.; Elsevier Publishers, 2006.	

Course: Mathematics and Statistics (CBSGS)					
Course Code: DAL07	**Second Year B. Pharm**				**Semester: IV**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basic mathematics covered in secondary and higher secondary school.				
Course objectives :	• To train students in basic statistical calculations				

Course Outcomes: After the completion of course learner will be able to:		PO Mapped
CO1	Solve problems involving mean, median and mode	1
CO2	Solve problems involving measurement of dispersion	1
CO3	Solve problems involving sampling distribution	1
Topics covered :		
Unit I:	**Measurement of Central Tendency: Arithmetic Mean, median and mode**	**Hours: 10**
Unit II:	**Measures of Dispersion**	**Hours: 18**
1) Range, quartile deviation, mean deviation and standard deviation, 2) Coefficients of variation, moments, skewness and kurtosis, generating moments, 3) Probability expectations and variance, 4) Binomial, Poisson and Normal Distributions, 5) Fitting of curves by the method of least squares {Y = a + bX, Y = a + bX + cX2Y = aXb, Y = abX, Y = acbX}		
Unit III:	**Sampling distribution for mean and proportion**	**Hours: 08**
1) Test of hypothesis for specified values of mean and proportion for large samples, 2) Testing equality of two means and proportions, 3) Students "t" test for single sample and paired observation, F-test and analysis of variance, testing of attributes, Chi-square distribution.		
Reference material:	1. Fundamentals of Statistics, Gupta S. C., Himalaya Publication. 2. Mathematics for Pharmacy Students (Vol. I), Gujar K. N., Bhavale Ashok, Career Publicaiton. 3. Measurement, Statistics of Computation, C Cornmich D, John Wiley and Sons. 4. Biostatistics in Pharmaceutical Industry, Buchner R. C., Marcel Decker Inc. 5. Integral Calculus, Shanti Narayan, S. Chand Publication.	

Course: Pharmaceutical Analysis LAB I (CBSGS)		
Course Code: DPC 11	**Second Year B. Pharm**	**Semester: IV**
Type of course : Practical	**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**	**Semester-end assessment**

Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Basic concepts related to the chemical laboratory. • Basic idea of handling chemicals and instruments		
Course objectives :	• To make students understand basic of different types of titrimetric analytical chemistry including various methods of preparation, reactions and reagents involved. • To make students aware about role of reagents in different titrimetric analysis.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the role of different chemicals used for the determination of the strength and percentage purity of pharmaceuticals.	1,2
CO2	Apply suitable analytical methods for different pharmaceuticals	1,4,6
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	1,5

Topics covered :

Unit I:	**Acid-Base titrations:**	**Hours: 4**

1) Assay of Aspirin API (with special emphasis on the test for salicylic acid).
2) Assay of Aspirin tablets.
3) Estimation of Total alkalinity
4) Assay of Benzoic acid.

Unit II:	**Redox titrations:**	**Hours: 4**

5) Assay of hydrogen peroxide solution (Permanganatometry).
6) Assay of Ascorbic acid API (Iodimetry)
7) Assay of Sodium metabisulphite API (Iodometry)
8) Assay of KMnO4 (Back Iodometry)
9) Assay of Ascorbic acid tablets/ Dried Ferrous sulphate/ Ferrous fumarate/ paracetamol (Cerrimetry).
10) Assay of Potassium iodide (Iodate titration)

Unit III:	**Complexometric titrations:**	**Hours: 4**

11) Assay of Calcium gluconate injection.
12) Assay of Zinc sulphate.
13) Assay of Magnesium sulphate.

Unit IV:	**Miscellaneous titrations:**	**Hours: 4**

14) Assay of Sulphacetamide sodium using external indicator.
15) Assay of Soluble Aspirin tablets (Solvent extraction followed by Bromometry-

iodometry).		
Unit V:	**Gravimetric analysis:**	**Hours: 4**
16) Ni2+ using Dimethyl glyoxime/ Al3+ as Al-oxinate. 17) Ba2+ as BaSO4.		
Unit VI:	**Demonstration titrations:**	**Hours: 4**
18) Assay of Pyridoxine hydrochloride/ Sodium benzoate using non-aqueous titration method. 19) Assay of Sodium chloride. 20) Assay of Potassium chloride.		
Reference material:	1. Vogels' Textbook of Quantitative Chemical Analysis by Mendham J, Denney R C, Barnes J D, Thomas N, 2002, 6th Edition, Pearson Education Ltd. 2. the latest edition of the Indian Pharmacopoeia 2010 has to be referred, except for gravimetric analysis.	

Course: Pharmaceutics Lab II (CBSGS)			
Course Code: DPH 10	**Second Year B. Pharm**		**Semester: IV**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Prior knowledge of preformulation, physical pharmacy, dispensing pharmacy and basic pharmaceutics. • Have basic understanding of unit processes like drying, mixing, refrigeration covered under the subject of pharmaceutical engineering.		
Course objectives :	To orient the students with the formulation and quality control tests of disperse systems and semi-solid dosage forms and suppositories		
Course Outcomes: After the completion of course learner will be able to:			**PO Mapped**
CO1	Select ingredients, formulate and perform quality control test of disperse systems like suspensions and emulsions		1,2

CO2	Select ingredients, formulate and perform quality control test of semi-solid dosage form and suppositories	1,2
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3

Topics covered :

Unit I:	**SUSPENSIONS:**	**Hours: 10**

(a) Antacid Suspension (Aluminium Hydroxide gel I.P' 2010/ Magnesium hydroxide oral suspension I.P' 2010)
(b) Paracetamol Suspension
(c) Calamine Lotion I.P' 2010
(d) Microscopic evaluation, rheology and sedimentation rate studies for any one of the above suspensions.

Unit II:	**EMULSIONS:**	**Hours: 12**

(a) Liquid Paraffin Emulsion I.P ' 2010
(b) White Liniment B.P.C, 73
(c) Turpentine Liniment I.P ' 66
(d) Benzyl Benzoate Application I.P ' 2010
(e) Microscopy of any one of the above emulsion

Unit III:	**OINTMENTS:**	**Hours: 10**

(a) Simple Ointment I.P ' 66
(b) Sulphur ointment I.P ' 66 (Microscopic evaluation)
(c) Emulsifying ointment I.P ' 66
(d) Compound Benzoic acid ointment I.P' 2010 in emulsifying ointment base
(e) Iodine ointment, Non – staining B.P.C 68
(f) Iodine ointment, Non – staining with methyl salicylate B.P.C 68

Unit IV:	**CREAMS:**	**Hours: 2**

(a) Cetrimide cream I.P' 2010

Unit V:	**GELS:**	**Hours: 2**

(a) Diclofenac sodium gel

Unit VI:	**PASTES:**	**Hours: 2**

(a) Titanium dioxide paste B.P.C' 73

Unit VII:	**SUPPOSITORIES:**	**Hours: 2**

(a) Indomethacin Suppositories I.P' 2010

Reference material:	1. Relevant editions of Indian Pharmacopoeia, British Pharmaceutical Codex. 2. Lachman Leon, Liberman Herbert A., kaing Joseph L., "Theory and practice of Industrial Pharmacy" 3rd edition, 1987, Varghese Publishing house, Mumbai. 3. Allen, Loyd V.Jr, "Remingtons- the Science and Practice of Pharmacy, Vol 1 / 2, 22nd edition,

	Pharmaceutical Press.

Course: Pharmacology Lab. – I (CBSGS)			
Course Code: DPL- 06	**Second Year B. Pharm**		**Semester: IV**
Type of course : Practical	**Contact 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semesterend assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Prerequisites :	• Basic knowledge of biology, knowledge of dose response relationship and drug-receptor interaction, concept of agonist, antagonist; types of antagonism. • Physiology of muscle contraction, regulation of heart rate and force of contraction		
Course objectives :	1. To introduce students to experimental pharmacology. 2. To develop skills for performing *in-vitro* pharmacological experiments. 3. To enable students to correlate the experimental findings to theoretical concepts.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Demonstrate understanding of care and ethics involved in using animals for experimentation and describe the salient features and experimental uses of common laboratory animals	1,2,3,4,7,8
CO2	Explain concepts of experimental pharmacology, skillfully handle isolated tissues, record and interpret dose response curves	1,2,3,4,7,8
CO3	Comment on potency and efficacy of drugs, dose response relationship; identify potentiating and antagonizing drugs by studying dose response curves; Identify the drug/ion by studying the responses produced on heart and eye and explain the mechanism of action of said drugs	1,2,3,4,7,8
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3,4,5,7,8
Topics covered :		
Unit I:	**Dose response curve (DRC) of Ach using suitable isolated tissue preparation (e.g. Cock ileum)**	

Unit II:	**Demonstrations:**	
• Effect of drugs on isolated frog heart (CDs) • Adrenaline, ACh, Atropine, propranolol • Effect of excess calcium and potassium on isolated heart • Effect of lack of calcium and potassium on isolated frog heart • Effect of digitalis on hypodynamic heart		
Unit III:	**Simulated experiments (CDs**	
• Effect of drugs on eye • Effect of drugs on GI motility		
Unit IV:	**Demonstration with the help of CDs or kymograph recordings:**	
• Effect of neostigmine on DRC of Ach • Effect of pancuronium on DRC of Ach (Give the readings to the students and ask them to plot the graphs and draw conclusions from the results eg. Identify type of antagonism existing between two drugs by studying the nature of the graphs, competitive and non competitive. Find out the potency of the drugs by studying the DRC and determining IC50 values) Calculation of pA2 value of atropine using Ach as an agonist.		
Unit V:	**Tutorials**	
• Laboratory animal handling • Care and ethics in animal experimentation		
Reference material:	**Books: Latest editions of following books to be referred:** **1.** Kulkarni, S.K. Handbook of Experimental Pharmacology; 3rd Ed.; Vallabh Prakashan, New Delhi. 2005. **2.** Gosh M.N. Fundamentals of Experimental Pharmacology, 3rd Ed.; Hilton & Company, Calcutta. 2005. **3.** S.B. Kasture A Handbook of Experiments in PreClinical Pharmacology 1st Ed.Career Publications. 2006. **4.** W.I.M. Perry, Pharmacological Experiments on Isolated Preparations. 2nd Ed.; E & S Livingstone,bEdinburgh & London, 1970.	

Course: Microbiology (CBSGS)		
Course Code: DAL 08	**Second Year B. Pharm**	**Semester: IV**
Type of course : Practical	**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**	**Semester-end assessment**

Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Basics terminology and theoretical concepts in microbiology		
Course objectives :	1. Develop understanding and skills of identification and cultivation of bacteria based on different morphological characteristics 2. Develop skills of aseptic techniques		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand basic microbiological lab techniques like microscopy, staining, sterilization, and aseptic techniques.	1
CO2	Acquire technical skills of identification , isolation and cultivation of pathogenic bacteria	1
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management.	3

Topics covered :	
Unit I:	Study of microscope and common laboratory equipments.
Unit II:	Gram Staining
Unit III:	Monochrome staining
Unit IV:	Negative staining
Unit V:	Cell wall staining
Unit VI:	Spore staining
Unit VII:	Capsule staining
Unit VIII:	Motility by hanging drop technique
Unit IX:	Preparation and sterilization of nutrient broth, agar slants, plates and inoculation techniques.
Unit XI:	Isolation of pure culture by pour plate and streak plate methods. Colony characterization and growth patterns in broth of cocci and bacilli.
Unit XII:	Total counts by Breeds smear method
Unit XIII:	Growth by optical density, total plate count
Unit XIV:	Study of yeast, Aspergillus and Penicillum with respect to morphology
Unit XV:	Observation on prepared slides of malarial parasites in blood smear, intestinal amoeba in stools.
Reference material:	Books 1. C. R. Kokare “Pharmaceutical Microbiology Experiments and Techniques”, Career Publication, Nashik. 2. R. S. Gaud and G. D. Gupta “Practical Microbiology”, Nirali prakashan, Pune.

	3. C. H. Collins, Patricia M. Lyne, J. M. Grange "Microbiological Methods "7th Edn. Butterworth- Heinemann Ltd Oxford, London

Third Year B. Pharm:
Semester V

Course: Organic Chemistry-III (CBSGS)					
Course Code: DPC 12	**Third Year B. Pharm**				**Semester: V**
Type of course: Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tool:	Periodic Theory test	Attendance	Quizzes	Teacher - Student interaction	End semester Examination
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basic concepts of aromaticity. Stereochemistry and stability pattern of cyclohexane. • Students should know various reagents used in common organic reactions.				
Course objectives :	• To make students aware about heterocyclic rings including its nomenclature, nature, synthesis and reactions. • To make students understand pericyclic reactions. • To make students understand importance of synthon approach and applications of catalysis in industry. • To make students familiar with different steroids, basic ring nucleus and stereochemical aspects.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand chemistry and synthesis of heterocyclic rings, role of organometallics and catalysis in industry and also learn stereochemical aspects and stability parameters of steroids.	1
CO2	Grasp and evaluate basic concepts involved in synthon approach and choose best possible route for synthesis.	1,2
CO3	Recognize the reaction from experimental conditions and transform one functional group to other.	1
CO4	Rank stability and reactivity behavior of steroid nucleus and heterocyclic rings.	1,2

Topics covered :		
Unit I:	**Heterocyclic Chemistry**	**Hours:**

		27
Nomenclature of mono, bi- and tri-cyclic hetero-aromatic, fused heterocyclic ring and bridge head system of the drug molecules. 2 Synthesis, properties and reaction of the heterocycles –Furan, pyrrole, thiophene, imidazole, pyridine,pyperidine,quinolone,isoquinolin		
Unit II:	**Pericyclic Reactions**	**Hours: 10**
HOMO and LUMO of pi systems, molecular orbitals and pericyclic reactions, concerted and pericyclic reactions. Electrocyclic reactions and stereochemistry, Woodward Hoffmann rule [4n and 4n+2] (conrotatory and disrotatory),Diel's Alder, Retro Diel's Alder. 2.3 Cycloaddition: 2π+2πand 4π+2π. Sigmatropic rearrangement: rearrangement, 3,3-rearrangements (Cope and Claisen).		
Unit III:	**Synthon Approach**	**Hours: 6**
Definition of reterosynthesis or disconnection approach, synthon, synthetic equivalent, functional group interconversion, functional group addition, functional group removal. Strategies for disconnection approach. Disconnection of simple alcohols, alkyl halide, ethers, olefins, esters, carboxylic acids, aryl ketones,heterocyclics ring. Design of retrosynthesis of some drugs		
Unit IV:	**Chemistry of Steroids**	**Hours: 7**
Definition of steroids and sterols, numbering and ring letters, orientation of projection formulae, stereochemistry of ring junction and side chain attachments, stereochemistry of substituents in the side chain. Types of steroid hormones:, androgens, estrogens, progestins, corticosteroids. Structure and synthesis of steroids, squalene, cholesterol, pregnenolone Conformation and chemical reactivity, steroid specific reactions of A and B rings, Addition-elimination, epoxide opening, relative rates of esterification, oxidation of epimeric alcohols, reduction of ketones.		
Unit V:	**Application of Catalysis in Organic Chemistry**	**Hours: 10**
Role of catalysis and its development -Classical and non-classical organic synthesis with examples like hydroquinone, amino acid ester synthesis. Catalysis by solid acid-base and its application in Friedal Craft reaction, Beckmann rearrangement, H-USY as solid acid catalyst and hydrocalcite base catalyst, application of base catalyst in condensation reactions. Catalytic hydrogenation and application in chemoselective synthesis of saquinavir intermediate, zeolite based MPV reduction. Catalytic oxidation by stable free radical and application in progesterone synthesis, application in sigmatropic reaction e.g. citral, catalytic oxidation with H2O2 under phase transfer catalysis. Catalytic C-C bond formation and its application in lozabemide, naproxen and in synthesis of biaryl compounds by Suzuki, Negishi, Kumada coupling. Biocatalysis and its significance, applications in 6-APA, aspartame, heteroaromatic		

oxidation mediated by yeast, vitamin B-6. Enantioselective catalysis and application in menthol synthesis. Application of catalysis in sustainable technology: Concept of E-factor and atom efficiency	
Reference material:	**Following books can be refered foe reference.** 1. I. L. Finar: Organic chemistry- Volumes 1 and 2, Pearson Education, Ed:5 2. Morrison and Boyd, Organic chemistry, Prentice Hall. 3. Clayden and Greeves, Organic chemistry, Oxford University Press. 4. S. H. Pine et al, Organic chemistry, McGraw-Hill Science/Engineering/Math. 5. S. Warren, Designing organic synthesis, and the disconnection approach, Wiley India Pvt. Ltd. 6. Corey and Chelg, The logic of chemical synthesis, JOHN WILEY & SONS, New York. 7. R. P. Iyer and A. Prabhu, Synthesis of drugs : A synthon approach.8. D. Lednicer: Steroid chemistry at a glance, Wiley. 9. I. Arends, R. Sheldon, U. Hanefeld, Green chemistry and catalysis, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheimpp 1-48. 10. J.G. Vries, A.H M. Vries, Innovations in pharmaceutical technology, Chemical Technology. 11. C. A. Busacca, D. R. Fandrick, J. J. Song, and C. H. Senanayakea, Adv. Synth. Catal. 2011, 353, 1825 – 1864 " The growing impact of catalysis in the pharmaceutical industry- Review"

Course: Cosmeticology (CBSGS)					
Course Code: DPH 11	**First Year B. Pharm**				**Semester: V**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-	• Prior knowledge of suspensions, Semi-solid formulation and large				

requisites :	scale processing. • Foundations in chemistry, anatomy, biochemistry, microbiology and pharmaceutics	
Course objectives :	To familiarize the learner with different cosmetic products, with respect to their raw materials, manufacturing, safety, performance and packaging.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Classify the different ingredients, use appropriate raw materials, processes and equipment for the formulation of skin care, personal care including oral care, hair care including shaving products, herbal cosmetics and baby toiletries.	1,
CO2	Classify the different ingredients, use appropriate raw materials, processes and equipment for manufacture of coloured cosmetics.	1,2
CO3	Understand regulatory and quality guidelines with respect to cosmetic and toiletry products including microbiological and toxicological testing.	2,8
Topics covered :		
Unit I:	**General Aspects in Cosmeticology**	**Hours: 11**
Definition of cosmetics, historical background, classification. Structure of skin, hair, nails, teeth. Regulatory aspects- Schedules to Drug and Cosmetics Rules - M II,S, Q. Raw materials including colours, perfumes, antioxidants, preservatives and water, herbal products Microbiological aspects of cosmetics. Toxicology of cosmetics-irritation and sensitization reactions to cosmetics, sensitivity testing and safety aspects.		
Unit II:	**Skin care products - raw materials, formulation, large scale manufacturing and quality control (including BIS) and functional evaluation**	**Hours:7**
Skin creams and lotions - Cleansing, cold, vanishing, moisturizing, hand and body products, face packs. Sunscreen, suntan and anti-sunburn preparations. Protective preparations-Barrier products, anti-acne, anti-wrinkle, bleach products		
Unit III:	**Colored cosmetics products- raw materials, formulation, large scale manufacturing and quality control (including BIS).**	**Hours: 8**
Foundation, face powders. Rouge, Eye makeup products. Lipsticks. Nail speciality products-cuticle softener, nail bleach, nail strengthener, Nail whites. Nail lacquer.		
Unit IV:	**Hair care products -raw materials, formulation, large scale manufacturing and quality control (including BIS)**	**Hours: 7**

	and functional evaluation.	
Shampoos (including antidandruff and antilice), Hair grooming, hair waving, hair straighteners and conditioners. Hair colorants. Depilatories.		
Unit V:	**Shaving preparations raw materials, formulation, large scale manufacturing and quality control (including BIS) and functional evaluation.**	**Hours: 4**
Wet shaving preparations-foaming and brushless. Dry shaving preparations and after shave products.		
Unit VI:	**Oral and personal hygiene products - raw materials, formulation, large scale manufacturing and quality control (including BIS) and functional evaluation.**	**Hours: 8**
Toothpaste, medicated toothpaste. Toothpowder, Mouthwashes and denture cleansers. Bath products-shower gels, body washes, bubble washes, bath salts. Antiperspirants and deodorants, insect repellants. Baby toiletries - Oils, creams & lotions, shampoos, powders		
Reference material:	1. Harry's Cosmeticology Edited by J. B. Wilkinson and R. J. Moore, Longman Scientific & Technical Publishers 2. Cosmetics Science and Technology, Edited by M. S. Balsam, E. Sagarin, S. D. Gerhon, S. J. Strianse and M. M. Rieger, Volumes 1,2 and 3.Wiley-Interscience, Wiley India Pvt. Ltd. 3. Poucher's Perfumes, cosmetics & Soaps, Editor- Hilda Butler, Klewer Academic Publishers, 4. Netherlands 5. Cosmetic Technology, Ed. By S. Nanda, A. Nanda and R. Khar, Birla Publications Pvt. Ltd., New Delhi 6. Handbook of Cosmetic Science and Technology, edited by M. Paye, A. O.Barel, H. I. Maibach, Informa Healthcare USA, Inc. 7. Encyclopedia of Pharmaceutical Technology, Vol. 6, Eds. James Swarbrick, James C. Boylan, Marcel Dekker Inc. **8.** BIS Guidelines for different cosmetic products.	

Course: Pharmaceutical Biotechnology (CBSGS)		
Course Code: DAL 09	**Third Year B. Pharm**	**Semester: V**
Type of course : Theory	**Contact Hours: 3 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**	**Semester-end assessment**

Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**

Pre-requisites :	• Basic knowledge in concepts of microbiology • Knowledge of basic biochemistry of enzymes and nucleic acids-DNA and RNA • Fundamental knowledge about immune system organs and cells.
Course objectives :	• To provide insight into to topics such as Microbiological assays and Microbial limit tests, Fermentation Technology, r-DNA technology • To introduce the students to topics such as techniques used in molecular biology, Enzyme and cell immobilization, Immunology, Vaccines & Sera, Cell culture (plant and animal)

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand Microbiological assays and limit tests, applications of fermentation technology in pharma industry	1,6
CO2	Aquire Basic knowledge about immunology, serological tests, immune disorders and vaccine preparations	1,6,8
CO3	Have brief insight into recombinant DNA technology and its applications, and important techniques involving DNA, concept of gene therapy and transgenic plant and animals	1,6,8
CO4	Understand basic concepts in plant and animals cell culture and pharmaceutical application of cell cultures; and review the techniques for enzymes immobilization and its applications	1,6

Topics covered :

Unit I:	**Introduction to Biotechnology**	**Hours: 04**

1. Definitions, scope, relevance to Pharma Industry.
2. Microbiological limit tests – Need, standards for raw materials of natural origin (Pharmacopoeial with some examples)
3. Microbiological assays - Diffusion bioassays, turbidometry, end point assays.

