SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

Bachelor of Pharmacy

CGPA Syllabus 2014-15

Final Year B. Pharmacy (2017-18)

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Bachelor of Pharmacy

Credit System Structure of Teaching & Examination w.e.f. 2014-15

Final Year B. Pharmacy (Semester-VII)

Code	Course	Hrs./Week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
4.7.1	Sterile Dosage Forms	3	-	-	3	30	70	-	100
4.7.2	Pharmaceutical Jurisprudence	3	-	-	3	30	70	-	100
4.7.3	Medicinal Chemistry-III	3	-	-	3	30	70	-	100
4.7.4	Pharmaceutical Analysis-V	3	-	-	3	30	70	-	100
4.7.5	Pharmacology-III	3	-	-	3	30	70	-	100
4.7.6	Pharmacognosy-III	3	-	-	3	30	70	-	100
	Total	**18**	**-**	**-**	**18**	**180**	**420**	**-**	**600**
Practical									
4.7.7	Sterile Dosage Forms	-	-	3	1.5	-	70	30	100
4.7.8	Medicinal Chemistry-III	-	-	3	1.5	-	70	30	100
4.7.9	Pharmaceutical Analysis-V	-	-	3	1.5	-	70	30	100
4.7.10	Pharmacology-III	-	-	2	1	-	70	30	100
4.7.11	Pharmacognosy-III	-	-	3	1.5	-	70	30	100
	Total	**-**	**-**	**14**	**7**	**-**	**350**	**150**	**500**
	Grand Total	**18**	-	**14**	**25**	**180**	**770**	**150**	**1100**

Abbreviations: **L**- Lectures, **T**- Tutorials, **P**-Practicals,
ISE - In Semester Exam., **ESE** - End Semester exam, **ICA**- Internal Continuous Assessment
Note : ISE -Three Tests , **ESE** - University Theory paper shall be of 70 marks of 3 hrs. duration

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Bachelor of Pharmacy

Credit System Structure of Teaching & Examination w.e.f. 2014-15

Final Year B. Pharmacy (Semester-VIII)

Code	Course	Hrs./Week			Credits	