Self study : Historical perspectives

Unit II:	**Fermentation Technology**	**Hours: 07**

1. Example of products of fermentation (microbial, animal and plant),
2. Types of fermenters (mechanically stirred, air-lift, tray),
3. Design of fermenter,
4. Factors affecting fermentation (innoculum preparation, temperature, pH, media composition, aeration, agitation, antifoam agents, strain optimization, growth kinetics)
5. Down stream process. Production of penicillin, single cell protein.

Self study : Production of dextran, tetracycline, amylase

Unit III:	Recombinant DNA technology	Hours: 11
1. Steps involved in rDNA technology, 2. Enzymes involved in DNA technology with reference to restriction endonucleases and ligase, 3. Vectors (Plasmid, Cosmid, YAC), 4. Gene expression/Host- (Bacterial expression system, yeast expression system, animal expression system, plant expression system) 5. Application of rDNA technology for production of pharmaceutical products e.g. Insulin. Self study : Production of human growth hormone, interferon. Preparation of a list of approved biotech derived products.		
Unit IV:	**Techniques used in molecular biology**	**Hours: 09**
1. Introduction to polymerase chain reaction, 2. DNA sequencing (Sanger, Maxam and Gilbert), RFLP, DNA fingerprinting, 3. cDNA library, gene library, Southern blotting technique, Northern blotting, Western blotting, 4. Introduction to gene therapy, transgenic animal and transgenic plants. Self study: SDS- PAGE.		
Unit V:	**Enzyme and cell immobilization**	**Hours: 06**
1. Methods for enzyme immobilization (adsorption, covalent binding, entrapment, microencapsulation) with examples and applications. 2. Introduction to biosensor and applications e.g. glucose oxidase, penicillinase		
Unit VI:	**Immunology**	**Hours: 15**
1. Host-microbe interactions, Introduction to terms-infection, infestation, pathogen, resistance, susceptibility etc. 2. Factors affecting pathogenicity and infection, 3. Innate defense mechanism – first line of body defense, physiological phenomena-inflammatory response, fever, cellular, mediators; soluble (humoral) mediators, phagocytosis. 4. Specific defense Mechanism – Characteristics, Antigen, Cell-mediated immunity, humoral immunity. 5. Antibody structure and types, pathways of immune response, clonal selection theory. Self study: organization of immune system-organs & cells involved. 6. Serology-Precipitation , agglutination, complement fixation tests, immunofluoroscence, RIA, ELISA. Introduction to Hypersensitivity & Allergy. 7.Immunodeficiency states- Primary & acquired, autoimmunity. Hybridoma technology – Production and application of monoclonal antibodies.		
Unit VII:	**Vaccines & Sera**	**Hours: 04**
1. Definitions and classification, 2. Outline of general method of preparation of bacterial & viral vaccines, typical		

examples of each type (diphtheria,TAB, polio), antisera (antitetanus sera) Q. C. aspects, 3.Recent trends in vaccines (recombinant vaccines) Self study: Outline of general method of preparation of BCG and rabies vaccine		
Unit VIII:	**Cell culture (plant and animal)**	**Hours: 04**
1. Tissue culture media, primary cell culture, continuous cell culture, 2. Pharmaceutical applications of animal cell culture. 3. Stem cell culture, cryopreservation/stem cell bank Self study: Media and media composition (typical) for plant and animal cell culture, names of commonly used animal cell lines, their tissue origin and typical applications		
Reference material:	Latest editions of the following books to be adopted. 1. R. C. Dubey , A textbook of biotechnology 2. B. D. Singh, Biotechnology. 3. S. P. Vyas and Dixit, Pharmaceutical Biotechnology, CBS publisher & distributers. 4. S. S. Kori , Pharmaceutical Biotechnology. 5. H. D. Kumar, Biotechnology, Affiliate East-West press Pvt. Ltd New Delhi. 6. Ananthnarayan, A textbook of microbiology, Orient Longman Pvt. Ltd. 7. W. B. Hugo and A. D. Russell, Pharmaceutical Microbiology, Blackwell Science. 8. David, Nelson, Lehninger - Principle of Biochemistry, W. H. Freeman & Co. 9. Pelezar, Chan & Krieg, Microbiology-Concepts and Applications, International Edn., McGraw Hill, Inc., 10. Weir Stewart: Immunology, Churchill Livingstone. 11. Chandrakant Kakote, Pharmaceutical Biotechnology. 12. Desmond S.T. Nicholl, An introduction to genetic engineering, Panima Publishing Corporation, New Delhi.	

Course: Pharmacology – II (CBSGS)					
Course Code: DPL 07	**Third Year B. Pharm**				**Semester: V**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE

Max. Marks:	**15**	**5**	**5**	**5**	**70**

Pre-requisites :	• Understanding of general principles of pharmacology • Basic knowledge of pathogenic microorganisms and common infections • Anatomy and physiology of endocrine and reproductive system and their related diseases. • Basic knowledge of immune system and signaling involved in immune responses • Basics of composition and functions of blood, role of haemoglobin, pathophysiology of anemia and physiology of clotting
Course objectives :	1. To give specific insights into the principal pharmacological actions and clinical uses of chemotherapeutic agents, immunomodulators, drugs acting on endocrine system and hematological system.

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Classify chemotherapeutic agents; explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs	1,3,4,7,8
CO2	Classify immunomodulators and drugs used in disorders of endocrine system into correct therapeutic categories; correlate the pathophysiology of few common endocrine diseases to their pharmacotherapy; explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs	1,3,4,7,8
CO3	Classify drugs used in disorders of hematological system into correct therapeutic categories; correlate the pathophysiology of few common disorders of hematological system to their pharmacotherapy; discuss and explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs	1,3,4,7,8

Topics covered :

Unit I:	**Chemotherapy**	**Hours: 30**

- Introduction to chemotherapy including drug resistance.
- Sulfonamides, trimethoprim, fluoroquinolones, nitrofurantoin, Penicillins, cephalosporins and cephamycins, Tetracyclines, chloramphenicol, macrolides, clindamycin, linezolid, streptogramins and fusidic acid, Aminoglycosides and spectinomycin
- Antifungal agents

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<tr><td colspan="3">

Antiviral agents including anti-HIV agents.
Chemotherapy of tuberculosis, leprosy, and malaria.
Chemotherapy of amoebiasis.
Anthelmintic drugs.
Chemotherapy of neoplastic diseases (Anticancer drugs).
SELF STUDY:

Rational use of antimicrobials. General principles of chemotherapy of infection.

</td></tr>
<tr><td>Unit II:</td><td>Immunomodulators</td><td>Hours: 09</td></tr>
<tr><td colspan="3">

Immunology:

Regulation of immune system,
Signalling pathways for its activation and inhibition.
Immunostimulants and immunosuppressants.
Immunomodulators in the treatment of HIV and Cancer.

SELF STUDY:

Physiology of immune system

</td></tr>
<tr><td>Unit III:</td><td>Drugs in Endocrine Disorders</td><td>Hours: 11</td></tr>
<tr><td colspan="3">

Thyroid and anti-thyroid drugs.
Insulin, antidiabetic agents including DPP-IV inhibitors.
Agents affecting bone mineral homeostasis.
Oxytocics
Oral contraceptives
SELF STUDY:

Corticosteroids

</td></tr>
<tr><td>Unit IV:</td><td>Drugs in Haematological Disorders</td><td>Hours: 10</td></tr>
<tr><td colspan="3">

Drugs used in anemia.
Coagulants and anti-coagulants.
Thrombolytics and anti-platelet agents.
SELF STUDY:

Physiology of blood coagulation.

</td></tr>
<tr><td>Reference material:</td><td colspan="2">Latest editions of the following books to be adopted:
1. Goodman & Gilman’s Pharmacological Basis of Therapeutics, McGraw Hill Companies Inc.
2. Satoskar R.S. Bhandarkar S.D. & Rege N. N. Pharmacology & Therapeutics, Popular Prakashan.
3. Rang & Dale Pharmacology, Churchill Livingstone.
4. Lippincott’s Illustrated Reviews: Pharmacology- Lippincott-Raven Howland & Nyeets Publishers NY.
5. Laurence D. R. & Bennett Clinical Pharmacology, Elsevier NY.
6. Kulkarni S. K. Handbook of Experimental Pharmacology, Vallabh</td></tr>
</table>

	Prakashan, New Delhi. **7.** Katzung B. G. -Basic and Clinical Pharmacology, Appleton and Lange publications. **8.** Ghosh M. N. Fundamentals of Experimental Pharmacology Hilton & Company, Kolkata.

Course: Pharmaceutical Management (CBSGS)					
Course Code: DAL 10	**Third Year B. Pharm**				**Semester: V**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Knowledge of pathophysiology, Pharmacology and pharmaceutical dosage forms • Communication skills and Presentation Skills				
Course objectives :	1. To introduce the concept of management to the learner 2. To impart skills for applying concepts of pharmaceutics and pharmacology along with disease knowledge inorder to design marketing plan and strategies to get market share of any particular product 3. To impart information about the Inventory control, concept and techniques to improve production in packaging, marketing, sale and accounting.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Have basic information about pharmaceutical industry	4
CO2	Understand the principles of management with reference to pharma industry	5
CO3	Understand Financial management and marketing and sales	4

Topics covered :		
Unit I:	**Understanding of health care industry**	**Hours: 05**
• Different components of health care industry/ What constitutes health care		

industry • Indian pharmaceutical industry (in today's scenario and its potential as your career option) • Details of therapy segment, major companies and major brands • Elements of pharmaceutical industry in order to understand its working uniqueness of medical products marketing-C&F agent, stockist & retailer/chemist. • Different working style of acute, chronic and OTC therapy segment		
Unit II:	**Financial Management**	**Hours: 02**
• Understanding basic concept of market share, growth, profitability • Basics of balance sheet and profit and loss account		
Unit III:	**SWOT analysis**	**Hours: 03**
• Basic concept SWOT analysis • Application of SWOT analysis considering any therapeutic class of a drug		
Unit IV:	**Brand Plan**	**Hours: 04**
• Importance of brand plan • Basic elements of a brand plan		
Unit V:	**Identifying Market Segments and Targets (STP)**	**Hours: 03**
• Segmentation: Geographic, demographic, psychographic and behavioural • Targeting: Effective segmentation criteria, evaluation and selection of market segment • Positioning: Understanding the importance of positioning based on indication with live examples from pharmaceutical industry		
Unit VI:	**Product Life Cycle (PLC)**	**Hours: 04**
• Importance of PLC • How to manage product at different stages of PLC		
Unit VII:	**4 P's of Marketing Mix (Product, Price, Promotion, Place)**	**Hours: 03**
• Product: Different types of pharmaceutical products (acute, chronic and OTC) • Pricing: How to determine the pricing of products, determination of NRV (Net Retail Value) and MRP (Maximum Retail Price) • Place: All India, Hospitals, Govt./ Corporate purchasers, ESIS schemes, NGOs. • Promotion: direct distribution, direct home delivery, dispensing, scheme, etc. • Packaging: importance of packaging in pharmaceutical products, types of packing and its importance.		
Unit VIII:	**Important Marketing models**	**Hours: 04**
• BCG matrix • Porter's 5 force model		
Unit IX:	**Soft skills and self-development**	**Hours: 02**

• Human resource management: Leadership, motivation, delegation, conflict management and communication, time management, multitasking, planning and organizing and stress management • Skills to excel in interview: dress code, body language and handling difficult situations, dos and donts of resume making (Self Study)		
Unit X:	**Pharmaceutical quality and legal regulatory bodies**	**Hours: 06**
• DPCO- meaning and its role • Quality management: FDA regulations and approvals, WHO requirements • General awareness of Global requirements of MHRA/ MCA/ TGA/ USFDA/ ISO up gradation/ Six sigma concept • Clinical research, patent registration and IPR		
Unit XI:	**Case Studies**	**Hours: 05**
Unit XII:	**Presentations**	**Hours: 04**
Reference material:	**Latest editions of the following books to be adopted:** 1. Kotler, Loshy&Jha, Marketing Management. 2. Dr. RajanSaxena, Marketing Management. 3. Adrian Palmer, Introduction to Marketing Management. 4. Prasanna Chandra, Financial Management. 5. M. Pandey, Financial Management. 6. K. Ashwathapa, Human Resource management. 7. Subba Rao, Personnel & Human Resource Management. 8. K. Ashwathapa, Production & Operations Management. 9. S. N. Chary, Production & Operations Management. 10. S. A. Chunawala, Production & Operations Management. 11. Ronald Ballon, Business Logistics/ Supply Chain Management. 12. Robert Hanfiels, Introduction to Supply Chain Management.	

Course: Organic Chemistry Lab II (CBSGS)			
Course Code: DPC 13	**Third Year B. Pharm**		**Semester: V**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**

Pre-requisites :	Basic organic chemistry theoretical aspects. All the procedures for identification of compounds.	
Course objectives :	• To make student understand different separation techniques used for isolation of organic compounds. • To make students aware about derivative preparation and its importance in identification of compounds. • To introduce students regarding recrydtalliosation techniques and develop practical hands for the same.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand different techniques for separation of binary mixture and importance of derivative preparation in identification of compounds.	1,2
CO2	Acquire the basic concepts and practical skills of qualitative tests to identify the components.	1,2
CO3	Demonstrate proper planning for execution of experimental set up and conclude the findings with proper flow.	3
Topics covered :		
Unit I:	Separation and quantification of binary mixtures by physical and chemical methods. Identification of one component and confirmation by preparation of a suitable derivative. Minimum eight binary mixtures, covering a wide variety of types to be studied	
Unit II:	Theoretical aspects of recrystallization	
Unit III:	Recrystallization of organic compounds: at least two with the use of different solvents.	
Reference material:	**Following books can be referred.** 1. A laboratory hand book of organic qualitative analysis and separation, V.S. Kulkarni, S. P. Pathak, D.Ramchandra & Co., Pune. 2. Text book of organic practical chemistry, V.S. Kulkarni, S. P. Pathak, D. Ramchandra & Co., Pune. 3. R. L. Shriner, R. C. Fuson and D. Y. Curtin, The systematic Identification of Organic compounds, 6thEd., Wiley, New York, 1980. 4. A. I. Vogel, A textbook of practical organic chemistry, 4th edition, Wiley New York, 1978. 5. Comprehensive Practical Organic Chemistry: Qualitative Analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India) Limited, 2000. 6. Comprehensive Practical Organic Chemistry: Preparation and Quantitative analysis, V.K. Ahluwalia, Renu Aggarwal, Universities Press (India) Limited, 2000.	

Course: Pharmaceutical Biotechnology Lab (CBSGS)			
Course Code: DAL21	**Third Year B. Pharm**		**Semester: V**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Basic idea about sterility and handling of micro-organisms • Basic Knowledge about microbiology		
Course objectives :	**1.** Acquire basics of microbiological tests and assays and knowledge of advanced techniques of biotechnology		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the principles behind various microbiological tests and assays and interpret the results for the same.	1
CO2	Acquire advanced techniques of biotechnology such as immobilization, DNA isolation and gel electrophoresis	1
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management.	3

Topics covered :		
Unit I:	Air microbiology by solid and liquid impingement methods.	**Hours: 4**
Unit II:	Coliform count of water by MPN technique.	**Hours: 4**
Unit III:	Test for sterility as per IP (Injection water/ nonabsorbent cotton/ soluble powder/ear drops).	**Hours: 4**
Unit IV:	Microbial limit test on excipients as per I.P. – Hard gelatin, tragacanth, starch, lactose	**Hours: 4**
Unit V:	Studies on selective media: McConkey Agar, Cetrimide Agar, Vogel Johnson, Salt mannitol agar.	**Hours: 4**
Unit VI:	Antibiotic sensitivity test by disc method.	**Hours: 4**
Unit VII:	Widals test tube agglutination method	**Hours: 4**
Unit VIII:	Biochemical tests (Catalase, Oxidase, Urease, Nitratase, Protease, Amylase and IMVIC).	**Hours: 4**
Unit IX:	Antimicrobial assay of antibiotic, introduction to zone of inhibition and calculation.	**Hours: 4**

Unit XI:	Immobilization of enzymes/cells by calcium alginate/gelatin/agar.	**Hours: 4**
Unit XII:	Isolation of DNA.	**Hours: 4**
Unit XIII:	Selection and isolation of bacteria by replica plating.	**Hours: 4**
Unit XIV:	Determination of thermal death time and thermal death point.	**Hours: 4**
Unit XV:	Effect of Ultra-Violet exposure on growth of E coli.	**Hours: 4**
Unit XVI:	Demonstration of electrophoresis either by PAGE or Agarose gel electrophoresis.	**Hours: 4**
Reference material:	**1.** Medical Laboratory Technology: A Procedure Manual for Routine Diagnostic Tests (Vols. I, II & III), Kanai L. Mukherjee (Chief Editor), Tata McGraw Hill Publishing Company Ltd., New Delhi. **2.** An Introduction to GENETIC ENGINEERING, 2nd Edition, Desmond S. T. Nicholl, Cambridge University Press. **3.** Biotechnology: A Textbook of Industrial Microbiology, 2nd Edition, Wulf Crueger & Anneliese Crueger, Panima Publishing Corporation, New Delhi/Bangalore	

Course: Cosmeticology Lab (CBSGS)			
Course Code: DPH 12	**Third Year B. Pharm**		**Semester: V**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Foundations in chemistry, anatomy, biochemistry, microbiology and pharmaceutics. • Foundations in suspension and semi-solid formulation, processing and quality control		
Course objectives :	• To orient the students with the formulation, processing, quality control, labeling and packaging of cosmetic products for hair, skin, nail and oral care.		
Course Outcomes: After the completion of course learner will be able to:			**PO Mapped**

CO1	Integrate acquired knowledge to suggest safe and effective formulation, processing and control of cosmetic products for hair, skin, nail and oral care.	2
CO2	Apply the acquired knowledge and skills for labeling and packaging of cosmetic products.	2
CO3	Manufacture safe and efficacious cosmetics by applying good manufacturing practices.	2

Topics covered :		
Unit I:	Cleansing milk/lotion	**Hours: 2**
Unit II:	Cold cream	**Hours: 3**
Unit III:	Vanishing cream	**Hours: 2**
Unit IV:	Sunscreen cream	**Hours: 2**
Unit V:	Foundation makeup	**Hours: 3**
Unit VI:	Moisturizing Lotion	**Hours: 2**
Unit VII:	Anti-acne cream	**Hours: 2**
Unit VIII:	Anti-wrinkle cream	**Hours: 2**
Unit IX:	Clear liquid shampoo	**Hours: 2**
Unit X:	Eye shadow	**Hours: 2**
Unit XI:	Nail lacquer	**Hours: 3**
Unit X:	Lipstick	**Hours: 3**
Unit XI:	Toothpaste/ medicated toothpaste	**Hours: 2**
Unit XII:	Mouthwash	**Hours: 2**
Unit XIII:	Lather shaving cream	**Hours: 2**
Unit XIV:	Brushless shaving cream	**Hours: 2**
Unit XV:	Aftershave lotion	**Hours: 2**
Unit XVI:	Face powder	**Hours: 2**
Unit XVII:	Facepack	**Hours: 2**
Reference material:	1. Harry's Cosmeticology Edited by J.B. Wilkinson and R. J. Moore, Longman Scientific & Technical Publishers 2. Cosmetics Science and Technology, Edited by M.S. Balsam, E. Sagarin, S. D. Gerhon, S. J. Strianse and M. M. Rieger, Volumes 1,2 and 3.Wiley-Interscience, Wiley India Pvt. Ltd. 3. Poucher's Perfumes, cosmetics & Soaps, Editor- Hilda Butler, Klewer Academic Publishers, Netherlands 4. Cosmetic Technology, Ed. By S. Nanda, A. Nanda and R. Khar, Birla Publications Pvt. Ltd., New Delhi 5. Handbook of Cosmetic Science and Technology, edited by M. Paye, A. O. Barel, H. I. Maibach, Informa Healthcare USA, Inc. 6. Encyclopedia of Pharmaceutical Technology, Vol. 6, Eds. James	

	Swarbrick, James C. Boylan, Marcel Dekker Inc. 7. BIS Guidelines for different cosmetic products.

Semester VI

<table>
<tr><td colspan="6">Course: Pharmaceutical Chemistry – II (CBSGS)</td></tr>
<tr><td colspan="2">Course Code:DPC-14</td><td colspan="3">Third Year B. Pharm</td><td>Semester: VI</td></tr>
<tr><td colspan="3">Type of course: Theory</td><td colspan="3">Contact Hours: 4Hrs/week</td></tr>
<tr><td>Course assessment Methods:</td><td colspan="4">Continuous mode of assessment</td><td>Semester-end assessment</td></tr>
<tr><td>Assessment Tool:</td><td>Periodic Theory test</td><td>Attendance</td><td>Quizzes</td><td>Teacher - Student interaction</td><td>ESE</td></tr>
<tr><td>Max. Marks:</td><td>15</td><td>5</td><td>5</td><td>5</td><td>70</td></tr>
<tr><td>Pre-requisites:</td><td colspan="5">• Basic organic chemistry concepts which includes the knowledge of the IUPAC Nomenclature, Chemical structure and Stereochemistry of a molecule.
• Understanding of the structure and function of the pathogenic bacteria.</td></tr>
<tr><td>Course objective:</td><td colspan="5">1. To make them understand Pharmacokinetic and Pharmacodynamic concepts of drug
2. To make them understand SAR, MOA study of phase I and II metabolites of various drugs
3. To make them understand properties of various drug molecules/ enzymes/ receptor structures and their therapeutic applications along with the synthesis of drugs</td></tr>
<tr><td colspan="5">Course Outcomes: After the completion of course learner will be able to:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="4">Understand the basic Pharmacokinetic and Pharmacodynamic concepts of drug at molecular level like proteins, nucleic acids as drug targets.</td><td>1</td></tr>
<tr><td>CO2</td><td colspan="4">Acquire and comprehend the knowledge of tools of SAR, MOA study of phase I and II metabolites of various drugs with rational development of drugs.</td><td>1,6</td></tr>
<tr><td>CO3</td><td colspan="4">Integrate and correlate all the properties of various drug molecules/ enzymes/ receptor structures and their therapeutic applications along with the synthesis of drugs.</td><td>1,6</td></tr>
<tr><td colspan="6">Topics covered</td></tr>
<tr><td>Unit I:</td><td colspan="3">Pharmacodynamics</td><td>Hours: 5</td></tr>
<tr><td colspan="6">1.1-Drug targets at molecular level –
Cell Structure.</td></tr>
</table>

Lipids, carbohydrates, proteins and nucleic Acids as drug targets. 1.2- Intermolecular bonding forces like electrostatic, hydrogen bonding, van der Waal's interactions, dipole-dipole and ion-dipole interactions and hydrophobic interactions.		
Unit II:	**Proteins as Drug Targets**	**Hours: 9**
2.1- Primary, secondary, tertiary and quarternary structure of proteins and post translational Modifications 2.2- Proteins as drug targets / Drugs. Monoclonal antibodies, peptides. Introduction to proteomics. 2.3- Enzymes as Drug targets 2.4. Receptors as Drug Targets. Types of receptors and signal transduction - Ion Channels, G-protein coupled receptor (GPCR), Kinases, nuclear receptors Concept of agonist, antagonist, partial agonist, inverse agonist, concept of desensitization/sensitization, tolerance, affinity, efficacy, potency (Self Study)		
Unit III:	**Nucleic Acids as Drug target**	**Hours: 8**
3.1- Primary, secondary and tertiary structure of DNA 3.2- DNA intercalation, DNA alkylation, antisense therapy		
Unit IV:	**Pharmacokinetics and Physicochemical Properties of Drug Action**	**Hours: 6**
4.1- Solubility, partition coefficient, acidity-basicity, pKa, bioisosterism, stereochemistry (geometrical, optical and conformational), Protein Binding 4.2- Drug metabolism – Phase I and Phase II Reactions		
Unit V:	**Tools of the Trade (Structure Activity Relationship – SAR)** **Introduction to the concepts of SAR –A Case Study**	**Hours: 1**
Discussion on the following classes of drugs including enzyme/receptor structure, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, SAR, metabolism, molecular mechanism of action, introduction to rational development, drug resistance, if any, of following classes of drugs		
Unit VI:	**Antiinfective Agents**	**Hours:10**
6.1- Antibiotics: Penicillins (natural and semisynthetic penicillins like Penicillin G, Penicillin V, ampicillin*, amoxicillin, cloxacillin*, oxacillin, naficillin, methicillin and ampicillin prodrugs like bacampicillin and hetacillin). _-lactamase inhibitors like clavulinic acid, (self study – tazobactam). Cephalosporins (cephalexin, cefadroxil, cefazolin, cefamandole, cefoxitin, cefuroxime, cefotaxime, ceftriaxone, cefpodoximeproxetil) Tetracyclines (tetracycline, chlortetracycline, oxytetracycline, doxycycline, and minocycline and its prodrug – rolitetracycline); Macrolides, (erythromycin, roxithromycin, azithromycin -		

only highlights of structure to be discussed). Aminoglycosides (gentamicins, and neomycins, - only highlights of structure to be discussed) Carbapenems (Emepenem, meropenem). Monobactams (Aztreonam, Tigemonam). Chloramphenicol, Linezolid. Only highlights of structures of Vancomycin, Bacitracin, Polymyxin B. 6.2- Sulfonamides: (Self study) Short, intermediate and long acting sulfonamides, sulfonamides for ophthalmic infections, ulcerative colitis and for reduction of bowel flora. Sulfamethoxazole, sulfadiazine*, sulisoxazole, sulfacetamide, sulfasalazine 6.3- Fluoroquinolones: Norfloxacin, ciprofloxacin*, sparfloxacin, gatifloxacin, levofloxacin, lomefloxacin		
Unit VII:	**Antiparasitic Agents**	**Hours: 6**
7.1- Antimalarial Agents: Natural products like cinchona alkaloids (with stereochemistry and drug action) and artemisinin and its derivatives like artether, artemether and artesunate, synthetic antimalarials such as 8- aminoquinolines e.g. primaquine*, 4- aminoquinilines e.g. chloroquine*, Quinolinemethanols e.g. mefloquine; misc like halofantrine, lumefantrine and; DHFR inhibitors like pyrimethamine* and proguanil, cycloguanil, atovaquone, sulfadoxine Combination therapy. 7.2- Drugs for treatment of amoebiasis, giardiasis and trichomoniasis: Drugs for treatment of amoebiasis, giardiasis and trichomoniasis (Self Study). Metronidazole*, tinidazole, secnidazole, diloxanide furoate*, nitazoxanide. 7.3- Anthelmintics: Albendazole, mebendazole*, thiabendazole, diethylcarbamazine, ivermectin, praziquantel, pyrantel pamoate 7.4- Drugs for the treatment of pneumocystis, trypanosomiasis, leishmaniasis(Self Study) Atovaquone, pentamindine, co-trimoxazole, trimetrexate, benznidazole, eflornithine, melarsoprol, suramin, nifurtimox, sodium stibogluconate, miltefosine)		
Unit VIII:	Antimycobacterial Agents	**Hours: 3**
Antitubercular drugs - PAS*, ethionamide, isoniazid, pyrazinamide, ethambutol*, antitubercular antibiotics (streptomycin, rifampin, rifapentine, capreomycin, cylcoserine – the first four only highlights of structure to be discussed), fluoroquinolones, bedaquiline. Antileprotic drugs.- Dapsone*, clofazimine, rifampin. Combination therapy		
Unit IX:	Antifungal Agents	**Hours: 3**
Natural products like griseofulvin , amphotericin B and nystatin (later two only general aspects of structure related to activity). Antifungal azoles like clotrimazole*, miconazole, ketoconazole, fluconazole, and itraconazole. Allyl amines like naftifine, butenafine and terbinafine. Flucytosine and tolnaflate		

Reference material	1. Graham L. Patrick, An Introduction to Medicinal Chemistry, Oxford University Press. 2. Gareth Thomas, Fundamentals of Medicinal Chemistry, Wiley, New York. 3. Richard B. Silverman, The Organic Chemistry of Drug Design and Drug Action, Academic Press. 4. Thomas L. Lemke, David A Williams, Foye's Principles of Medicinal Chemistry, Lippincott Williams & Wilkins. 5. John M. Beale, John H. Block, Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams & Wilkins. 6. AshutoshKar, Medicinal Chemistry, New Age International Publishers. 7. Alex Gringauz, Introduction to Medicinal Chemistry, Wiley. 8. Daniel Lednicer, Lester A. Mitscher, The Organic Chemistry of Drug Synthesis, John Wiley and Sons. 9. H. J. Roth & A. Kleemann, Pharmaceutical Chemistry, Volume 1, Organic Synthesis, Ellis Horwood Series in Pharmaceutical Technology, Halsted Series. 10. Ruben Vardanyan and Victor Hruby, Synthesis of Essential Drugs, Elsevier. 11. Kleemann& Engel, Pharmaceutical Substances: Syntheses, Patents, Applications, Thieme Publications.

Course: Pharmaceutical Analysis II (CBSGS)					
Course Code: DPC 15	**Third Year B. Pharm.**				**Semester: VI**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Basic information about organic & inorganic chemistry and details of non instrumental method of analysis.				
Course	Basic knowledge and fundamentals of electromagnetic radiation and				

objectives :	their properties, spectroscopic principles and general chemistry	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the fundamental principles of operation of modern analytical instrumentation such as spectrophotometers and radiopharmaceuticals.	1,4
CO2	Apply analytical principles in various pharmaceutical analytical techniques used in drug discovery & development.	1,2,4
CO3	Integrate theoretical analytical methods and statistical methods to solve problems in the industrial and hospital settings for evaluating and interpreting data.	1,2,6
Topics covered :		
Unit I:	**Basis of spectrophotometry**	**Hours: 8**
Terms- • Electromagnetic radiation, Visible light and electromagnetic spectrum, wavelength, wave number, frequency, absorbance, transmittance ***(Self study- 0.5h)***, singlet state, triplet state, fluorescence, phosphorescence and energy transitions. • Atomic spectra, molecular spectra, atomic absorption spectroscopy, atomic emission spectroscopy, molecular absorption spectroscopy, molecular emission spectroscopy. Instrumentation for: UV-Vis, Fluorescence ***(Self study-1 hr)***, FTIR spectroscopy • Sources of electromagnetic radiation • Monochromators (Filters, prisms, gratings) • Sample cells • Detectors • Colorimeter & UV-Vis Spectrophotometers-Single beam and Double beam (including Block diagram & ray diagram). • Filter fluorimeter (including Block diagram) and Spectrofluorimeter. • Interferometer in FTIR		
Unit II:	**Atomic absorption spectroscopy (AAS) and Flame emission spectroscopy (Flame photometry)**	**Hours: 3**
• Principle, partial emission spectrum of sodium • Difference between atomic absorption spectroscopy and flame emission spectroscopy, Advantages and disadvantages ***(Self study-1 hr)*** • Instrumentation: Radiation sources (For AAS-Hollow cathode lamp, Electrode discharge lamps; For Flame photometry-Inductively coupled plasma source, Direct current plasma source); Flame atomization (types of flames, flame structure, flame atomizers). • Sample preparation • Spectral Interferences and Chemical Interferences in AAS.		

• Cationic, Anionic and Physical interferences in Flame photometry. • Pharmaceutical applications		
Unit III:	**UV-Visible spectroscopy**	**Hours: 7**
Terms-chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromism, hypochromism, wavelength maxima, specific absorbance, molar absorptivity, cut-off wavelength for solvents • General concepts-Types of absorbing electrons, electronic transitions, • Beer-Lambert's law-statement, derivation of mathematical expression, limitations. • Choice of solvents ***(Self study-0.5 h)*** • Chemical derivatization. • Application of Beer's law in quantitative spectrophotometric assays-Single component assays-use of a standard absorptivity value -use of a calibration graph -single and double point standardization • Measurement of Equilibria constant. • Measurement of rate constant Numericals based on Beer-Lambert's law.		
Unit IV:	**Fluorescence spectroscopy**	**Hours: 6**
Origin of fluorescence and phosphorescence spectra, Fundamental equation for fluorescence intensity, factors affecting fluorescence intensity (intensity of radiation source, quantum yield, molecular structure and rigidity, temperature, solvents, pH, dissolved oxygen, quenchers & concentration) Chemical derivatization of non-fluorescent compound to fluorescent compound (e.g: use of Dansyl chloride, Fluoresamine, o-phthalaldehyde) ***(Self study-0.5 h)***, Choice of fluorimetry over UV-Vis spectroscopy with respect to Sensitivity and Specificity. Pharmaceutical Applications ***(Self study-0.5 h)***		
Unit V:	**Infrared / Near IR spectroscopy**	
I.R. regions, requirements for I.R. absorption, vibrational and rotational transitions, dipole changes, types of molecular vibrations, potential energy diagrams (harmonic oscillator and anharmonic oscillator), Vibrational frequency, factors influencing vibrational frequencies, force constants, vibrational modes (normal mode, combination bands and overtone bands), Finger print region • Sample preparation for I.R spectroscopy-Solids (mulling, pelleting & thin filmdeposition, and in solution form), Liquids (Neat and in solution form). • Sample handling: Attenuated Total Reflectance and Diffuse Reflectance. • Pharmaceutical applications of IR spectroscopy (including characteristic IR absorption frequencies of some common bond types such as hydroxyl stretch, nitrile stretch and carbonyl stretch of aldehydes and ketones, aliphatic and aromatic C-H stretch) ***(Self study-1 hr)*** • Pharmaceutical applications of Near IR spectroscopy including PAT (Process Analytical Techniques).		
Unit VI:	**Raman Spectroscopy**	**Hours: 3**

• Principle of Raman scattering. • Comparison between I.R. Spectroscopy and Raman Spectroscopy ***(Self study-0.5 h)*** • Raman instrumentation-Sources of light, Sample illumination system (Liquid, solid and fibre optic sampling), Block diagram of Raman spectrometer. • Applications***(Self study- 0.5 h)***		
Unit VII:	**Thermal methods of analysis**	**Hours: 4**
• Principle, instrumentation, working and applications of thermogravimetry(TG) • Factors affecting TG curve Principle, instrumentation, working and applications of : • Differential Thermal Analysis (DTA) ***(Self study-1 hr)*** • Differential Scanning Calorimetry (DSC)		
Unit VIII:	**Radiochemistry and Radiopharmaceuticals**	**Hours: 5**
Fundamentals of radioactivity: • Properties of radionuclide, Radionuclide, Radioisotope, Radioactive decay, halflife of radioactivity, specific activity, Becquerel, curie, Sievert and Gray***(Self study-0.5 h)*** • Relative biological effectiveness, Radionuclidic purity, Radiochemical purity, Geiger-Muller Counting, liquid Scintillation Counting • Safety aspects of radiopharmaceutical laboratory ***(Self study-0.5 h)*** Quality control of radiopharmaceuticals: Physical, Chemical (Radionuclidic purity, Radiochemical purity), and pharmaceutical properties ***(Self study-0.5 h-***apyrogenicity, pH and absence of particulate), Isotope dilution analysis (Direct and Inverse), 99mTc generator.		
Unit IX:	**X-Ray Diffraction Technique**	**Hours: 2**
• Fundamentals- Origin of X-ray, Bragg's law & its mathematical derivation, and Miller indices ***(Self study-0.5 h)*** • Pharmaceutical applications		
Unit X:	**Statistical data handling**	**Hours: 4**
• Normal Distribution Numericals based on: • Confidence limits & Tests of significance (F-test, Student t-test-paired and unpaired) • Linear regression analysis and correlation coefficient • Rejection of results (Q-test)		
Reference material:	Latest editions of the following books to be adopted 1 D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, Saunders College Publishing, USA. 2 K. A. Connors, A Textbook of Pharmaceutical Analysis, John Wiley and Sons, Canada. 3 A. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I and II, CBS Publishers and Distributors, India. 4 D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Saunders College Publishing, USA.	

	5 G. D. Christian, Analytical Chemistry, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd. 6 H. H. Willard, L. L. Merrit and J. A. Dean, Instrumental Method of Analysis, CBS Publishers & Distributors, New Delhi. 7 Ashutosh Kar, Pharmaceutical Drug Analysis, New Age International (P) Ltd. Publishers, India. 8 S. S. Mahajan, Instrumental Methods of Analysis, Popular Prakashan Pvt Ltd., India. 9 G.R. Chatwal and S. K. Anand, Instrumental methods of chemical analysis, Revised and enlarged, Himalaya Publishing House Pvt. Ltd. 10 Indian Pharmacopoeia, The Indian Pharmacopeia Commission, Ghaziabad, Government of India. 11 United States Pharmacopoeia. 12 J. Mendham, R. C. Denney, J. D. Barnes, M.J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, 6th Ed., Pearson Education Ltd. 13 D.G. Watson, Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists, Churchill Livingstone Elsevier. 14 J.W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, Marcel Dekker, New York, USA. 15 R. Kellnar, J. M. Mermet, M. Otto, M. Valcarceland, H. M. Widmer, Analytical Chemistry: A modern approach to analytical science, Wiley-VCH, USA. 16 J. W. Munson, Pharmaceutical Analysis: Modern methods (in two parts), Marcel Dekker Inc., USA. 17 W. Kemp, Organic Spectroscopy, Reprinted, Palgrave Publishers Ltd., New York, USA. 18 R. M. Silverstein, F. X. Webster and D. J. Kiemle, Spectrometric identification of organic compounds, John Wiley & Sons, Inc. (Indian edition), New Delhi. 19 D.B. Troy and P. Beringer, Remington-The Science and Practice of Pharmacy, Vol. I & II, Walters Kluwer/ Lippincott Williams & Wilkins (Indian edition), New Delhi. 20 J.W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, 6th Ed., Marcel Dekker, New York, USA. 21 J.R. Dyer, Applications Of Absorption Spectroscopy Of Organic Compounds, Prentice- Hall of India Pvt. Ltd, New Delhi, India. 22 D. L. Pavia, G. M. Lampman, G.S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, Brooks / Cole Cengage Learning, Australia. 23 S. Bolton and C. Bon, Pharmaceutical statistics: Practical and clinical

	applications, Drugs and Pharmaceutical Sciences Series, Vol. 203, Informa Healthcare, USA.

Course: Pharmaceutics III (CBSGS)					
Course Code: DPH 13		**Second Year B. Pharm**			**Semester: VI**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Prior knowledge of preformulation, physical pharmacy, and basic pharmaceutics. Have basic understanding of unit processes like drying, mixing, air handling covered under the subject of pharmaceutical engineering.				
Course objectives :	To train the learner about various aspects of manufacturing and evaluating solid oral dosage forms and aerosols.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand formulation consideration, large scale manufacturing packaging and quality control of solid oral dosage forms.	1,2
CO2	Understand aerosol dosage form with respect to fill composition, container and quality control.	1,2
CO3	Select appropriate coating techniques, polymers and choose suitable equipments for the same	1,2

Topics covered :

Unit I:	**TABLETS**	**Hours: 19**

- Definition, advantages and limitations, preformulation aspects.
- Tablet formulation and design, additives, excipients with examples
- Large scale manufacturing.
- Drying as a unit operation.
- Equipments for mixing.
- Direct compression, wet Granulation, dry Granulation (Slugging and roller compaction)
- Compression – (Single station tablet press and Rotary press), physics of tablet compression (brief).

- Processing problems in tableting.
- Quality control of tablets.
- ***Self Study*** *-Types of tablets-Effervescent, succal, lozenges, chewable, sublingual, dispersible, soluble, orodispersible. layered tablets.Layout of tablet section.*

Unit II:	**CAPSULES**	**Hours: 9**

- Definition, types of capsules, advantages and limitations, and raw materials including gelatin and other materials.
- Hard gelatin capsule: Manufacturing of hard gelatin capsule shells, size, size selection, sealing, storage, defects of shells.
- Hard capsule fill formulation aspects: Large scale manufacturing.
- Filling of hard capsule shells, types of fills and excipients.
- Filling equipments: classification-volumetric, dosator type and tamping type (one example of each type of equipment).
- Humidity control in capsule manufacturing and filling area.
- Problems in capsule filling & remedies
- Soft gelatin capsules: Properties, nature of shell and contents, Formulation aspectsconcepts(minim/gm)
- Large scale manufacturing- Rotary Die Process
- ***Self study*** -Quality Control of empty capsule shell and hard and soft gel capsules. Layout of capsule section.

Unit III:	**PACKAGING**	**Hours: 03**

- Blister and strip Packing, manufacturing defects, QC
- ***Self study*** -Packing materials

Unit IV:	**AEROSOL**	**Hours:06**

- Definition, advantages & disadvantages, desirable features. Components –
- Prepellants-types, selection, two phase & three phase systems
- Containers – Tin Plate, Aluminum, Glass, Plastics, Valve, & Actuator Standard valve (detail) & specialized valves (in brief).
- Product concentrate Different formulation systems- solution, Dispersions, Foams Powders.
- Manufacturing and Quality Control testing.

Unit V:	**COATING OF TABLETS**	**Hours:08**

- Need for tablet coating, types of coating, tablet core properties
- Sugar coating – Raw materials, Steps in detail, Sugar coating
- Film coating including Enteric coating.
- Raw materials, Aqueous film coating, film coating defects/problems
- Coating Equipments – Conventional & modified pans, coating columns (fluidized bed coating), Spray equipment & other accessories
- ***Self study*** –Quality control of coated tablets.

Reference material:	1. Aulton Michael E., "Pharmaceutics: The Science of Dosage Form Design", Churchill Livingstone Publishers, London 2. Lachman Leon, Liberman Herbert A., Kaing Joseph L., "The Theory and Practice of Industrial Pharmacy", Varghese Publishing House, Mumbai. 3. Liberman Herbert A., Lachman Leon, Schwartz Joseph B., "Pharmaceutical Dosage Forms – Tablets", Volume 1/2/3, Marcel Dekker Inc., New York. 4. Larry L. Augsburger and Stephen W. Hoag., "Pharmaceutical Dosage Forms – Tablets" Volume 1/2/3, Informa Healthcare, New York. 5. Cole G., "Pharmaceutical Coating Technology" Taylor and Francis Ltd., Bristol, PA. 6. S.J. Carter Ed., "Tutorial Pharmacy - Cooper and Gunns", CBS Publishers & Distributors, Mumbai.

Course: Pharmacognosy & Phytochemistry I (CBSGS)					
Course Code: DPG 01	**Third Year B. Pharm**				**Semester: VI**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	▪ Basic knowledge of botany, tissues and cell in context to plants				
Course objectives :	1. To introduce Pharmacognosy as a core subject in Pharmacy curriculum and its scope in health care Industry. 2. To enlighten an overview of Cultivation and Plant Tissue Culture and its significance. 3. To provide fundamental knowledge related to structure and functions of plant tissues and cell contents 4. To explain various extraction techniques, primary and secondary metabolites, their role, functions along with their general biosynthetic pathway. 5. To illustrate various evaluation parameters of Drugs of Natural Origin and their assessment and its significance as per WHO. 6. To give insight regarding pharmacognostic study of various				

	categories of plant metabolites.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Acquire the concept, scope and prospects of Pharmacognosy, Phytomedicine and Traditional systems of medicines	1, 7
CO2	Comprehend the botanical aspects, nomenclature, authentication, classification, sources, cultivation, collection and processing of medicinal plants	1, 7
CO3	Understand the morphology and microscopy of different parts of the plants, concept of primary and secondary metabolites and their biosynthetic pathways.	1, 7
CO4	Integrate and apply the principle and techniques of extraction and Plant tissue culture.	1, 7
CO5	Understand and apply evaluation parameters of Drugs of natural origin and assessment of their identity, purity, safety and efficacy as per WHO norms.	1, 7
CO6	Acquire and apply knowledge of Pharmacognostic study of crude drugs containing Carbohydrates, fibres and proteins and enzymes.	1, 4, 7
Topics covered :		
Unit I:	**Introduction to Pharmacognosy**	**Hours: 07**
1.1. Historical development, modern concept and scope of Pharmacognosy and Phytochemistry. Sources of drugs of natural origin (DONO) including plants, animals, minerals, marines and plant tissue culture products with examples of each source. Significance of pharmacognosy in various systems of medicine racticed in India viz. Ayurveda, Unani, Homeopathy and Siddha. Introduction to the concept of phytomedicines. Self study: (4 or 5 examples of each of the following) • Examples of sources of DONO • Examples of drugs used in different traditional systems of medicine.		
1.2. Introduction to organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins), unofficial and official drugs as per the Indian Pharmacopoeia with suitable examples. Classification of DONO based on alphabetical, morphological, pharmacological, chemical, taxonomical and chemotaxonomical methods along with the significance of each method		
Unit II:	**Commercial Production, Collection and Preparation of Crude Drugs**	**Hours: 07**
2.1. Overview of cultivation, collection, preparation, drying and storage (Pest control, moisture control) of crude drugs. Self study:		

Commerce of crude drugs and 4-5 examples of plants from different geographical sources and climatic zones.		
2.2. Factors affecting quality of crude drugs – Exogenous Factors, Environmental Factors and Endogenous factors: Mutation, Polyploidy and Hybridization. Introduction to plant tissue culture and its applications to Pharmacognosy. Plant growth regulators and their application to tissue culture, propagation of plants and production of secondary metabolites.		
Unit III:	**Morphological and histological characteristics of crude drugs**	**Hours: 12**
3.1. Study of ergastic cell contents including calcium oxalate crystals, starch grains and aleurone grains and idioblasts		
3.2. Study of morphology and histology of monocot and dicot roots, rhizomes, stems, barks, woods, leaves, flowers, fruits and seeds. Details of mountants, clearing agents and microchemical reagents. Self study: • Classification of roots, stems, fruits • Salient features of monocot, dicot root and stem • Different types of inflorescence		
3.3. Identification and significance of morphological & microscopic differences between plants of allied species as exemplified by digitalis, brahmi, cinnamon & tinospora.		
Unit IV:	**Introduction to Phytoconstituents**	**Hours: 06**
4.1. Brief introduction to Primary and secondary metabolites in plants with structures. Self Study: • Any two examples of each class of phytoconstituents and significance of phytoconstituents for therapeutic application		
4.2. Study of their biosynthetic pathways with structures (Including shikimic acid pathway and acetate hypothesis, polyketides and terpenoids)		
Unit V:	**Extraction of phytochemicals**	**Hours: 05**
5.1. Introduction to general methods of extraction of different classes of phytochemicals from crude drugs viz. maceration, percolation, soxhlet extraction, Dien Stark assembly for moisture content determination and extraction of volatile oil. Introduction to newer techniques of extraction like microwave assisted extraction, countercurrent extraction and supercritical fluid extraction. Self Study: • Commercial applications of recent methods of extraction techniques with any two examples.		
5.2. General methods of extraction for following classes of phytoconstituents : alkaloids, glycosides & tannins		
Unit VI:	**Evaluation & Quality Control of Drugs Of**	**Hours: 08**

	Natural Origin (DONO)	
6.1. Introduction & significance of evaluation of DONO. Study of organoleptic, microscopic, physical, chemical and biological methods of evaluation of crude drugs with respect to pharmacopoeias. Introduction to WHO guidelines and monographs of drugs of natural origin.		
6.2. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida. Study of adulteration and substitution of crude drugs. Self Study: • Examples of adulteration and substitution of crude drugs		
Unit VII:	**Study of Fibres**	**Hours: 03**
7.1. Study of plant, animal & mineral fibres with respect to their classification, sources, production, chemistry, commercial utility and significance in Pharmaceutical Industry for the following: Absorbent & nonabsorbent cotton, jute, flax, hemp, asbestos, glass wool, silk, wool, rayon, viscose		
Unit VIII:	**Study of carbohydrate containing drugs of natural origin**	**Hours: 08**
8.1. Detailed study of Carbohydrates with respect to chemistry, sources, preparation, evaluation and commercial utility as Pharmaceutical Aids and Medicines for the following: Cellulose and cellulose derivatives, starches, honey, inulin, alginic acid, malt and malt extract, dextran, pectin, chitin, tamarind kernel powder (TKP).		
8.2. Plants as sources of gums including tragacanth, acacia, sterculia, xanthan, guar gum, galactomannans. Plants as sources of mucilages including agar, Isapghol and linseed. Self Study: Study of monograph of any two carbohydrate containing drugs as per I.P.		
Unit IX:	**Proteins and Enzymes**	**Hours: 04**
9.1. Study of Proteins and Enzymes with respect to sources, preparation and uses – protein hydrolysates, gelatin, casein, thyroid hormones, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). Study of plant lectins with respect to sources, composition and applications for Abrin, ricin. Self study: • Marketed formulations containing serratiopeptidase and their applications.		
Reference material:	**Latest editions of the following books to be adopted** 1) Trease D. & Evans W. C.: Text Book of Pharmacognosy: W. B. Saunders. 2) Tyler V.E., Brady L.R. & Robbers J. E.: Pharmacognosy; LeaFeibger, USA. 3) Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi. 4) Kokate C.K., Purohit A. P. & Gokhale S. B.: Pharmacognosy;	

	Nirali Publications, Pune. 5) Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman& Hall, London. 6) Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited. 7) Vasudevan T.N. & Laddha K.S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon. 8) The Indian Pharmacopeia: The Controller of Publication; Delhi. 9) Brain K.R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol. 10) Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal. 11) Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal. 12) Kokate C. K.: Practical Pharmacognosy;Vallabh Prakashan. 13) Wagner, Bladt & Zgainski; Plant Drug Analysis; Springer Verlag. 14) Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune. 15) Vasudevan T. N. and Laddha K. S.:Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

Course: Hospital Pharmacy and Drug Store Management (CBSGS)					
Course Code: DPH 14	**First Year B. Pharm**				**Semester: VI**
Type of course : Theory			**Contact Hours: 34 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	This course does not require any prior knowledge or skills.				
Course objectives :	To equip the learner with basic knowledge for setup and management of Hospital Pharmacy and a drug store.				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**

CO1	Understand the role of pharmacist in hospital set up like ensuring effective and safe storage, distribution and usage of drugs and controlled substances, sterilization and handling of hospital supplies such as surgical supplies.	1,3,5,8
CO2	Have basic knowledge about setting up and managing a drug store.	1,5,8

Topics covered :

Unit I:	**Introduction to Hospitals and Hospital Pharmacy**	**Hours: 5**

Definition, Classification, Organizational structure of Hospital, administration and functions of hospitals
Definition, History, Development and Current status of Hospital Pharmacy
Duties and Responsibilities of Hospital Pharmacist
Layout, space and facilities, Concept of Pharmaceutical care.

Unit II:	**Pharmacy and Therapeutics Committee**	**Hours: 5**

Objective, Composition and Functions of P and T Committee, Drug Utilization Review
Hospital Formulary: Definition, advantages, limitations, preparation, content, with few examples, selection of drugs, publication and format
Hospital Pharmacy procedural manual

Unit III:	**Purchasing procedure in hospitals (self study)**	**Hours: 3**

Purchasing procedure and storage
Inventory control in hospitals

Unit IV:	**Drug Distribution systems in Hospitals**	**Hours: 4**

Dispensing to In – patients, Outpatients, Unit dose dispensing, Prepackaging
Dispensing of controlled substances

Unit V:	**Central Sterile Supply Services**	**Hours: 6**

Advantages, Plan, Location, Layout
Sterilization of surgical dressings – methods of packing, loading and prevention of wetting of dressings. Sterilization of rubber gloves, syringes, needles, catheters, tubings, surgical instruments, mattresses, utensils and bedpans and other accessories
Manufacturing and Bulk compounding of large volume parenterals, Total Parenteral Nutrition and Intravenous additives.

Unit VI:	**Safe use of medication in hospitals**	**Hours: 2**

Medication errors and ASHP Guidelines to prevent errors, Infection control in hospitals

Unit VII:	**Health Accessories**	**Hours: 2**

Wheel chairs, canes, crutches, bedpans, vapourizers, syringes, needles, clinical thermometers, first aid supplies

Unit VIII:	**Introduction to Pharmacy Practice**	**Hours:3**

Pharmacy Trade or Profession, Community Pharmacy, Code of Ethics for a pharmacist.

Unit IX:	**Channels of distribution and Forms of Business Organization**	**Hours: 5**
Wholesalers and Retailers and their professional role. Hindu undivided family, Sole Proprietorship, Partnership, Co – operative society and Company Planning of retail pharmacy and Entrepreneurship.		
Unit X:	**Drug Store Management**	**Hours: 5**
Legal aspects, Licenses and Registrations. Location analysis and layout design. Sales promotion and Window display		
Unit XI:	**Purchasing and Inventory control in retail trade**	**Hours: 3**
Purchasing procedure in retail trade Inventory control (Want Book, Systematic Want Book, Open to Buy budgeting, ABC, VED, EOQ analysis), Use of computers for Inventory control		
Unit XII:	**Risk Management and Frauds in retail practice**	**Hours: 2**
Risk management, Insurance policies and Frauds in retail practice		
Reference material:	1. Hospital Pharmacy, W. E. Hassan, Edition, Lea and Febiger, Philadelphia. 2. A text – book of Hospital Pharmacy, S.H. Merchant and Dr. J.S. Quadry, B.S. Shah Prakashan, Ahmedabad. 3. Hospital Pharmacy, Dr. H. P. Tipnis and Dr. Amrita Bajaj, Career Publication, Maharashtra. 4. Gennaro Alfonso R, Remington – The Science and Practice of Pharmacy", Lippincott Williams and Wilkins. 5. Principles and methods of Pharmacy Management, Smith, Lea and Febiger, Philadelphia. 6. Drug store management, Nolen and Maynard. McGraw Hill. 7. Drug Store and Business Management, A. P. Battasse, Unique Publication. 8. Text book of Forensic Pharmacy, N. K. Jain, Vallabh Prakashan	

Course: Pharmaceutical Chemistry Lab II (CBSGS)			
Course Code: DPC16	**Third Year B. Pharm**		**Semester: VI**
Type of course: Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**

<table>
<tr><td colspan="2">Pre-requisites :</td><td colspan="2">• Basic principles & introductory study in synthetic chemistry, reaction & schemes involved in the synthetic procedure.
• Recrystallization techniques</td></tr>
<tr><td colspan="2">Course objectives :</td><td colspan="2">1. To Make them aware about different newer and greener techniques available for synthesis
2. To make them understand different parameters involved in newer synthetic methods.
3. To make them analyze the merits and demerits of these greener techniques with conventional method of synthesis.</td></tr>
<tr><td colspan="2">Course Outcomes: After the completion of course learner will be able to:</td><td colspan="2">PO Mapped</td></tr>
<tr><td>CO1</td><td>Understand the traditional method of synthesis & apply the basic concepts & practical skills in the designing of new synthetic drug</td><td colspan="2">1</td></tr>
<tr><td>CO2</td><td>Identify & apply green methods of synthesis like microwaves techniques</td><td colspan="2">1, 2</td></tr>
<tr><td>CO3</td><td>Demonstrate oral & written communication skills & ability to plan the experimentation with proper time management</td><td colspan="2">7</td></tr>
<tr><td colspan="4">Topics covered :</td></tr>
<tr><td>Unit I:</td><td colspan="2">Traditional methods of synthesis to be followed for each of the Unit Operations in addition to specific methods as indicated.
1. Acetylation - Synthesis of aspirin using Microwave Procedure Ref: Green Chemistry V. K. Ahluwalia, pg. no. 7.3. Synthesis of Acetanilide as per Green Chemistry DST Monograph
2. Halogenation – Synthesis of p-bromoacetanilide as per Green Chemistry, DST Monograph
3. Esterification of Ibuprofen using DCC coupling.
4. Oxidation - Synthesis of benzoic by oxidation of toluene or benzyl alcohol with alkaline potassium permanganate.
5. Hydrolysis of methyl benzoate.
6. Reduction - ketones: Synthesis of benzhydrol by reduction of benzophenone with zinc and sodium hydroxide) or synthesis of m-nitroaniline by partial reduction of m- dinitrobenzene with sodium polysulfide.
7. Nitration: Synthesis of 5-nitrosalicylic acid as per Green Chemistry, DST Monograph.
8. Synthesis of benzimidazole.</td><td>Hours: Total 40</td></tr>
<tr><td>Reference material:</td><td colspan="3">1. Vogel’s A Text book of Practical Organic Chemistry by Vogel, Longman group limited, London.</td></tr>
</table>

	2. Practical Organic Chemistry by Mann FC & Saunders BC, Longman Group Limited, London. 3. Laboratory Techniques in Organic Chemistry, Ahluwalia V.K. I.K. Publishers. 4. Green Chemistry, V. K. Ahluwalia. 5. New Trends in Green Chemistry, V K Ahluwalia and M Kidwai, KluwerAcademic Publishers 6. Monograph on Green laboratory Experiments, Grenn Chemistry Task Force Committee, DST. 7. Practical Organic Synthesis: A Student's Guide - Reinhart Keese, Martin Brändle, Trevor Toube. 8. Advanced practical Medicinal Chemistry by Ashutosh Kar, New Age International Publications.

Course: Course: Pharmaceutical Analysis Lab – II (CBSGS)			
Course Code: DPC 17	**Third Year B. Pharm**		**Semester: VI**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites:	Basic principles of UV Vis spectroscopy, colorimeter, fluorimeter, Potentiometer. Calculation and interconversion of various units of concentration like normality, molarity, ppm, ug/ml, mg/ml		
Course objectives :	1. To understand the operation of analytical instruments like UV, pH meter, flame photometer, colorimeter, etc 2. To develop sample preparation and analysis skill 3. Enhance understanding of theoretical principles of each technique		
Course Outcomes: After the completion of course learner will be able to:			**PO Mapped**
CO1	Understand the principles and purpose of each analytical experiment. He will be able to distinguish, compare between various analytical tools or procedures and understand the judicious choice of particular analytical tool or procedure for analyzing a		1,6

	sample.	
CO2	Demonstrate proper planning for executing the analytical procedure adhering to Good laboratory practice and infer the findings and conclude if the sample analyzed is of pharmacopeial standards. Learner will be able to report the results and finding in proper format	1,2,8
CO3	Develop interest in analytical equipment's like UV, FTIR by observing its working and will develop research acumen.	1,6,7
Topics covered :		
Unit I:	Assay of finished products by **UV spectroscopy, using A (1%, 1 cm)**-minimum assay of 5 formulations to be done. • Paracetamol tablets • Propranolol tablets • Atenolol tablets • Hydrochlorthiazide tablets • Frusemide tablets • Albendazole tablets • Rifampicin capsules	**Hours: 8**
Unit II:	Assay of drugs using **single point and double point standardization** method by UV spectroscopy. *e.g*. Paracetamol	**Hours: 4**
Unit III:	**Colorimetric assays (Construction of calibration curve using linear regression analysis)** • Assay of streptomycin injection. • Assay of salicylic acid.	**Hours:8**
Unit IV:	**Fluorimetric analysis** • Assay of quinine sulphate. • Effect of different concentrations of iodide ions on fluorescence of quinine sulphate.	**Hours: 8**
Unit V:	**Potentiometric titrations using pH meter** • Determination of pKa and normality of phosphoric acid (Second end-point). • Determination of normalities of individual acids in a mixture of acids. (*e.g*: HCl and H3PO4- Second end point).	**Hours: 8**
Unit VI:	**Demonstration experiments:** • Determination of Na+/ K+ by Flame photometry. • Working of FTIR and Interpretation of IR spectra of any one drug.	**Hours: 4**

Reference material:	1 Indian Pharmacopoeia, The Indian Pharmacopoeia Commission, Ghaziabad, Government of India. 2 G. D. Christian, Analytical Chemistry, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd. 3 A. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I and II, CBS Publishers and Distributors, India. 4 United States Pharmacopoeia. 5 J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education Ltd. 6 D. G. Watson, Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists, Churchill Livingstone Elsevier. 7 R. M. Silverstein, F. X. Webster and D. J. Kiemle, Spectrometric identification of organic compounds, John Wiley & Sons, Inc. (Indian edition), New Delhi.

Course: Pharmacognosy & Phytochemistry Lab I (CBSGS)			
Course Code: DPG 04	**Third Year B. Pharm**		**Semester: VI**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	1. Should be well versed with working and application of microscope in botany. 2. Should have basic knowledge of plant botany and plant tissues.		
Course objectives :	1. To demonstrate working and use of camera lucida, stage micrometer and ocular micrometer and its significance in microscopic studies. 2. To describe histological characters and cell contents of various plant tissues and its importance in microscopic studies. 3. To illustrate identification of the crude drug by morphological examination, fibres and unorganised drugs by chemical tests.		
Course Outcomes: After the completion of course learner will be			**PO**

able to:		Mapped
CO1	Identify and recognize the crude drug by morphological examination, unorganised drug and fibres by chemical tests	1, 7
CO2	Establish the purity and detect adulterants in the crude drugs by quantitative microscopy **and physical evaluation.**	1, 7
CO3	Recognize plant tissues, histological characters and cell contents by microscopic examination.	1, 7
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	1, 3, 7
Topics covered :		
Unit I:	Quantitative microscopy (Estimation of Leaf constants i.e. Stomatal Index, Vein islet number and Vein termination number, Palisade ratio)	**Hours:08**
Unit II:	Evaluation of Cinnamon powder or Nux vomica powder by Lycopodium Spore method.	**Hours:04**
Unit III:	Determination of alcohol soluble and water soluble extractives, Total ash value and acid insoluble ash and water soluble ash value for any one crude drug as per I.P.	**Hours:04**
Unit IV:	Microscopical Studies of basic tissues both monocot and dicot stem, leaves, roots, bark, seed, fruits.	**Hours:04**
Unit V:	Study of different types of starch grains, calcium oxalate crystals, Trichomes and stomata	**Hour: 04**
Unit VI:	Identification of Fibres and Minerals based on chemical tests as covered in theory. Tests for detection of honey, starch, tragacanth, acacia, guar gum, agar.	**Hours: 08**
Unit VII:	Extraction and detection of starch/pectin from any one source	**Hour: 04**
Unit VIII:	Morphological identification of any twenty crude drugs and their salient morphological features: Acacia tears, Agar strips, Sterculia lumps, Cinnamon, Cassia, Tinospora, Isapghul, Senna, Potato, Pyrethrum, Tragacanth ribbons, Bael, Tamarind, Rhubarb, Squill, Colchicum corm, Senna pod, Any one inflorescence, Hibiscus, Red sandalwood.	**Hours:04**
Reference material:	**Latest Editions of the following books to be adopted** 1. Trease D. & Evans W.C.: Text Book of Pharmacognosy:W. B. Saunders. 2. Tyler V. E., Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA. 3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi.	

	4. Kokate C. K., Purohit A.P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune. 5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London. 6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited. 7. Vasudevan T. N. & Laddha K. S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon. 8. The Indian Pharmacopeia: The Controller of Publication; Delhi. 9. Brain K. R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol. 10. Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal. 11. Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal. 12. Kokate C. K.: Practical Pharmacognosy; Vallabh Prakashan. 13. Wagner, Bladt & Zgainski; Plant Drug Analysis; Springer Verlag. 14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune. 15. Vasudevan T. N. and Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

Course: Pharmaceutics Lab III (CBSGS)			
Course Code: DPH 15	**Third Year B. Pharm**		**Semester: VI**
Type of course : Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Prior knowledge of preformulation, dispensing pharmacy and basic pharmaceutics. • Have basic understanding of unit processes like mixing, granulation and drying. • Basic knowledge of simple calculations and handling glassware and analytical instruments.		

Course objectives :	To familiarise the students with the practical aspects of formulation, manufacturing and testing solid oral dosage forms.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Evaluate the excipients used in the manufacture of tablets and capsules	1,2
CO2	Formulate, manufacture, evaluate and label tablets and capsules	1,2
CO3	Manufacture safe and efficacious tablets and capsules by applying good manufacturing practices and evaluate inhalation products	2
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	3
Topics covered :		
Unit I:	A. Evaluation of Excipients-Bulking agents- At least one excipient in Conventional and Directly Compressible form for : Flow properties , Bulk density, Compressibility and Particle size and Discussion of Observations. B. Evaluation Of Excipients-Disintegrating Agents for their swelling Index and Discussion of Observations C. Evaluation Of Excipients of tablets-Lubricants and Glidants-Influence on flow properties of granules, Results and discussion. Results and discussions	**Hours: 10**
Unit II:	Granulation for Soluble Aspirin Tablets IP and Evaluation. 3. Granulation, Compression and evaluation of Riboflavin Tablets IP 96	**Hours: 5**
Unit III:	Granulation, Compression and evaluation of Riboflavin Tablets IP 96.	**Hours: 5**
Unit IV:	Granulation, Compression and evaluation of Chewable Antacid Tablets	
Unit V:	Granulation Compression and evaluation of Paracetamol Tablets IP 96.	**Hours: 5**
Unit VI:	Preparation and evaluation of orodispersible tablet for low dose drug.	**Hours: 5**
Unit VII:	Dissolution Test of Paracetamol Tablet IP	**Hours: 4**
Unit VIII:	Evaluation of Capsule shells, filling of Ampicillin trihydrate capsule and their evaluation.	**Hours: 2**
Unit XIV:	Introduction to different devices for inhalation and demo of evaluation of a suitable commercial product for simple test related to spray and weight / drug content per	**Hours: 4**

	discharge	
Reference Books	1. Aulton Michael E., "Pharmaceutics: The Science of Dosage Form Design", Churchill Livingstone Publishers, London 2. Lachman Leon, Liberman Herbert A., Kaing Joseph L., "The Theory and Practice of Industrial Pharmacy", Varghese Publishing House, Mumbai. 3. Liberman Herbert A., Lachman Leon, Schwartz Joseph B., "Pharmaceutical Dosage Forms – Tablets", Volume 1/2/3, Marcel Dekker Inc., New York. 4. Larry L. Augsburger and Stephen W. Hoag., "Pharmaceutical Dosage Forms – Tablets" Volume 1/2/3, Informa Healthcare, New York. 5. Cole G., "Pharmaceutical Coating Technology" Taylor and Francis Ltd., Bristol, PA. 6. S.J. Carter Ed., "Tutorial Pharmacy - Cooper and Gunns", CBS Publishers & Distributors, Mumbai. 7. IP and BP	

Final Year B. Pharm:
Semester VII

<table>
<tr><td colspan="6">Course: Pharmaceutical Chemistry III (CBSGS)</td></tr>
<tr><td colspan="2">Course Code:
DPC18</td><td colspan="3">Final Year B. Pharm</td><td>Semester:
VII</td></tr>
<tr><td colspan="3">Type of course : Theory</td><td colspan="3">Contact Hours: 3 Hrs/week</td></tr>
<tr><td colspan="2">Course assessment Methods:</td><td colspan="3">Continuous mode of assessment</td><td>Semester-end assessment</td></tr>
<tr><td colspan="2">Assessment Tool:</td><td>Periodic Theory test</td><td>Quiz</td><td>Attendance</td><td>Student Teacher Interaction</td><td>End semester Examination</td></tr>
<tr><td colspan="2">Max. Marks:</td><td>15</td><td>5</td><td>5</td><td>5</td><td>70</td></tr>
<tr><td colspan="2">Pre-requisites :</td><td colspan="5">• Basic Knowledge of IUPAC nomenclature of drug molecules, their structures, influence of functional groups.
• Anatomy and Physiology of Cardiovascular system.
• Knowledge of basic backbone of chemotherapeutic molecules.</td></tr>
<tr><td colspan="2">Course objectives :</td><td colspan="5">To learn structural activity relationships and metabolites of anticancer, antiviral and CVS drugs.</td></tr>
<tr><td colspan="5">Course Outcomes: After the completion of course learner will be able to:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="4">Understand pharmacokinetic, pharmacodynamics and chemistry aspects of drug molecules belonging to various classes like cardiovascular drugs, chemotherapeutic molecules etc.</td><td>1,4</td></tr>
<tr><td>CO2</td><td colspan="4">Apply the knowledge of structure to relate with biological activities and learn routes of synthesis of such molecules.</td><td>1,4</td></tr>
<tr><td>CO3</td><td colspan="4">Apply this knowledge to rationally develop new drug molecules using the knowledge of mode of action, route of synthesis and SAR.</td><td>1,4</td></tr>
<tr><td colspan="6">Topics covered :</td></tr>
<tr><td>Unit I:</td><td colspan="4">Anti-Cancer agents:</td><td>Hours: 7</td></tr>
<tr><td colspan="6">Alkylating agents like mechlorethamine , chlorambucil* (self study), melphalan*, cyclophosphamide*, mitomycin C, busulfan, carmustine, lomustine, streptozocin, dacarbazine and procarbazine, timozolomide
Antimetabolites like azaserine , methotrexate*, pralatrexate, azacytidine, 5-fluorouracil, cytarabine (Ara–C), 6-MP and 6-TG.</td></tr>
</table>

Antibiotics like dactinomycin, daunorubicin, doxorubicin , bleomycin and other natural products like vincristine, vinblastine, paclitaxel, docetaxel, topotecan, irinotecan (only highlights of structure to be discussed for bleomycin and natural products) Platinum compounds like cisplatin and oxaliplatin Histone Deacetylase Inhibitors: romidepsin, vorinostat Tyrosine Kinase Inhibitors: imatinib, dasatinib, lapatinib Combination therapy for breast cancer, leukemia (Self study)		
Unit II:	**Antivirals agents including anti-HIV agents:**	**Hours: 3**
Aamantadine*, rimantadine, oseltamivir, zanamivir, acyclovir and its prodrugs, ganciclovir, famciclovir, penciclovir, idoxuridine, vidarabine, azidothymidine*, Stavudine Reverse transcriptase inhibitors: , azidothymidine*, stavudine, lamivudine, zalcitabine, didanosine, abacavir, Non-nucleosides reverse-transcriptase inhibiotors: delaviridine, nevirapine, efavirenz, Enfuviritide. HIV-protease inhibitors: raltegravir, saquinavir, ritonavir, (only highlights of structure of protease inhibitors). Drugs like nelfinavir, lopinavir, atazanavir, amprenavir, telaprevir and Combination antitherapy (Self Study)		
Unit III:	**Cardiovascular Drugs**	**Hours: 21**
Cardiac Glycosides Digitalis glycosides (digitoxin, digoxin, lanatoside C) Antianginal agents: Amyl nitrite, isosorbide dinitrate, pentaerythritol tetranitrate, verapamil, bepridil, diltiazem, nifedipine*, amlodipine, nimodipine, nicardipine, dipyridamole* Antiarrhythmic agents: quinidine, procainamide*, disopyramide, lidocaine, tocainide, mexilitine, encainide, amiodarone, propafenone, verapamil, diltiazem, propranolol, sotalol* Diuretics Site 1. Carbonic anyhydrase inhibitors: acetazolamide*, methazolamide, brinzolamide, ethoxzolamide Site 2. High celing or loop diuretics: Sulphamoyl anthranilic acids like furosemide*, azosemide and and bumetanide and phenoxyacetic acids ethacrynic acid* Site 3. Thiazide and Thiaaizide like diureties, chlorthiazide*(self study) hydrochlorthiazide, benzthiazide, methyclothiazide, trichlormethiazide, chlorthalidone, metolazone, quinethazone, indapamide Site 4. Potassium sparing diureties such as spironoloactone, eplerenone (self study) triamterene and amiloride. Osmotic diuretics- mannitol, isosorbide. Agents affecting Renin-Angiotensin Pathway and Calcium Blockers ACE Inhibitors- captopril* enalapril, benazepril, ramipril, Lisinopril Angiotensin II receptor blockers- losartan, valsartan, candesartan, telmisartan.		

Calcium channel blockers- verapamil bepridil, diltiazem, nifedipine, amlodipine, nimodipine, nicardipine
Renin Inhibitors- aliskiren (self study)
Aldosterone antagonists: spironolacone, eplerenone (self study)
Vasodilators/Sympatholytics
Vasodilators- Hydralazine* diazoxide
Non-selective beta blockers- propranolol, nadolol
Selective beta-1 blockers- acebutalol, atenolol, esmolol
Selective alpha-2 blockers- prazosin* terazosin
Mixed alpha-beta blockers- carvedilol, labetalol
K-channel agonists- Minoxidil
Antihyperlipoproteinemics - Clofibrate*, gemfibrozil, ciprofibrate,
HMG-CoA reductase inhibitors: lovastatin, atorvastatin, simvastatin, rosuvastatin, niacin, ezetimibe.
Thrombolytics, Anticoagulants, Antiplatelets
Warfarin* dicoumarol, anisidione, phenindione, aspirin, triflusal, indobufen (self study), dipyridamole, cilostazol, ticlopidine, clopidogrel, abciximab (self study)

Unit IV:	Antihistaminics	**Hours: 3**

Antihistaminies:H1 and H2 receptors Emphasis to be on the second generation H1 antagonists such as fexofenidine, astemazole, loratidine, cetrizine, mizolastine, and acrivastine, H2 receptor antagonists like cimetidine (self study) ranitidine*, famotidine, nizatidine, proton pump inhibitors like omeprazole, rabeprazole, pantoprazole and lansoprazole.

Unit V:	Hypoglycemics and Insulin Analogues	**Hours: 3**

Hypoglycemics (Insulin not to be discussed)
Biguanides e.g. metformin
Sulfonylureas: 1st Generation like tolbutamide, chloropropamide, tolazamide and acetohexamide*(self study); 2nd Generation like glyburide* glypizide and glimepride,glyclazide and meglitinides like repaglinide, nateglinide.
Thiazolidinediones such as troglitazone, ciglitazone, rosiglitazone and pioglitazone.
GLP-1 agonists and DPP-IV inhibitors- exenatide and liraglutide (no structures), saxagliptin, vildagliptin, sitagliptin, linagliptin
β – Glucosidase inhibitors like acarbose, voglibose, and miglitol.
Insulin analgoues: Lispro insulin, glargine insulin

Unit VI:	Anaesthetics	**Hours: 3**

General: Halothane, isoflurane*, enflurane, sevoflurane, ketamine, propofol, thiopental.
Local:
Amino esters – procaine, tetracaine, benzocaine*
Amino amides – lidocaine*, mepivacaine, bupivacaine, ropivacaine Amino ethers – pramoxine

Amino ketones – dyclonine Alcohols – benzyl alcohol, eugenol	
Reference material:	Latest eEditions of the following books to be adopted. 1. An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press. 2. Fundamentals of Medicinal Chemistry, Gareth Thomas, Wiley, New York. 3. The Organic Chemistry of Drug Design and Drug Action, Richard B.Silverman, Academic Press. 4. Foye's Principles of Medicinal Chemistry, Thomas L. Lemke, David A Williams, Lippincott Williams & Wilkins. 5. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale, John H. Block, Lippincott Williams & Wilkins. 6. Medicinal Chemistry, Ashutosh Kar, New Age International Publishers. 7. Introduction to Medicinal Chemistry, Alex Gringauz, Wiley. 8. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Lester A. Mitscher, John Wiley and Sons. 9. Pharmaceutical Chemistry, Volume 1, Organic Synthesis, H. J. Roth & A. Kleemann, Ellis Horwood Series in Pharmaceutical Technology, Halsted Series. 10. Synthesis of Essential Drugs, Ruben Vardanyan and Victor Hruby, Elsevier. 11. Pharmaceutical Substances: Syntheses, Patents, Applications, Kleemann & Engel, Thieme Publications.

Course: Pharm. Analysis III (CBSGS)					
Course Code:DPC 20	**Final Year B. Pharm**				**Semester: VII**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites	• Fair idea about spectroscopic principles. Learner should have				

:	basic idea about electromagnetic radiation and their properties. • Conversant with the magnetic and electronic effects of electromagnetic waves. • Learner should have knowledge about relationship between energy of electromagnetic waves and wavelengths
Course objectives :	1) To make Learner understand the principle of instrumentation of various analytical techniques. 2) To help the learner understand how the chemical or physical properties help in choosing as proper analytical technique. 3) To develop analytical thinking, enhance student's understanding as how structures of new molecules are interpreted by using analytical techniques

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the important terms, principles, factors which govern the principles, Instrumentation and working of various analytical tools like NMR, Mass spectrometry, and chromatographic techniques.	1,6,7
CO2	Choose proper analytical tool, illustrate and apply his understanding in making decisions related to application of the tools for quality control and assurance of pharmaceutical products.	1,6,8
CO3	Interpret the analytical data and use the same for structural elucidation of organic compounds, quantitative and qualitative evaluation	1,2,6,8

Topics covered :

Unit I:	Multicomponent analysis by UV Spectroscopy	**Hours: 2**

Assay as a single component sample
Corrected interference
Assay after solvent extraction
Simultaneous Equation method
Absorbance Ratio method
Difference Spectroscopy method
Derivative Spectroscopy

Unit II:	Concepts of Chromatography	**Hours: 6**

Terminologies: stationary phase, mobile phase, retention time, gradient and isocratic elution, normal and reverse phase chromatography, planar chromatography, retention factor, chromatogram, internal standard, reference standard, working standard, tailing factor (symmetry factor), asymmetry factor, resolution, signal to noise ratio, column chromatography, preparative chromatography, adsorption chromatography and partition chromatography.

Classification of chromatographic methods (Self study-0.5 hr) Quantitative analysis (Peak height, peak areas, calibration curve, internal standard, and area normalization) Optimization of column performance (Column efficiency and band broadening, shape of peak-Gaussian, Plate height, Number of theoretical plates, van Deemter equation, Capacity factor, Selectivity factor, Tailing factor, peak width, and Resolution) Numericals related to column performance.		
Unit III:	High Performance Liquid chromatography (HPLC)	**Hours: 4**
Instrumentation: Mobile phase reservoir Pumps (reciprocating, displacement, pneumatic) (Self study-30 min0.5 hr) Sample injection systems (Rheodyne injector and autosampler) Column types (analytical, guard and preparative columns) and column packing (porous, pellicular and monolithic), Detectors (Concept of solute and bulk property detector-Refractive index ,UV-Vis, Phototodiode array, fluorescence, , Electrochemical, Evaporative Light Scattering), Difference between UPLC and HPLC (Self study-0.5 hr) Applications, Advantages and Limitations of HPLC (Self study-0.5 hr)		
Unit IV:	Gas chromatography (GC)	**Hours: 3**
Introduction Instrumentation Carrier gas supply Sample injection system including Head space analysis Columns (Packed, Open tubular columns, Capillary columns) and column ovens (Self study-0.5 hr) Detectors (Thermal conductivity, Electron capture, Flame ionization) Applications, Advantages and Limitations of GC (Self study-0.5 hr)		
Unit V:	Planar chromatography	**Hours: 3**
Paper chromatography-Principle, Developmental techniques (Ascending, Descending, Radial and Two-dimensional), Spray reagents and Pharmaceutical applications (Self study-0.5 hr) TLC-Principle, types of adsorbents, Developmental techniques (Self study-0.5 hr), Visualisation techniques, factors affecting resolution, Pharmaceutical applications of TLC and Preparative TLC. HPTLC-Advantages of HPTLC over TLC and HPLC (Self study-0.5 hr) Instrumentation-Applicator, photodensitometry, photodocumentation.		
Unit VI:	Ion exchange chromatography, Ion Pair and Size Exclusion chromatography Principle, Stationary phases, Mobile phases and Applications (Self study-0.5 hr)	**Hours: 3**

Unit VII:	Nuclear Magnetic Resonance Spectroscopy (1H-NMR)	**Hours: 8**
1H-NMR phenomenon- spinning nucleus, precessional motion, precessional frequency, gyromagnetic ratio, energy transitions and relaxation processes, NMR Spectra, Chemical shift, shielding and deshielding, Vanderwaal's deshielding, Deuterium exchange, Chemical and magnetic equivalence, anisotropic effect (eg. Alkanes, alkenes, alkynes, carbonyl, aromatic and cyclohexane), Solvents, Reference compounds and internal standards. Measurement of chemical shift: Scales used. Factors affecting chemical shift (Electronegativity-Shielding and Deshielding, Vanderwaal's deshielding, anisotropic effect) Instrumentation of NMR Spectrometer (including schematic representation) (Self study-0.5 hr) Principle of FT NMR (including representation of conversion of time domain spectra to frequency domain spectra) Spin-spin coupling-Spin-Spin splitting: N+1 rule (Pascal's triangle), theory of spin-spin splitting, formation of doublet, triplet and quartet due to possible spin orientations, inverted tree diagram, Coupling constants & values for alkyl, alkenyl , aromatic). Information obtained from proton NMR-Chemical shift, splitting, coupling constant, integration. (Self study-0.5 hr)		
Unit VIII:	Mass Spectrometry	**Hours:8**
Principle & basic theory- Mass spectrum, relative abundance, mass to charge ratio, molecular ion, fragment ion (daughter ion), metastable ion, base peak, isotope peak, mass to charge ratio. Instrumentation: Basic components of mass spectrometer (including block diagram). Ionisation methods: Electron Ionisation, Chemical Ionisation, Desorption Ionisation (MALDI), Fast Atomic Bombardment, Atmospheric Pressure Ionisation (Electrospray, APCI, APPI). Analysers: Quadrupole, Ion Trap and Time of Flight.		
Unit IX:	Hyphenated techniques	**Hours: 2**
Significance, interfaces and applications of LC-MS GC-MS (Self study-1 hr)		
Unit X	Structure Elucidation by spectral techniques using UV, IR, 1H-NMR and Mass spectrometry UV-Woodward Fieser rules for predicting λmax (acyclic & cyclic dienes, and α, β unsaturated ketones (acyclic and 6 membered ring). (Note-only alkyl substituents to be studied). (Practice problems-Self study-0.5 hr)	**Hours:8**

	Elucidation of structure of a compound using IR and 1H NMR data- Problems for simple organic compounds with molecular formula given (Practice problems-Self study-0.5 hr) Mass spectrometry: Fragmentation: Representation of fragmentation process, Basic types of fragmentation: Fissions (homolytic and heterolytic, α and β fission). Rearrangement (McLafferty, Retro Diel-Alders, 4-membered cyclic rearrangement) Nitrogen rule and Even electron rule. (Practice problems-Self study-0.5 hr min)	
Unit XI	Analytical method Validation as per ICH guidelines. (Self study- 0.5 hr)	**Hours:2**
Reference material:	1. D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, Saunders College Publishing, USA. 2. K. A. Connors, A Textbook of Pharmaceutical Analysis, John Wiley and Sons, Canada. 3. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Vol. 6, Part I and II, CBS Publishers and Distributors, India. 4. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Saunders College Publishing, USA. 5. G. D. Christian, Analytical Chemistry, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd. 6. H.H. Willard, L. L. Merrit and J. A. Dean, Instrumental Method of Analysis, CBS Publishers & Distributors, New Delhi. 7. Ashutosh. Kar, Pharmaceutical Drug Analysis, New Age International (P) Ltd. Publishers, India. 8. S. S. Mahajan, Instrumental Methods of Analysis, Popular Prakashan Pvt Ltd., India. 9. G. R. Chatwal and S. K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House Pvt. Ltd. 10. Indian Pharmacopoeia, The Indian Pharmacopoeia Commission, Ghaziabad, Government of India. 11. United States Pharmacopeia 12. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, 13. Pearson Education Ltd. 14. D. G. Watson, Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists.	

	15. Churchill Livingstone Elsevier. 16. J. W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, Marcel Dekker, New 17. York, USA. 18. R. Kellnar, J. M. Mermet, M. Otto, M. Valcarceland, H. M. Widmer, Analytical Chemistry: A modern approach 19. to analytical science, Wiley-VCH, USA. 20. J. W. Munson, Pharmaceutical Analysis: Modern methods (in two parts), Marcel Dekker Inc., USA. 21. W. Kemp, Organic Spectroscopy, Palgrave Publishers Ltd., New York, USA. 22. R. M. Silverstein, F. X. Webster and D. J. Kiemle, Spectrometric identification of organic compounds, John 23. Wiley & Sons, Inc. (Indian edition), New Delhi. 24. D. B. Troy and P. Beringer, Remington-The Science and Practice of Pharmacy, Vol-I & II, Wolters Kluwer/ 25. Lippincott Williams & Wilkins (Indian edition), New Delhi. 26. J. W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, Marcel Dekker, New 27. York, USA. 28. J. R. Dyer, Applications Of Absorption Spectroscopy Of Organic Compounds, Prentice- Hall of India Pvt Ltd, 29. New Delhi, India. 30. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, Brooks/Cole Cengage 31. Learning, Australia. 32. Y. R. Sharma, Elementary organic spectroscopy-Principles and Chemical Applications, S. Chand & Company Ltd, 33. New Delhi, India. 34. L. R. Snyder, J. J. Kirkland, J. L. Glajch, Practical HPLC Method Development, Wiley-Interscience publication, 35. John Wiley & Sons, Inc., Canada. 36. S. Ahuja and M. W. Dong, Handbook of Pharmaceutical Analysis by HPLC, Volume 6 of Separation Science and 37. Technology, Elsevier Academic Press, Indian edition.

Course: Pharmacology – III (CBSGS)		
Course Code: DPL-08	**Final Year B. Pharm**	**Semester: VII**
Type of course : Theory	**Contact Hours: 3 Hrs/week**	

Course assessment Methods:	Continuous mode of assessment				Semester-end assessment
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Anatomy and physiology of nervous tissue, central nervous system, respiratory system and their related diseases. • Anatomy, physiology of digestive system and diseases related to it.				
Course objectives :	1. To give specific insights into the principal pharmacological actions and clinical uses of anti-inflammatory agents and drugs acting on central nervous system, gastrointestinal system. 2. To familiarize the students with symptoms and treatment of heavy metals (Lead, Mercury, Arsenic), pesticide, methanol and opioid poisoning.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Classify drugs acting on central nervous system (CNS) into correct therapeutic categories; correlate the pathophysiology of few common disorders of CNS to their pharmacotherapy; explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs.	1,3,4,7,8
CO2	Outline steps involved in biosynthesis of autacoids; describe actions and effects of various autacoids; explain their principal pharmacological actions including the mode of action, side effects and uses, including those used to treat pain and inflammatory disorders.	1,3,4,7,8
CO3	Classify drugs acting on gastrointestinal system into correct therapeutic categories; correlate the pathophysiology of few common disorders of gastrointestinal system to their pharmacotherapy; explain the principal pharmacological actions, including the mode of action, side effects and uses of related drugs.	1,3,4,7,8
CO4	Describe symptoms of methnol, heavy metals, opioids and pesticide poisoning and suggest treatment for the same.	1,3,4,7,8

Topics covered :		
Unit I:	**Drugs acting on Central Nervous System**	**Hours: 23**
• Aliphatic alcohols • General and Local anesthetics		

<table>
<tr><td colspan="3">

Sedatives, Hypnotic and anxiolytic agents
Antiepileptic drugs
Drugs Used in Parkinson’s disease
Drugs used in Alzheimer’s disease
Antipsychotic, antidepressant, anti-mania drugs
Opioid analgesics
CNS stimulants
SELF STUDY:

Physiology of CNS and central neurotransmitters

</td></tr>
<tr><td>Unit II:</td><td>Autacoids; Drug therapy of inflammation</td><td>Hours: 10</td></tr>
<tr><td colspan="3">

Histamine, bradykinin and their antagonists
Serotonin, agonists and antagonists
Lipid derived autacoids, Eicosanoids and platelet activating factor
NSAIDs
Pharmacotherapy of Asthma
SELF STUDY:

Pharmacotherapy of Gout

</td></tr>
<tr><td>Unit III:</td><td>Drugs acting on gastrointestinal tract</td><td>Hours: 9</td></tr>
<tr><td colspan="3">

Antacids and Drugs for peptic ulcers
Emetics, antiemetics and Prokinetics
Drugs for constipation and diarrhoea
Drugs for Inflammatory Bowel Diseases
SELF STUDY:

Innervations and hormones of GIT: Neuronal control and hormonal control

</td></tr>
<tr><td>Unit IV:</td><td>Principles of Toxicology</td><td>Hours: 3</td></tr>
<tr><td colspan="3">

Heavy metals (Lead, Mercury, Arsenic)Poisoning
Pesticide and Opioid Poisoning and treatment
SELF STUDY:

Environmental toxicants

</td></tr>
<tr><td>Reference material:</td><td colspan="2">Latest editions of the following books to be adopted
1. Goodman & Gilman’s Pharmacological Basis of Therapeutics, McGraw Hill Companies Inc.
2. Satoskar R.S. Bhandarkar S.D. &Rege N.N. Pharmacology & Therapeutics, Popular Prakashan.
3. Rang & Dale Pharmacology, Churchill Livingstone.
4. Lippincott’s Illustrated Reviews: Pharmacology- Lippincott-Raven Howland &Nyeets Publishers NY.
5. Laurence D.R. & Bennett Clinical Pharmacology, Elsevier NY.
6. Kulkarni S.K. Handbook of Experimental Pharmacology, VallabhPrakashan, New Delhi.</td></tr>
</table>

	7. B.G.Katzung-Basic and Clinical Pharmacology, Appleton and Lange publications. **8.** Ghosh M.N. Fundamentals of Experimental Pharmacology Hilton & Company, Kolkata.

Course: Pharmaceutics IV (CBSGS)					
Course Code: DPH 16	**Final Year B. Pharm**				**Semester: VII**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Prior knowledge of Preformulation, basic pharmaceutics, anatomy and physiology. • Basic understanding of microbiology and sterilization process. Basic knowledge of simple mathematical calculations. Basic knowledge of chemical reactions like hydrolysis and oxidation.				
Course objectives :	Course is designed to introduce the students to the concept of Novel drug delivery systems.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the different routes of drug administration like parenteral, ocular and oral for sustained and controlled release systems.	1,2
CO2	Integrate acquired knowledge to suggest safe and effective formulation, processing and control of parenteral, ocular and oral products.	1,2
CO3	Explain the platform technologies for oral SR/CR products.	1,2
CO4	Understand stability of the drugs and pharmaceuticals, ICH guidelines and the regulatory aspect of marketing a drug product globally.	1,2,3

Topics covered :		
Unit I:	Introduction to sterile dosage forms - Parenteral products.	**Hours: 16**
Various routes of parenteral administration, pyrogens, vehicle,- WFI preparation, purity, storage and distribution, vehicles other than WFI, additives in parentertal		

<table>
<tr><td colspan="3">products.
Containers - glass and plastics- types and evaluation, rubber closures and testing.
Personnel, facilities- layout, environmental control cleanliness classes, air handling (HVAC systems), HEPA filters, laminar flow
SVP – formulation considerations, types, product procedures, freeze drying.
LVP – types, formulation aspects, packaging.
QA & QC- sterility test, pyrogen/ endotoxin test, particulate evaluation, leaker test.</td></tr>
<tr><td>Unit II:</td><td>Ophthalmic Products</td><td>Hours: 9</td></tr>
<tr><td colspan="3">Physiology of eye lachrymal system, tears, precorneal tear film, cornea, ocular bioavailability
Formulation and packaging of various ophthalmic products - solutions, suspension, ophthalmic ointments and gels, preservatives and efficacy test, additives
QA and QC sterility test, clarity, particle size for suspension, tests on ointments and collapsible tubes
Contact lens solutions: types of lenses, cleaning solution, disinfection solution, lubricants, multipurpose solutions and packages</td></tr>
<tr><td>Unit III:</td><td>Oral sustained and controlled release systems</td><td>Hours: 10</td></tr>
<tr><td colspan="3">Advantages of SR systems, biopharmaceutical consideration and dose calculation of drug loading, maintenance
Properties of drug with reference to the design of oral SR systems
Matrix and reservoir type of systems, dissolution controlled systems, diffusion controlled systems, ion exchange controlled systems
Evaluation of sustain release systems</td></tr>
<tr><td>Unit IV:</td><td>Stability Studies</td><td>Hours: 9</td></tr>
<tr><td colspan="3">Importance of stability studies, kinetic principles, Arrhenius equation and derivation of shelf life based on Arrhenius equation, limitations and advantages of Arrhenius equation
Degradation pathways- hydrolysis, oxidation, photolytic degradation, methods to enhance stability of drugs
Accelerated stability studies, introduction to ICH guidelines
Interactions with containers and closures</td></tr>
<tr><td>Reference material:</td><td colspan="2">1. Pharmaceutical Dosage forms, Parenteral Medications. Vol I.II.III, Ed. By Kenneth A. Avis, Leon Lachman, and H .A. Liberman. Marcel Dekker INC.
2. Pharmaceutics. The science of dosage form design, Ed. M. E. Aulton, Churchill Livingstone.
3. Modern Pharmaceutics, Ed. By Gilbert S. Banker and Christopher T. Rhodes. Marcel Dekker INC.
4. The Theory And Practice of Industrial Pharmacy, Ed. By Leon Lachman, H. A. Liberman, J. L. Kaing; Varghese Publishing House.
5. Remington, The Science and Practice of Pharmacy, Vols. I and II,</td></tr>
</table>

	B.L. Publications Pvt. Ltd. 6. Ophthalmic Drug Delivery Systems, Edited by Ashim K. Mitra, Volume 58, Marcel Dekker INC. 7. Turco and Kings, Sterile Dosage Forms, Lea and Febiger, Philadelphia. 8. Michel J. Akers, Quality Control of Parenterals, Marcel Dekker INC. 9. Controlled Drug Delivery-Fundamentals and Applications, Robinson Joseph R., Lee Vincent H, Vol 29, Marcel Dekker INC. 10. Pharmacetuical Technology, Vols. I, II, RSR Murthy, Ashutosh Kar, New Age Publishers, New Delhi

Course: Pharmacognosy & Phytochemistry II (CBSGS)					
Course Code: DPG 02	**Final Year B. Pharm**				**Semester: VII**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	▪ General scheme of pharmacognostic study of crude drug. ▪ Various evaluation parameters of Drugs of Natural Origin as per WHO and its significance. ▪ General biosynthetic pathway of primary and secondary metabolites. ▪ Basic knowledge of medicinal botany, various extraction processes and phytoconstituents (primary & secondary metabolites).				
Course objectives :	1. To give insight of pharmacognostic study of various secondary metabolites like alkaloids and glycosides and their biosynthetic pathway. 2. To acquaint the learners with crude drugs as Lipids, Tannins, Pesticides, Nutraceuticals and drugs containing Sulphides, polyacetylenes and their role in health care industry.				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**

CO 1	Acquire the knowledge of Pharmacognostic study of crude drugs containing Lipids, Tannins, Alkaloids, Glycosides.	1, 4, 7
CO 2	Describe the biosynthetic pathway of Alkaloids and Glycosides.	1, 7
CO 3	Acquire the knowledge of Pharmacognostic study of crude drugs containing Pesticides, Nutraceuticals and drugs containing Sulphides, polyacetylenes.	1, 4, 7

Topics covered :

Drugs indicated in bold font are to be studied for detailed pharmacognostic scheme

Unit I:	**Lipids (Waxes, fats, fixed oils)**	**Hours:10**

1.1. General introduction to lipids.

Study of the following drugs with respect to sources, classification, general properties, methods of extraction, preservation, storage, composition, evaluation, therapeutic uses and general applications. – Arachis, castor, sesame, linseed, jojoba, olive, almond, mustard, cottonseed, coconut, safflower, sunflower, croton, neem, rice bran, wheatgerm, hydnocarpus, cod-liver oil.

Self study

• Methods of storage and preservation of oils and fats.

1.2. Detailed study of following lipids with respect to chemistry, sources, extraction & / or preparation, preservation, evaluation and therapeutic use - Kokum butter, coca butter, Shea butter, woolfat, spermaceti wax, beeswax, carnauba wax, lecithin and introduction to glycolipids.

Self study –

• Spermaceti and its substitutes

• Uses and examples of glycolipids

Unit II:	**Tannins**	**Hours: 04**

2.1. Introduction to the structures of simple phenolics and their occurrence. Introduction to tannins and their definition, classification, occurrence, chemistry, detection, estimation and therapeutic applications.

2.2. Study of sources, composition, extraction and applications of Galls, catechu (pale & black) & Kino. Study of following tannin containing members with respect to their sources, properties, and therapeutic applications - arjuna, ashoka, harda, behra, green tea, pomegranate peel.

Study of urushiol from poison ivy.

Self study-

• Role of tannins in healthcare with suitable examples

Unit III:	**Alkaloids:**	**Hours:15**

3.1. Introduction to alkaloids- Definition, classification, properties, general methods of extraction, detection and estimation. Study of following drugs containing alkaloids with respect to their chemistry (structures), sources, salient features of extraction and specific tests for detection (if any) and biopotenial :

Alkaloidal Amines – Ephedra, colchicum
Tropane - belladonna, datura, stramonium, hyoscyamus, coca, Ashwagandha
Indole - Rauwolfia, vinca, nux vomica, ergot
Steroidal – kurchi
Terpene – Aconite
Quinazoline – Vasaka

3.2. Study of following drugs containing alkaloids with respect to their chemistry (structures),sources, salient features of extraction and specific tests for detection (if any) and biopotenial :
Benzyl isoquinoline – opium
Isoquinoline - Ipecac, hydrastine, berberine, curare alkaloids
Quinoline - cinchona
Pyridine-Piperidine – Tobacco, Lobelia, pepper
Purine - cocoa, tea, coffee, cola
Glycoalkaloids – Solanum
Imidazole – Pilocarpus

3.3. Biosynthesis of lysergic acid, opium alkaloids, tropane alkaloids, colchicines, emetine, quinine.
Self study –
• Pharmacopoeial status of any five alkaloidal drugs

Unit IV:	**Miscellaneous phytochemicals**	**Hours:03**

4.1. Polyacetylenes
Introduction to composition & properties of polyacetylenes from matricaria
Sulphur containing compounds
Thiophenes from tagetes. Study of sources, structure and properties of sulphur containing compounds from Allium species (A. cepa and A. sativum).
Napthoquinones
Study of alkana, henna, and plumbago with respect to active constituents and uses.
Benzoquinone
Study of Embelia ribes.

Unit V:	**Glycosides**	**Hours: 08**

5.1. Introduction to glycosides their occurrence, chemistry, extraction and uses
a) Anthroquinone - Rubia, cochineal, **aloes**, hypericum, cascara, andira, **senna**, rhubarb.
Biosynthesis of Aloe emodin
Self study –
• Commercial uses and preparation of aloes

5.2. Chemistry, extraction & uses of following classes of glycosides :
b) Isothiocyanate - Brassica
c) Cyanogenetic - bitter almond, wild cherry
Biosynthesis of amygdaline

Unit VI:	Pesticides of natural origin	Hours:03
6.1. Detailed study of following pesticides of natural origin with respect to their merits demerits, sources, active constituents and applications - Neem, Pyrethrum & Tobacco Self Study • Commercially available pesticides and their composition		
Unit VII:	**Nutraceuticals**	**Hours:02**
7.1. Introduction to nutraceuticals. Study of the following drugs as nutraceuticals with respect to biological source, probable active constituents anduses – Alfalfa, Arnica, Apricot pits, bran, Chamomile, Chicory, Cucumber, Fenugreek, Onion, Garlic, Hydrocotyle, Hibiscus, Hops, Honey, Marigold, Amla, Ginseng, Ashwagandha, Gingko biloba, Spirulina, Gymnema, Momordica, Tinospora. Self study: • Study of marketed nutraceutical preparations (any 2)		
Reference material:	**Latest Editions of the following books to be adopted.** 1. Trease D. & Evans W.C.: Text Book of Pharmacognosy:W.B. Saunders. 2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA. 3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi. 4. Kokate C. K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune. 5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London. 6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited. 7. Vasudevan T. N. & Laddha K. S.: A Textbook of Pharmacognosy, Vrinda PublicationHouse, Jalgaon. 8. The Indian Pharmacopeia: The Controller of Publication; Delhi. 9. Brain K. R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol. 10. Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press,Manipal. 11. Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal. 12. Kokate C. K. : Practical Pharmacognosy; Vallabh Prakashan. 13. Wagner, Bladt & Zgainski; plant Plant Drug Analysis; Springer Verlag. 14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune.	

	15. Vasudevan T. N. Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

Course: Pharmaceutical Jurisprudence (CBSGS)					
Course Code: DPH 17	**Final Year B. Pharm**				**Semester: VII**
Type of course : Theory			**Contact Hours: 3 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	This course does not require any prior knowledge or skills.				
Course objectives :	The course is designed to provide detailed information about the drug and cosmetics regulatory aspects at national level.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand and apply laws pertaining to Import, Manufacture and Sale of Drugs and Cosmetics	1,2
CO2	Describe laws pertaining to regulation of pharmacy education its practice in India	1,2
CO3	Comprehend Government policies on Drug Pricing, Control of Narcotics and Psychotropic Drugs	1,2

Topics covered :		
Unit I:	Historical perspectives including details of Chopra Committee and Hathi Committee	**Hours: 1**
Unit II:	Pharmacy Act 1948	**Hours: 5**
Definitions Pharmacy Council of India and State Councils : Composition and Functions Preparation of registers and qualifications for entry into registers Educational Regulations and Approval of Courses and Institutions Offences and Penalities		
Unit III:	Drugs and Cosmetics Act 1940 and Rules 1945	**Hours: 18**
Definitions Advisory Bodies : DTAB and DCC : Composition and Function 2 Analytical Bodies : Drug control Laboratories and Government Analyst Executive Bodies : Licensing Authorities, Controlling Authorities, Drug Inspectors		

and Customs Collectors Provisions regarding Import of Drugs Provisions regarding Manufacture of Drugs Provisions regarding Sale of Drugs Labeling and Packing of Drugs Provisions applicable to Manufacture, Sale, labeling and Packing of Ayurvedic Drugs 1 Provisions applicable to Import, Manufacture, Sale, labeling and Packing of Homeopathic Drugs Provisions applicable to Import, Manufacture, Sale, labeling and Packing of Cosmetics Offences and corresponding penalties Broad Content of various Schedules of the Drugs and Cosmetics Act; Schedule M and Schedule Y in moderate details		
Unit IV:	Drugs and Magic Remedies (Objectionable Advertisements) Act	**Hours: 3**
Definitions Prohibited Advertisements, Savings Case studies		
Unit V:	Narcotic Drugs and Psychotropic Substances Act 1985	**Hours: 3**
Definitions Narcotics Commissioner and other Officers Illicit Traffic and measures to prevent illicit traffic of opium 12 Offences and corresponding penalties		
Unit VI:	Drugs Prices Control Order 2013	**Hours: 3**
Background of DPCO Definitions Calculation of prices for drug products Micellaneous heads under the order		
Unit VII:	Medicinal and Toilet Preparation (Excise Duties Act) 1955	**Hours: 2**
Definitions, restricted and unrestricted preparations Manufacturing in bond and outside bond		
Unit VIII:	Food Safety and Standards Act 2006 and Rules 2011	**Hours: 2**
Definitions : Food, Adulterant and Food additive Authorities and bodies : Food Safety and Standards Authority of India, Central Advisory Committee, Food safety Officer, Commissioner of Food Safety in the State, Analytical Laboratories and Food Analysts Packaging and Labeling of Foods		
Unit IX:	Indian Patents Act 2005	**Hours: 3**
Background : Intellectual Property and its types		

Definitions, features of a patent Criteria for patentability and inventions not patentable in India Process of patenting in India		
Unit X:	Bombay Shops and Establishments Act	**Hours: 1**
Definitions of Shops and Commercial Establishments and Provisions under the Act in Brief		
Unit XI:	Factories Act 1954	**Hours: 1**
Definitions 11.2 Provisions under the Act in Brief		
Unit XII:	Indian Penal Code and Code of Criminal Procedures	**Hours: 1**
Provisions pertaining to different courts, jurisdiction and power Provisions governing entry, search, arrest, bailable and non-bailable offences, cognizable and non-cognizable offences		
Unit XIII:	Introduction To Drug Regulatory Affairs	**Hours: 2**
Brief overview of Drug Regulatory Agencies of US, Australia, Europe, UK, Japan and Australia. Introduction to USFDA, European, ICH and WHO guidelines		
Reference material:	1. Govt. Of India Publications of above Acts and Rules. 2. Kuchekar B. S., Khadtare A. M., Itkar S. C., Forensic Pharmacy, Nirali Prakashan. 3. N. K. Jain, Textbook of Forensic Pharmacy, Vallabh Prakashan. 4. Mittal B. M.- A Textbook of Forensic Pharmacy, Vallabh Prakashan. 5. Deshpande S. W. -Drugs & Cosmetics Act. 6. Guarino Rechard A. – New Drug Approval Process, Marcel Decker.	

Course: Pharmaceutical analysis Laboratory III (CBSGS)			
Course Code: DPC48	**Final Year B. Pharm**		**Semester:VII**
Type of course : Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**5**	**5**	**40**
Pre-requisites	• Well versed with the dilution calculation.		

:	• Handling of pipettes and use of volumetric flask and filtration techniques. He should have understanding of calibration and use of standards. • Basic understanding of GLP in lab
Course objectives :	1. To understand the GLP in analytical lab and how GLP helps in minimizing errors in analytical lab. 2. To understand the working of the colorimeter, flurimeter,Uv and HPLC 3. To enhance the sample preparation and analytical skills for single and multicomponent analysis

Course Outcomes:		**PO Mapped**
CO1	Learner will be able to understand the principles and purpose of each analytical experiment. He will be able to distinguish, compare between various analytical tools or procedures and understand the judicious choice of particular analytical tool or procedure for analyzing a sample	1,6,7
CO2	He would be able to execute the analytical procedure adhering to Good laboratory practice and infer the findings and conclude if the sample analyzed is of pharmacopeial standards.	1,8
CO3	He would be able to demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3

Topics covered :

Unit I:	Determination of pka 1 and pka 2 of phosphoric acid.	**Hours: 4**
Unit II:	Determination of HCl and phosphoric acid in a given mixture potentiometrically	**Hours: 4**
Unit III:	Assay of paracetamol tablets, propanolol tablets, albendazole tablets, Rifampicin capsules as per I. P.	**Hours: 4**
Unit IV:	Assay of quinine sulphate by fluorimetry	**Hours: 4**
Unit V:	Study of quenching effects of iodide ions on fluorescence of quinine sulphate	**Hours: 4**
Unit VI:	Assay of phenylephrine hydrochloride ophthalmic solution by difference spectroscopy.	**Hours: 4**
Unit VII:	Assay of caffeine and sodium benzoate injection by simultaneous equation method and absorbance ration method.	**Hours: 4**
Unit VIII:	Assay of trimethoprim in cotrimoxazole tablets as per I. P.	**Hours: 4**
Unit IX:	Assay of nifedipine and atenolol tablets by UV.	**Hours: 4**
Unit X	Determination of streptomycin base colorimetrically from	**Hours: 4**

	Injection.	
Unit Xi	Identification of sample by TLC.	**Hours: 4**
Unit XII	**Demonstration experiments:** 1. Assay of sample by HPLC/ HPTLC/ GC. 2. Qualitative analysis by I. R. 3. Determination of K+ from KCI by flame photometry. 4. Selection of mobile phase for TLC. 5. Identification of amino acids by paper chromatography.	**Hours: 4**
Reference material:	1. A.H. Beckett and J.B. Stenlake, Practical Pharmaceutical Chemistry, 4th Edn., Part I and II, CBS Publishers and Distributors, India, 2005. 2. G. D. Christian, Analytical Chemistry, 6th Edn., John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd., 2008. 3. Indian Pharmacopoeia, The Indian Pharmacopeia Commission, Ghaziabad, Government of India, 2010. 4. United States Pharmacopeia 5. J. Mendham, R. C. Denney, J. D. Barnes, M.J. K. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, 6th Edn., Pearson Education Ltd, 2002. (Seventh impression 2008) 6. D.G. Watson, Pharmaceutical Analysis –A textbook for pharmacy students and pharmaceutical chemists. 3rd Edn., Churchill Livingstone Elsevier, 2012. 7. L. R. Snyder, J. J. Kirkland, J. L. Glajch, Practical HPLC Method Development, 2nd Edn., Wiley-Interscience Publication, John Wiley & Sons, Inc., Canada, 1997. 8. S. Ahuja and M. W. Dong, Handbook of Pharmaceutical Analysis by HPLC, Volume 6 of Separation Science and Technology, 1st Edn., Elsevier Academic Press, Indian edition, 2009.	

Course: Pharmaceutics Lab IV (CBSGS)			
Course Code: DPH 18	**Final Year B. Pharm**		**Semester: VII**
Type of course : Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	Prior knowledge of basic pharmaceutics, simple calculations and		

	handling glassware and analytical instruments. Have basic understanding of unit processes like dispensing and mixing. Basic understanding of microbiology and sterilization process.
Course objectives :	To train the learner with the practical aspects of formulation, manufacturing and quality control tests of parenteral and ophthalmic products.

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Demonstrate the intricacies of formulation and development of parenterals and ophthalmic products.	2,4,5
CO2	Understand and know about quality control and documentation of a manufacturing process.	2,4,5
CO3	Know about the pharmacopoeial tests for these products and their packaging material.	2,4,5
CO4	Predict shelf life of the product by accelerated stability studies.	1, 2
CO5	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	3

Topics covered :

Unit I:	Preparation and monographic testing of Water for Injection IP.	**Hours: 2**
Unit II:	Processing and monographic testing of Glass containers and rubber closures as per IP.	**Hours: 4**
Unit III:	Product –Package interaction- quantitative estimation of preservative absorption by rubber closures.	**Hours: 4**
Unit IV:	Preparation and documentation of the following injections: a. Sodium chloride and Dextrose injection IP. b. Calcium gluconate injection IP c. Ascorbic acid injection IP. d. Official injection using an oily vehicle e. Official parenteral suspension	**Hours:12**
Unit V:	Preparation and documentation of following ophthalmic products: a. Sulphacetamide eye drops, BPC. b. Official antibiotic eye ointment c. Contact lens solution	**Hours: 10**
Unit VI:	Accelerated stability testing of Aspirin	**Hours: 4**
Unit VII:	Sterility test and environmental control - Demonstration	**Hours: 4**
Reference Books	1. Pharmaceutical Dosage forms, Parenteral Medications. Vol I.II.III, Ed. By Kenneth A. Avis, Leon Lachman, and H .A. Liberman.	

	Marcel Dekker INC. 2. Pharmaceutics. The science of dosage form design, Ed. M. E. Aulton, Churchill Livingstone. 3. Modern Pharmaceutics, Ed. By Gilbert S. Banker and Christopher T. Rhodes. Marcel Dekker INC. 4. The Theory And Practice of Industrial Pharmacy, Ed. By Leon Lachman, H. A. Liberman, J. L. Kaing; Varghese Publishing House. 5. Remington, The Science and Practice of Pharmacy, Vols. I and II, B.L. Publications Pvt. Ltd. 6. Ophthalmic Drug Delivery Systems, Edited by Ashim K. Mitra, Volume 58, Marcel Dekker INC. 7. Turco and Kings, Sterile Dosage Forms, Lea and Febiger, Philadelphia. 8. Michel J. Akers, Quality Control of Parenterals, Marcel Dekker INC. 9. Controlled Drug Delivery-Fundamentals and Applications, Robinson Joseph R., Lee Vincent H, Vol 29, Marcel Dekker INC. 10. Pharmacetuical Technology, Vols. I, II, RSR Murthy, Ashutosh Kar, New Age Publishers, New Delhi. 11. Current editions of IP, BP and USP

Course: Pharmacology Lab. – II (CBSGS)			
Course Code: DPL-09	**Final Year B. Pharm**		**Semester: VII**
Type of course : Practical	**Contact 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Basic knowledge of biology, knowledge of dose response relationship and drug-receptor interaction, concept of agonist, antagonist; types of antagonism. • Skill to set up isolated tissue preparation and plot dose-response curve • Knowledge of drugs acting on CNS- sedative hypnotics, anti-Parkinsonian agents, anti-psychotics, anti-epileptics; and analgesics.		

Course objectives :	1. To introduce students to different methods of bioassay. 2. To develop skills for performing *in-vitro* pharmacological experiments. 3. To enable students to interpret experimental results of *in-vitro* and *in-vivo* pharmacological experiments and draw conclusions. 4. To enable students to correlate the experimental findings to theoretical concepts. 5. To introduce to students the guidelines of toxicity studies.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Explain concepts of bioassays, skillfully handle isolated tissues and determine concentration of test samples using different methods of bioassays.	1,2,3,4,7,8
CO2	Describe principle and interpret data of preclinical models used to screen analgesic, skeletal muscle relaxant, locomotor, anti-epileptic and anti-catatonic activity of said drugs	1,2,3,4,7,8
CO3	Explain principles and outline protocols of toxicity studies	1,3,4,7,8
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	2,3,4,5,7,8
Topics covered :		
Unit I:	**Experiments:**	
• Bioassay of Acetylcholine using suitable isolated tissue preparation e.g. Cock ileum • Bioassay of Atropine using suitable isolated tissue preparation e.g. Cock ileum		
Unit II:	**Demonstrations: (with kymograph recordings or audio-visual aids)**	
• Bioassay of oxytocin • Behavioral Pharmacology Demonstrations/ Simulated experiments (CDs). o To study effect of drugs on locomotor activity in rodents using actophotometer. o To study the muscle relaxant property of drug using Rota-rod. o To study analgesic activity of drug using an analgesiometer. o To study anticonvulsant activity of drugs using maximal electroshock/ chemically induced seizures. o To study phenothiazines induced catalepsy using suitable animal model.		
Unit III:	**Toxicity studies**	
• Introduction to CPCSEA, OECD guidelines • Introduction to acute, sub-acute and chronic toxicity studies		
Reference material:	**Latest editions of the following books to be adopted:** **1.** Kulkarni S. K. Handbook of Experimental Pharmacology,	

	Vallabh Prakashan, New Delhi. **2.** Ghosh M.N. Fundamentals of Experimental Pharmacology Hilton & Company, Kolkata. **3.** S. B. Kasture. A handbook of Experiments in Pre-Clinical Pharmacology, Career Publications. **4.** W. L. M. Perry, Pharmacological Experiments on isolated preparations, E & S Livingstone, Edinburg & London. **5.** Patil C. R. X-cology (Software), Pragati Book Co. Pvt. Ltd, Pune.

Course: Pharmacognosy & Phytochemistry – Lab. – II (CBSGS)			
Course Code: DPG 05	**Final Year B. Pharm**		**Semester : VII**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	▪ Should be well versed with working and application of microscope. ▪ Should have basic knowledge of plant tissues and cell contents.		
Course objectives :	1. To explain the basic techniques of section cutting, mounting, staining and significance of microscopic and morphological studies. 2. To enlighten Chromatography and Spectroscopy and its significance in evaluation of drugs of natural origin. 3. To demonstrate extraction process and Thin Layer Chromatography (TLC) of phytoconstituents in crude drugs and its estimation by spectroscopy.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Identify and recognize crude drug morphologically and study of systematic arrangement of tissues by microscopical examination.	1, 7
CO2	Identify the components of binary mixture by microscopy.	1, 7
CO3	Demonstrate extraction, identification and estimation of	1, 7

	Phytoconstituents by chromatography and spectroscopy.	
CO4	Demonstrate oral and written communication skills and ability to Plan the experimentation with proper time management	1, 3, 7
Topics covered :		
Unit I:	Study of morphology, histology and powder characteristics of cinchona bark and, extraction, chemical tests and TLC of quinoline alkaloids from Cinchona.	**Hours:04**
Unit II:	Study of morphology, histology and powder characteristics and tests for alkaloids of Rauwolfia.	**Hours: 04**
Unit III:	Study of morphology, histology and powder characteristics of leaflets of senna. Extraction, chemical test and TLC of anthraquinone glycosides from senna.	**Hours:04**
Unit IV:	Study of morphology , histology and powder characteristics of seeds of nuxvomica and extraction, chemical test and TLC of alkaloids of nux vomica	**Hours: 04**
Unit V:	Study of morphology and histology of Datura, Ephedra, Vasaka, Kurchi, Ashwagandha, Arjuna, linseed	**Hours: 12**
Unit VI:	Microscopical examination of powder mixtures of drugs mentioned above.	**Hours: 04**
Unit VII:	Extraction and quantification of any one alkaloid by U.V and Demonstration of HPTLC.	**Hours: 04**
Unit VIII:	Morphological identification of twenty crude drugs and their salient morphological features Arachis, Castor, Sesame, Almond, Mustard, Ashoka, Galls, Pale and black catechu, Colchicum, Coffee beans, Vinca leaf, Ergot/ long pepper, Rhubarb, Wild cherry bark, Neem seeds and leaves, Pyrethrum, Henna, Aconite, Pepper black, kokum.	**Hours: 04**
Reference material :	**Latest Editions of the following books to be adopted.** 1. Trease D. & Evans W.C.: Text Book of Pharmacognosy:W.B. Saunders. 2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA. 3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi. 4. Kokate C. K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune. 5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London. 6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.	

	7. Vasudevan T. N. & Laddha K.S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon. 8. The Indian Pharmacopeia: The Controller of Publication; Delhi. 9. Brain K. R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol. 10. Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal. 11. Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal. 12. Kokate C.K.: Practical Pharmacognosy; Vallabh Prakashan. 13. Wagner, Bladt & Zgainski; plant Drug Analysis; Springer Verlag. 14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune. 15. Vasudevan T. N. Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.

Semester VIII

<table>
<tr><td colspan="6">Course: Pharmaceutical Chemistry IV (CBSGS)</td></tr>
<tr><td>Course Code: DPC21</td><td colspan="4">Final Year B. Pharm</td><td>Semester: VIII</td></tr>
<tr><td colspan="2">Type of course : Theory</td><td colspan="4">Contact Hours: 3 Hrs/week</td></tr>
<tr><td>Course assessment Methods:</td><td colspan="3">Continuous mode of assessment</td><td colspan="2">Semester-end assessment</td></tr>
<tr><td>Assessment Tools:</td><td>MSE</td><td>Quiz</td><td>Attendance</td><td>STI</td><td>ESE</td></tr>
<tr><td>Max. Marks:</td><td>15</td><td>5</td><td>5</td><td>5</td><td>70</td></tr>
<tr><td>Pre-requisites :</td><td colspan="5">• Basic organic chemistry concepts which includes the knowledge of the IUPAC Nomenclature, Chemical structure and Stereochemistry of a molecule.
• Study of Autacoids and their role in inflammation l structure and Stereochemistry of a molecule.
• Mechanism of actions with effect of stereochemistry for various classes of drugs of a molecule.
• Concept of receptor site binding and their required structures body of a molecule.</td></tr>
<tr><td>Course objectives :</td><td colspan="5">To learn structural activity relationships and metabolites of Analgesic, ANS and CNS drugs.</td></tr>
<tr><td colspan="5">Course Outcomes: After the completion of course learner will be able to:</td><td>PO Mapped</td></tr>
<tr><td>CO1</td><td colspan="4">Understand pharmacokinetic, pharmacodynamics and chemistry aspects of drug molecules belonging to various classes like CNS drugs and NSAIDs.</td><td>1,4</td></tr>
<tr><td>CO2</td><td colspan="4">Apply the knowledge of structure to relate with biological activities and learn routes of synthesis of such molecules.</td><td>1,4</td></tr>
<tr><td>CO3</td><td colspan="4">Apply this knowledge to rationally develop new drug molecules using the knowledge of mode of action, route of synthesis and SAR.</td><td>1,4</td></tr>
<tr><td colspan="6">Topics covered :</td></tr>
<tr><td>Unit I:</td><td colspan="4">CNS Drugs</td><td>Hours:20</td></tr>
<tr><td colspan="6">Sedatives – Hypnotics
Barbiturates: phenobarbital, butabarbital, amobarbital, secobarbital, pentobarbital; benzodiadepines: chlordiazepoxide, diazepam, nitrazepam*, temazepam, alprazolam, estazolam; zolpidem, eszopiclone, ramelteon (last 3 for self study – 1 hr).</td></tr>
</table>

Types of seizures (Self study- 1 hr)
phenobarbital, mephobarbital, phenytoin, mephenytoin, ethotoin, trimethadione, ethosuximide, methsuximide, phensuximide, diazepam, clonazepam, carbamazepine*, valproic acid, vigabatrine, progabide, lamotrigine, tiagabine
Antidepressants
MAO Inhibitors (self study – 1 hr) Iproniazide, moclobemide, phenelzine, tranylcypromine; imipramine*, chlorimipramine, amitriptyline, nortriptyline, doxepine* fluoxetine*, paroxetine, sertraline, escitalopram, amoxapine
Anxiolytics
Oxazepam, buspirone, meprobamate, tybamate (last two for self study- 1 hr)
Antipsychotics
chlorpromazine*, triflupromazine, thioridazine, fluphenazine, trifluperazine, chlorprothixen(self study), haloperidol* (synthesis for self study- 1 hr), droperidol ,pimozide, risperidone, loxapine, clozapine, sulpiride
Antiparkinson's
carbidopa, levodopa, selegiline, amantadine, benztropine, procyclidine, orphenadrine (last 3 for self study- 1 hr)

Unit II:	ANS Drugs:	**Hours:17**

Adrenergic Drugs:
Alpha adrenergic agonists: phenylephrine*, naphazoline, xylometazoline, oxymetazoline, methyldopa, clonidine, guanabenz, guanafacine Beta agonists : Isoproterenol, colterol, metaproterenol, terbutaline*, albuterol, isoxsuprine, ritodrine Alpha antagonist : tolazoline, phentolamine, phenoxybenzamine, prazosin, doxazosin Beta Antagonists : pronethalol, propranolol*, pindolol, sotalol, timolol, atenolol, metoprolol, esmolol, acebutolol, carvedilol, labetalol* (last two for self study, including synthesis of labetalol) Other adrenergic agents (Self study-2 hrs) : amphetamine, pseudoephedrine, ephedrine, guanethidine, propylhexedrine, reserpine
Cholinergic Drugs
Muscarinic agonists : methacholine, carbachol, bethanechol, pilocarpine Acetylcholineesterase inhibitors : physostigmine, neostigmine*, pyridostigmine, edrophonium, echothiophate, malathion, parathion, paraoxonC, sarin, pralidoxime AntiAlzheimer's : Tacrine*, donepezil, rivastigmine Cholinergic antagonists : Atropine, scopolamine, homatropine, ipratropium
cyclopentolate*, dicyclomine*, benztropine, procyclidine, isopropamide, tropicamide, Ganglion blockers : (Self study- 1 hr) trimethaphan, mecamylamine, hexamethonium Neuromuscular blockers :(Self study) tubocurarine, gallamine, succinylcholine, decamethonium

Unit III:	Analgesic Drugs	**Hours:12**

Opioid peptides(Self study)
Different types of opioid receptors, agonists, partial agonists and antagonists of these receptors Morphine, codeine, levorphanol, buprenorphine, phenazocine, pentazocine,

meperidine*,alpha and beta prodine, pheniridine, anileridine, fentanyl, methadone, dextropropoxyphene*, tramadol, nalorphine, naloxone, naltrexone Antidiarrhoeals (Self study-1 hr) : loperamide, diphenoxylate

NSAIDS

paracetamol, aspirin, indomethacin, sulindac, mefenamic acid, ibuprofen, naproxen*, flurbiprofen, nabumetone, diclofenac*, piroxicam*, nimesulide, celecoxib, rofecoxib

Cytokine inhibitors :(Self study-1 hr) infliximab, rituximab, anakinra, abatacept

Drugs in Gout : colchicine, probenecid, sulfinpyrazole, allopurinol, febuxostat

Unit IV:	Drugs affecting Male and Female health (Steroids)	**Hours: 5**

Testosterone, 17-alphamethyltestosterone, oxymesterone, fluoxymesterone, stanazolol, danazol (Self study) estradiol, ethinyl estradiol, mestranol, medroxyprogesterone acetate, megestrol acetate, norethindrone, norgestrel, diethylstilbestrol*(Synthesis for self study), clomiphene (Self study), tamoxifen, anastrozole, letrozole, exemestane (Self study-1 hr) medroxy progesterone acetate, megesterol acetate, norethindrone and norgestrel

Unit V:	Drugs affecting Hormonal systems: Thyroid Hormones, Adrenocorticosteroids, Calcium Homeostasis	**Hours: 6**

Thyroid Hormones (Self study- 1 hr) levothyroxine, propylthiouracil, methimazole, carbimazole

Adrenocorticosteroids cortisone, hydrocortisone, prednisone, prednisolone, dexamethasone and betamethasone, flurometholone, fluocinolone, triamcinolone, aldosterone, fludrocortisone

Calcium Homeostasis (Self study-1 hr) raloxiphene, alendronate, teriparatide

Reference material:

Latest Editions of the following books to be adopted.

1. An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press.
2. Fundamentals of Medicinal Chemistry, Gareth Thomas, Wiley, New York.
3. The Organic Chemistry of Drug Design and Drug Action, Richard B.Silverman, Academic Press.
4. Foye's Principles of Medicinal Chemistry, Thomas L. Lemke, David A Williams, Lippincott Williams & Wilkins.
5. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale, John H. Block, Lippincott Williams & Wilkins.
6. Medicinal Chemistry, Ashutosh Kar, New Age International Publishers.
7. Introduction to Medicinal Chemistry, Alex Gringauz, Wiley.
8. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Lester A. Mitscher, John Wiley and Sons.
9. Pharmaceutical Chemistry, Volume 1, Organic Synthesis, H. J.

	Roth & A. Kleemann, Ellis Horwood Series in Pharmaceutical Technology, Halsted Series. 10. Synthesis of Essential Drugs, Ruben Vardanyan and Victor Hruby, Elsevier. 11. Pharmaceutical Substances: Syntheses, Patents, Applications, Kleemann & Engel, Thieme Publications.

Course: Pharmaceutics V (CBSGS)					
Course Code: DPH 19	**Final Year B. Pharm**				**Semester: VIII**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Prior knowledge about absorption of drugs by different routes. Basic knowledge about physicochemical characterization of transport of drugs *in-vitro* and *in-vivo*. Knowledge about Drugs and Cosmetics Act, Factory Act.				
Course objectives :	To introduce the students to the concepts of novel drug delivery systems and quality assurance.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand NDDS, need for the same, advantages over conventional delivery, various routes and technologies.	1,2
CO2	Apply the principles of documentation and Quality Assurance with respect to raw materials, actives, inactives, microbiological studies, packaging material and finished product.	1,2
CO3	Understand process validation in the Pharma industry.	1,2
CO4	Comprehend the Pharma production management, scale up of products from lab to pilot to production scale and design a factory layout of schemes for different formulations according to cGMP guidelines.	1,2
Topics covered :		
Unit I:	Introduction to NDDS	**Hours: 8**

Limitations of conventional dosage forms, need of NDDS, concept of targeting, advantages of targeting DDS Advantages, limitations, concept, design and one suitable application of a typical system – oral multiparticulate (microspheres and pellets), floating gastro-retentive systems, transdermal DDS (membrane permeation systems), ocular insert, colloidal DDS (liposomes, nanoparticles, microemulsions), implantable systems (intrauterine device) Introduction to concept of iontophoresis, sonophoresis		
Unit II:	Mucoadhesive drug delivery systems	**Hours: 6**
Mucoadhesion and theories, factors influencing mucoadhesion *In vitro-in vivo* methods to study mucoadhesion Bioadhesive polymers, systems with reference to various routes of administration (oral, buccal, nasal, pulmonary, rectal)		
Unit III:	Colonic targeting	**Hours: 4**
Physiology of colon, difficulties in colonic drug delivery Approaches - prodrug, pH sensitive polymers, polysaccharides, time release systems, osmotic systems, azo polymers and evaluation		
Unit IV:	4 Osmotic Systems	**Hours: 3**
Basic principles (osmosis) Classification, design and release kinetics of oral osmotic pumps, osmotic implants, applications and evaluation		
Unit V:	Microencapsulation	**Hours: 5**
Definition, need/ reasons, concepts of core and coat Methods of microencapsulation - phase separation coacervation (various techniques), wurster process, spray drying and related processes, interfacial polymerization, multiorifice centrifugal process, pan coating, solvent evaporation		
Unit VI:	Quality Assurance	**Hours: 8**
Raw material control, actives and inactive, in process control, sanitization, environmental and microbiological control, packaging and labeling control, finished product control cGMP Q. C. standards of identity, purity, quality and potency Statistical Quality Control - Q. C. Charts, sampling and sampling plans		
Unit VII:	Documentation	**Hours: 5**
Need and importance of documentation, maintenance and retrieval of documents		
Unit VIII:	Pilot plant scale up techniques	**Hours: 5**
Group's responsibilities, facilities, example of scaling up of manufacturing of tablets, liquids (suspension, solutions, emulsions) and semisolids		
Unit IX:	Validation	**Hours: 3**
Definition, Types, Qualification, Validation of raw materials		

<table>
<tr><td colspan="3">Process Validation – steps and documentation e.g: mixing and wet granulation
Equipment validation – e.g: mixer and granulator
Validation of sterilization process and equipment – microbial death kinetic terms,
F value applications, steps for validating steam sterilization</td></tr>
<tr><td>Unit X:</td><td>Production Management</td><td>Hours: 7</td></tr>
<tr><td colspan="3">Pharma industry - current scenario, Site selection and development – factors to be considered in designing a facility qualifications, selection, responsibilities and training
Material management - vendor audit, warehousing, sales forecasting, inventory control, production planning, elements of cost and cost controls</td></tr>
<tr><td>Unit XI:</td><td>Factory Layout</td><td>Hours: 4</td></tr>
<tr><td colspan="3">As per schedule M - general considerations/ steps,
Examples of Typical layout schemes for Tablets, capsule, liquids, sterile formulations manufacturing areas</td></tr>
<tr><td>Reference material:</td><td colspan="2">
The theory and practice of Industrial Pharmacy, Ed. Leon Lachman, H. A. Liberman, J. L. Kanig; Varghese Publishing House.
Remington, The science and practice of Pharmacy, Vols. I and II, B. L. Publications Pvt. Ltd.
Cole Graham, Pharmaceutical Production Facilities, Design and Applications.
Pharmaceutical Process Validation, Nash Robert A., Berry Ira R., Volume 57, Marcell Dekker INC, New York.
Pharmaceutical Dosage Forms: Parenteral medications. Vols. I, II, III, Ed Kenneth A. Avis, Leon Lachman and H. A. Liberman, Marcel Dekker INC.
Pharmacetuical Technology, Vols. I, II, R S R Murthy, Ashutosh Kar, New Age Int. Ltd.
Advances in controlled and novel drug delivery, Ed. N. K. Jain, CBS publishers and distributors.
Modern Pharmaceutics, Ed. Gilbert S. Bankerand Christopher T. Rhodes. Marcel Dekker INC.
Targeted and controlled drug delivery, Novel carrier systems, S. P. Vyas and R. K. Khar., CBS publishers and Distributors.
Controlled and novel drug delivery, Ed N. K. Jain, CBS publishers and distributors.
Controlled drug delivery, Concepts and Advances; S. P. Vyas and R. K. Khar, Vallabh Publishers.
Bioadhesive Drug Delivery Systems – Fundamentals, Novel Approaches and Development, Mathiowitz Edith. Chickering III, Donald E., Lehr Claus – Michael, Volume 98, Marcel
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	Dekker Inc. New York. 13. Nanoparticulate Drug Delivery Systems, Thasu Deepak, Dellers Michael, Pathak Yashwant, Volume 166, Marcel Dekker INC., New York. 14. Microencapsulation., Methods and Industrial Applications., D. Benita Simon, Marcel Dekker, INC, New York. 15. Controlled and Novel Drug Delivery, Jain N. K., CBS publishers and Distributors, New Delhi. 16. Ophthalmic drug delivery systems, Ed. Ashim K. Mitra, Volume 58, Marcel Dekker INC.

Course: Biopharmaceutics & Pharmacokinetics (CBSGS)					
Course Code: DPH 19	**Final Year B. Pharm**				**Semester: VIII**
Type of course : Theory			**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	Prior understanding of basic process of anatomy and physiology of human body, preformulation studies on different dosage forms, routes of administration and concepts of pharmacokinetics and pharmacodynamics. The subject also requires a thorough understanding of mathematical concepts of differntiation and integration.				
Course objectives :	To provide a qualitative background in biopharmaceutics and its applications and overview of pharmacokinetics.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the concept of biopharmaceutics and pharmacokinetics and its application in drug discovery, development and clinical pharmacy	1,2
CO2	Understand the mechanisms and factors responsible for drug dissolution, transport and absorption, distribution, metabolism and excretion.	1,2
CO3	Understand various reactions and rate processes involved in absorption, metabolism and distribution processes.	1,2

CO4	Understand and apply the concept of compartmental and non-compartmental models to explain the pharmacokinetics of the drugs.	1,2

Topics covered :

Unit I:	**Introduction**	**Hours: 5**

Introduction to the subject of biopharmaceutics and ppharmacokinetics. Emphasis on the importance in drug discovery, development and clinical pharmacy and applications.

Definitions: ADME, bioavailability, bioequivalence

Drug transport: different mechanisms of drug transport, physiology of cell

Membrane and passage of drugs across cell membrane.

Unit II:	**Absorption**	**Hours:10**

Routes of drug administration: emphasis on oral, parenteral and extravascular routes

factors affecting drug absorption: physicochemical factors (emphasis on pH Partition theory and solubility factors affecting drug absorption: physiological factors (emphasis on physiology of GIT)

Factors affecting drug absorption: formulation and dosage form factors (Self Study)

Unit III:	**Distribution**	**Hours: 5**

Factors affecting distribution: physiological barriers, tissue permeability and perfusion limited distribution.

Volume of distribution – concept, dependence on site/fluid of measurement, limits of values of volume of distribution.

Protein binding of drugs and its significance.

Unit IV:	**Metabolism/biotransformation**	**Hours: 8**

Phase I and phase II reactions

Factors affecting drug metabolism: age, species difference, genetic difference, induction and inhibition, drug- drug interaction first pass metabolism, concept of clearance , hepatic clearance and factors

Affecting hepatic clearance, hepatic extraction ratio, limits of values of organ clearance

Unit V:	**Excretion**	**Hours: 4**

Renal excretion, renal clearance and factors affecting renal clearance, excretion Ratio

Non hepatic and non-renal routes of elimination

Unit VI:	**Dissolution**	**Hours: 7**

Introduction to biopharmaceutical classification system of drugs

Theories of dissolution, dissolution rate and methods of enhancing dissolution rate.

Official and unofficial methods of dissolution rate testing. Application to different dosage forms

Unit VII:	**Pharmacokinetics**	**Hours: 16**

Pharmacokinetics: introduction to compartmental and physiological models.

Introduction to the one compartmental open model and its assumptions.

Concept of zero order and first order rate kinetics Mathematical treatment of pharmacokinetics upon One compartment open model) iv bolus dosing: importance of volume of Distribution. Clearance, elimination rate constant, half life, area under the curve (trapezoidal rule) Mathematical treatment of pharmacokinetics upon (one compartment open Model) extra-vascular dosing. Absorption rate constant, absorption half life, bioavailability. Introduction of the Concept of area under the curve, the trapezoidal rule and the method of Residuals. Concept of cmax and tmax Introduction to the rate of excretion method and sigma minus method for urine Analysis after iv administration Discussion of linear and nonlinear kinetics and description of factors resulting in Non linear kinetics. Application of pk principles through simple problems.		
Unit VIII:	**Bioavailability and bioequivalence**	**Hours: 5**
Concept of absolute and relative bioavailability Methods of assessment and enhancement of bioavailability Bioequivalence: study designs, introduction to the concept of biowaiver		
Reference material:	1. Latest eeditions of the following books to be adopted 2. Leon Shargel, Susanna Wu – Pong, Andrew B.C, Applied Biopharmaceutics and Pharmacokinetics, Singapor 3. Brahmankar D.M and Jaiswal Sunil B, Biopharmaceutics and Pharmacokinetics – A Treatise, Vallabh Prakashan. 4. Robert E. Notari, Biopharmaceutics and Pharmacokinetics – An Introduction, Marcel Dekker Inc., New York. 5. Milo Gibaldi, Biopharmaceutics and Clinical Pharmacokinetics", 1991, USA. 6. Malcom Roland, Thomas Tozer, Clinical Pharmacokinetics: Concept and Application, A Lea – Febiger book, USA **7.** Banakar, Umesh, Pharmaceutical Dissolution Testing, Volume 49, Marcel Dekker Inc, New York	

Course: Pharmacognosy & Phytochemistry III (CBSGS)		
Course Code: DPG 03	**Final Year B. Pharm**	**Semester: VIII**
Type of course : Theory	**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**	**Semester-end assessment**

Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	▪ Basic knowledge of medicinal botany and general biosynthetic pathways of plant metabolites. ▪ General scheme of pharmacognostic study of crude drug.				
Course objectives :	▪ To give insight of pharmacognostic study of various secondary metabolites like Steroidal and triterpenoidal drugs and Volatile oil along with their biosynthetic pathways. ▪ To acquaint the learners with traditional drugs, herbal excipients, cosmetics and crude drugs containing resins, Flavonoids, Phenylpropanoids, Terpenoids, and Iridoids, and their role in health care industry. ▪ To explain formulation and evaluation aspects of different Herbal and Ayurvedic preparations. ▪ To enlighten standardisation and regulatory aspects of different Herbal and Ayurvedic preparations.				

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Acquire the knowledge of Pharmacognostic study of crude drugs containing volatile oil, Steroidal and triterpenoidal drugs, resins, Flavonoids, Phenylpropanoids and iridoids	1, 4, 7
CO2	Describe the biosynthetic pathway of secondary metabolites.	1, 7
CO3	Attain the knowledge of traditional drugs, Herbal excipients and cosmetics	1, 7
CO4	Gain the knowledge of Ayurvedic and Herbal Formulations, standardisation and their regulatory aspects.	1, 7

Topics covered :

Drugs highlighted in bold font are to be studied for detailed pharmacognostic scheme

Unit I:	**Volatile Oils**	**Hours:11**

1.1. General introduction, composition, chemistry, general methods of extraction, therapeutic uses and commercial applications of volatile oils. Introduction to terpeneless volatile oils.

Study of sources, composition of volatile oils, salient features of extraction (if any) and applications of the following :

a. Umbelliferous fruits (Anise, Caraway, **Dill**, Ajowan, **Fennel**, **Coriander**, Cumin).

Biosynthesis of mono and sesquiterpenoid derivatives occurring in volatile oils.

Self study

Comparative study of morphology and microscopy of Umbelliferous fruits

1.2. Study of sources, composition of volatile oils, salient features of extraction (if any) and
applications of the following :
b. Hydrocarbon volatile oil – Turpentine oil
c. Alcohol – Peppermint, **Cardamom**, Rose oil, Peppermint
d. Aldehyde volatile oil - Lemon and Orange peel oil, Lemongrass
e. Ketone volatile oil - Camphor, spearmint (mint oils)
f. Ester volatile oil - Oil of Wintergreen
g. Ether volatile oil - **Eucalyptus oil**
h. Miscellaneous - Sandalwood, Sassurea, Star anise, Jatamansi, Valerian, Vetiver,
Phenyl propanoids - **Cinnamon, Cassia cinnamon, clove,** nutmeg.
Self study
- *Oils used in perfume industry any 2 examples*
- *Marketed formulations containing the volatile oils mentioned above (any 5)*

Unit II:	**Steriodal and Triterpenoidal drugs**	**Hours:09**

2.1. Introduction to steroidal and saponin glycosides with respect to their chemistry, general chemical tests. Detailed study of drugs with respect source, chemistry & biopotential of the following drugs - **Liquorice**, Quillaia, **Asparagus**, Ginseng, **Dioscorea**, Agave, Fenugreek, Bacopa, Hydrocotyle, Smilax, Sapindus, Acacia concinna.

2.2. Introduction to cardiac glycosides with respect to their classification, chemistry & general chemical tests. Detailed study of drugs with respect source, chemistry & biopotential of the following drugs – **Digitalis lanata, Digitalis purpurea,** Strophanthus, Squill, Nerium,
Thevetia.
Self Study:
• *Morphological and histological differences between different species of Dioscorea, Digitalis, Brahmi*

Unit III:	**Resins and resin combinations**	**Hours:05**

3.1. Introduction of resins as pathological products, definition, general properties, composition and applications. Study of occurrence, composition, uses and specific tests for identification of the following natural resins - Colophony, Myrrh, Benzoin, Balsams of Tolu and Balsam of Peru, Guggul, Asafoetida.

3.2. Introduction of metabolic resins and their methods of extractions.
Study of details of chemistry (structures of principal components), sources and uses of the following resins - Cannabis, Turmeric, Ginger, Capsicum, Shellac.
Self Study:
- *Morphology and microscopy of Ginger*
- *Preparation of Ginger and Turmeric for market*

Unit IV:	**Phenyl propanoids and related compounds**	**Hours:06**

4.1. Biosynthesis of phenyl propanoids. Examples of monomeric , dimeric and related

phenylpropanoid derivatives e.g., lignans, lignins and flavonoids.		
4.2. Flavonoids: Introduction to flavonoids, classification, chemical tests occurrence & their biopotential as exemplified by orange peel, garcinia, soyabean, liquorice, cranberry, buckwheat.		
4.3. Study of following drugs with respect to sources, constituents and uses – Podophyllum, Psoralea, Ammi majus, Phyllanthus *Self study:* • *Differences between two species of Podophyllum* • *Differences between two species of Tinospora* • *Herbal photosensitizer and photoprotective agents*		
Unit V:	**Iridoids & Miscellaneous phytochemicals**	**Hours:05**
5.1. Iridoids General introduction to iridoids. Study of Gentian, picrorrhiza. **Modified Triterpenoids** Quassia, tinospora, Artemisia, Taxus, Andrographis. **Tetraterpenoids** General introduction to tetraterpenoids. Study of carotenoids- lutein, crocin, zeaxanthin, and lycopene with respect to sources, chemistry, and biopotential. *Self study:* • *All sources and applications of lycopene*		
Unit VI:	**Traditional drugs**	**Hours:06**
6.1. Study of following traditional drugs with respect to common names, sources, and traditional uses & observed pharmacological activities of the following drugs - punarnava (*Boerhavia diffusa*), shankpusphi (*Convolvulus microphylla*), Leshun (*Allium sativum*), Guggul (*Commiphora mukul*), Kalmegh (*Andrographis paniculata*), Tulsi (*Ocimum sanctum*), valerian(*Valerian officinalis*), Artemisia(*Artemisia annua*), Chirata (*Swertia chirata*), Ashoka (*Saraca indica*)		
6.2. Study of all traditional drugs listed in Sec. 6.1, with respect to phytoconstituents. *Self study:* • *Study of marketed formulations containing traditional drugs (any two)*		
Unit VII:	**Study of Herbal Excipients & Cosmetics**	**Hours:06**
7.1. Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.		
7.2. Herbal Cosmetics - Importance of herbals as surfactants (soapnut), hair conditioners and hair colorants (henna, hibiscus, tea), herbals for skin care (aloe vera gel, turmeric, lemon peel, vetiver). *Self study:* • *Study of two examples of each type of excipient from natural sources*		

Unit VIII:	**Study of herbal formulations & Ayurvedic formulations**	**Hours:05**
8.1. Formulations based on substances of natural origin – Challenges and salient features of preparation of herbal formulations		
8.2. Ayurvedic Formulations–Introduction to Ayurvedic formulations like aristas, asava, gutika, taila, churna, avaleha, ghrita. Introduction to the concept of detoxification in Ayurveda. *Self study:* • *Examples of Ayurvedic formulations (any two)*		
Unit IX:	**Standardization, Regulations & Intellectual Property Rights of Herbal and Ayurvedic, Siddha & Unani (ASU) drugs**	**Hours:07**
9.1. Standardisation: Detailed study of Quality control of herbal drugs as per WHO guidelines. Safety parameters, toxicity concerns and herb- drug interactions. *Self study:* *Examples of Herbal drug interactions* • *Study of five examples of markers from each class of phytoconstituents for standardization*		
9.2. Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule T & Y of Drugs & Cosmetics Act for ASU drugs. Overview of Global regulatory issues. Indian and International patent laws, proposed amendments as applicable to herbal /natural products and processes, Intellectual Property Rights with special reference to phytoconstituents. *Self study:* • *Search on one case study of patent related to herb*		
Reference material:	**Latest Editions of the following books to be adopted.** 1. Trease D. & Evans W.C.: Text Book of Pharmacognosy:W. B. Saunders. 2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea & Feibger, USA. 3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi. 4. Kokate C. K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune. 5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London. 6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited. 7. Vasudevan T. N. & Laddha K. S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon.	

	8. The Indian Pharmacopeia: The Controller of Publication; Delhi. 9. Brain K. R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol. 10. Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press, Manipal. 11. Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal. 12. Kokate C. K.:Practical Pharmacognosy; Vallabh Prakashan. 13. Wagner, Bladt & Zgainski; Plant Drug Analysis; Springer Verlag. 14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune. 15. Vasudevan T. N. Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon. 16. Pulok K. Mukherjee, GMP for botanicals (Regulatory and Quality Issues on Phytomedicines), Editor Robert Verpoorte, Business Horizons New Delhi. 17. Pulok K Mukherjee, Quality control of herbal drugs, an approach to evaluation of botanicals, Business Horizons, New Delhi.

Course: Clinical Pharmacy (CBSGS)					
Course Code: DPL- 10	**Final Year B. Pharm**				**Semester: VIII**
Type of course : Theory			**Contact Hours: 2 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**				**Semester-end assessment**
Assessment Tools:	MSE	Attendance	Quizzes	TSI	ESE
Max. Marks:	**15**	**5**	**5**	**5**	**70**
Pre-requisites :	• Basic concepts of pharmacology • Pharmacology of drugs acting on various systems				
Course objectives :	1. To familiarize with the concept of clinical pharmacy, community pharmacy and hospital pharmacy. 2. To impart knowledge of therapeutic drug monitoring, drug interactions, use of drugs in special populations and the process of drug discover and development.				
Course Outcomes: After the completion of course learner will be able to:					**PO Mapped**

CO1	Be familiar with concept of clinical pharmacy, community pharmacy and hospital pharmacy; describe role of pharmacist in patient counseling and improving patient compliance.	1,3,4,7,8
CO2	Classify adverse drug reactions (ADRs) and drug interactions, identify risk factors of ADRs, demonstrate knowledge related to monitoring and reporting of ADRs and mechanisms of drug interactions	1,3,4,7,8
CO3	Define therapeutic drug monitoring (TDM) list the indications and describe strategies of (TDM)	1,3,4,7,8
CO4	Describe drug use in different populations based on age, gender and special conditions	1,3,4,7,8
CO5	Describe stages and processes of drug discovery and development.	1,3,4,7,8

Topics covered :

Unit I:	Concept of Clinical Pharmacy, Community pharmacy and hospital pharmacy (Definition, scope and objectives), Patient Counseling: Role of Pharmacist in patient counseling	**Hours: 3**
Unit II:	Patient Compliance, Methods of assessment of compliance, Reason for patient noncompliance, Strategies to improve compliance, Precaution and directions for medication, Administration instructions	**Hours: 2**
Unit III:	Adverse Drug reactions: Epidemiology, Classification, Risk factors, Monitoring, Detecting and reporting of ADR, Drug interactions: Types, General Considerations and Mechanisms	**Hours: 3**
Unit IV:	Drug interactions: Types, General Considerations and Mechanisms	**Hours: 3**
Unit V:	Drug use in special population	**Hours: 4**

- Drugs used in Geriatrics
- Drugs used in Paediatrics
- Drugs used in Pregnancy

Unit VI:	Therapeutic Drug Monitoring: Definition, indications and strategies	**Hours: 2**
Unit VII:	Drug discovery & development	**Hours: 13**

- Preclinical development
- Clinical development
- History, terminologies, types of clinical research, phases of clinical trials, role of clinical trial in new drug developments.
- Ethical issues in clinical trials: Principle of regulatory requirements, responsible conduct, supervision of ethics, (Informed Consent, Independent Ethics Committee, Institutional Review Board)

• Good Clinical Practice (GCP): Concept and importance • Definitions of essential documents; SOP, protocol, Investigator's brochure, informed consent forms and case report forms • Introduction to BA/BE studies • SELF STUDY: Pharmacovigilance: Definition, scope and aims of Pharmacovigilance	
Reference material:	1. Latest editions of the following books to be adopted 2. Clinical Pharmacy and Therapeutics, Roger Walker, Clive Edwards, Churchill Livingstone. 3. Clinical Pharmacy, Dr.Tipnis, Dr. Bajaj, Career Publications. 4. Clinical Pharmacology, P.N. Benett, M. J. Brown, Churchill Livingstone. 5. Text Book of Clinical Pharmacy Practice, G. Parthisarathi, Karin Nyfort Hansen, Milap C. Nahata, Orient Longman.

Course: Pharmaceutics Lab V (CBSGS)			
Course Code: DPH 21	**Third Year B. Pharm**		**Semester: VIII**
Type of course : Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tools:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	• Prior knowledge of preformulation and formulation development aspect of tablets, suppositories, microcapsules, ophthalmic preparations and their QC tests. • Prior knowledge of drug degradation reaction and chemical kinetics.		
Course objectives :	To orient the students with the formulation development of novel drug delivery systems, quality control and shelf life of products.		

Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand the formulation development of NDDS.	2,4
CO2	Explain the concept of dissolution testing as an important quality control tool and relate to its importance from regulatory point of view.	2,4,5
CO3	Apply pharmacokinetic principles of oral and iv routes of	2,4

	administration.	
CO4	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management	3
Topics covered :		
Unit I:	Preparation and in vitro release evaluation of sustained release oral granules/tablets-using hydrophobic and hydrophilic matrix materials.	**Hours: 4**
Unit II:	Dissolution testing of marketed formulations of conventional tablets containing freely soluble and poorly soluble drug (selection of medium).	**Hours: 5**
Unit III:	Calculations of pharmacokinetic parameters (plasma samples provided).	**Hours: 4**
Unit IV:	Preparation and evaluation of mucoadhesive buccal films (including mucoadhesive strength).	**Hours: 5**
Unit V:	Preparation and evaluation of film coated modified release/colon specific dosage form.	**Hours: 4**
Unit VI:	Microencapsulation of solid and liquid core using phase separation coacervation technique and evaluation of microcapsules.	**Hours: 5**
Unit VII:	Validation of process-dissolution/mixing.	**Hours: 5**
Unit VIII:	Assignment on SOP's of dissolution apparatus/tablet press/coating equipment.	**Hours: 4**
Unit IX:	Assignment on excipient/API specifications	**Hours: 4**
Reference Book	1. The theory and practice of Industrial Pharmacy, Ed. Leon Lachman, H. A. Liberman, J. L. Kanig; Varghese Publishing House. 2. Remington, The science and practice of Pharmacy, Vols. I and II, B. L. Publications Pvt. Ltd. 3. Cole Graham, Pharmaceutical Production Facilities, Design and Applications. 4. Pharmaceutical Process Validation, Nash Robert A., Berry Ira R., Volume 57, Marcell Dekker INC, New York. 5. Pharmaceutical Dosage Forms: Parenteral medications. Vols. I, II, III, Ed Kenneth A. Avis, Leon Lachman and H. A. Liberman, Marcel Dekker INC. 6. Pharmacetuical Technology, Vols. I, II, R S R Murthy, Ashutosh Kar, New Age Int. Ltd. 7. Advances in controlled and novel drug delivery, Ed. N. K. Jain, CBS publishers and distributors. 8. Modern Pharmaceutics, Ed. Gilbert S. Bankerand Christopher T.	

	Rhodes. Marcel Dekker INC. 9. Targeted and controlled drug delivery, Novel carrier systems, S. P. Vyas and R. K. Khar., CBS publishers and Distributors. 10. Controlled and novel drug delivery, Ed N. K. Jain, CBS publishers and distributors. 11. Controlled drug delivery, Concepts and Advances; S. P. Vyas and R. K. Khar, Vallabh Publishers. 12. Bioadhesive Drug Delivery Systems – Fundamentals, Novel Approaches and Development, Mathiowitz Edith. Chickering III, Donald E., Lehr Claus – Michael, Volume 98, Marcel Dekker Inc. New York. 13. Nanoparticulate Drug Delivery Systems, Thasu Deepak, Dellers Michael, Pathak Yashwant, Volume 166, Marcel Dekker INC., New York. 14. Microencapsulation, Methods and Industrial Applications., D. Benita Simon, Marcel Dekker, INC, New York. 15. Controlled and Novel Drug Delivery, Jain N. K., CBS publishers and Distributors, New Delhi. 16. Ophthalmic drug delivery systems, Ed. Ashim K. Mitra, Volume 58, Marcel Dekker INC.

Course: Pharmacognosy & Phytochemistry – Lab. – III (CBSGS)			
Course Code: DPG 06	**Final Year B. Pharm**		**Semester : VIII**
Type of course : Practical	**Contact Hours: 4 Hrs/week**		
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	ESE
Max. Marks:	**8**	**7**	**35**
Pre-requisites :	1. Basic knowledge of compound microscope, different types of carrying out histological studies (i.e. by taking Transverse and Longitudinal sections) and microchemical tests. 2. Basic processes for carrying out extraction of phytoconstituent of crude drug, its Thin Layer Chromatography (TLC) and estimation by spectroscopy.		
Course objectives :	1. To describe the various techniques of section cutting of different parts of plant.		

	2. To demonstrate extraction of volatile oil and its detection by Thin Layer Chromatography (TLC). 3. To explain qualitative Identification of various Phytoconstituents from herbal formulations with respect to various secondary metabolites by chemical tests.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Identify and recognize crude drugs morphologically and study of systematic arrangement of tissues by microscopical examination.	1, 7
CO2	Identify the components of binary mixture by microscopy.	1, 7
CO3	Demonstrate extraction, identification and estimation of Phytoconstituents by chromatography and spectroscopy.	1, 7
CO4	Demonstrate oral and written communication skills and ability to Plan the experimentation with proper time management	1, 3, 7
Topics covered :		
Unit I:	Study of morphology, histology, powder characteristics of Fennel and Coriander Extraction and detection of volatile oil from fennel.	**Hours04**
Unit II:	Study of morphology, histology, powder characteristics of Liquorice Extraction and detection of saponin glycosides and flavonoids from Liquorice.	**Hours04**
Unit III:	Study of morphology, histology, powder characteristics of Clove. Extraction of clove oil and detection of Eugenol by TLC and potassium euginate test.	**Hours04**
Unit IV:	Study of morphology, histology, powder characteristics of, Ginger, Quassia, Kalmegh, Eucalyptus, Cinnamon	**Hours12**
Unit V:	Microscopical examination of powder mixtures of drugs mentioned above.	**Hours04**
Unit VI:	Extraction and detection by TLC of curcumin from turmeric.	**Hours04**
Unit VII:	Morphological identification any twenty samples and their salient morphological features Anise and Star anise, Caraway, Dill, Ajowan, Cumin,Citrus peel, Sandalwood, Sassurea, Jatamansi, Valerian, Nutmeg and mace, Vetiver, Dioscorea, Fenugreek, Brahmi, Shikakai, Soapnut, Squill, Digitalis, Turmeric, Soyabean, Capsicum, Podophyllum, Picrorhiza, Punarnava, Apricot, Amla, Karela	**Hours:04**
Unit VIII:	Qualitative evaluation of phytoconstituents from herbal formulation with respect to volatile oils, saponin	**Hours:04**

	glycosides, cardiac glycosides, flavanoids.	
Reference material:	**Latest Editions of the following books to be adopted.** 1. Trease D. & Evans W.C.: Text Book of Pharmacognosy:W.B. Saunders. 2. Tyler V. E. Brady L. R. & Robbers J. E.: Pharmacognosy; Lea Feibger, USA. 3. Wallis T. E.; Text Book of Pharmacognosy; CBS Publishers, Delhi. 4. Kokate C. K., Purohit A. P. & Gokhale S. B.: Pharmacognosy; Nirali Publications, Pune. 5. Harbone J. B.: Phytochemical Methods: A guide to modern techniques Analysis: Chapman & Hall, London. 6. Bruneton J.: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited. 7. Vasudevan T. N. & Laddha K.S.: A Textbook of Pharmacognosy, Vrinda Publication House, Jalgaon. 8. The Indian Pharmacopeia: The Controller of Publication; Delhi. 9. Brain K. R. & Turner T. D.: The Practical Evaluation of Phytopharmaceuticals: Wright, Scientica, Bristol. 10. Iyengar M. A. & Nayak S. G.: Anatomy of Crude Drugs: Manipal Power Press Manipal. 11. Iyengar M. A.: Pharmacognosy of Powdered Drugs; Manipal Power Press, Manipal. 12. Kokate C.K.: Practical Pharmacognosy; Vallabh Prakashan. 13. Wagner, Bladt & Zgainski; Plplant Drug Analysis; Springer Verlag. 14. Khandelwal K. R.: Practical Pharmacognosy Techniques and Experiments; Nirali Prakashan, Pune. 15. Vasudevan T. N. Laddha K. S.: Practical Pharmacognosy; New Vrinda Publishing House, Jalgaon.	

Course: Pharmaceutical Chemistry Lab – III (CBSGS)			
Course Code: DPC 22	**Final Year B. Pharm**		**Semester: VIII**
Type of course : Practical		**Contact Hours: 4 Hrs/week**	
Course assessment Methods:	**Continuous mode of assessment**		**Semester-end assessment**
Assessment Tool:	MSE	Continuous assessment	End semester Examination
Max. Marks:	**8**	**7**	**35**

Prerequisite	1. Basic principles & introductory study in synthetic chemistry, reaction & schemes involved in the synthetic procedure. 2. Recrystallization techniques	
Course objectives :	1. To perform simple organic reactions which involve transformation and rearrangements 2. To synthesize drug intermediates using green chemistry approach.	
Course Outcomes: After the completion of course learner will be able to:		**PO Mapped**
CO1	Understand and apply the basic and conceptual knowledge of organic chemistry and use of different rearrangement reactions, practically performing the synthesis of drugs as per syllabus.	1
CO2	Understand the simple reactions which involve transformation or rearrangements.	1
CO3	Demonstrate oral and written communication skills and ability to plan the experimentation with proper time management.	3
Topics covered :		
Unit I:	Synthesis of the following Drugs and Drug Intermediates 1.1. Diels – Alder Reaction using Maleic Acid + Furan 2.2. Synthesis of Benzilic Acid: Conventional Method and Green Modification as in Green Chemistry DST Monograph 3.3. Synthesis of Benzoin from Benzaldehyde using Thiamine, Ref: Green Chemistry – V. K. Ahluwalia, pg. no. 2.5 4.4. Three Component Synthesis of Pyrimidone using Ethylacetoacetate, Benzaldehyde and Urea as per Green Chemistry DST Monograph 5.5. Synthesis of Dibenzylidene Acetone using LiOH as per Green Chemistry DST Monograph 6.6. Synthesis of Benzoic Acid using Cannizaro Reaction of Benzaldehyde, Ref: Green Chemistry, V. K. Ahluwalia pg. No. 65. 7.7. Hofmann rearrangement: Anthranilic acid from Phthalimide. 8.8. Reduction reaction: PABA from p-nitrobenzoic acid. 9.9. Synthesis of Benzocaine from PABA	
Reference material:	**Following books can be referred.** 1. A laboratory hand book of Organic qualitative analysis and separations, V.S. Kulkarni, S.P.Pathak, D. Ramchandra & Co., Pune 2. Text book of organic practical chemistry, V.S. Kulkarni, S.P.Pathak, D. Ramchandra & Co., Pune. 3. R. L. Shriner, R. C. Fuson and D. Y. Curtin, The systematic	

	Identification of Organic compounds, 6th Ed., Wiley, New York, 1980 4. A. I. Vogel, A textbook of practical organic chemistry, 4th edition, Wiely New York, 1978 5. Comprehensive Practical Organic Chemistry: Qualitative Analysis, V.K. Ahluwalia, S. Dhingra, Universities Press (India) Limited, 2000 6. Comprehensive Practical Organic Chemistry: Preparation and Quantitative analysis, V.K.Ahluwalia, Renu Aggarwal, Universitites Press (India) Limited, 2000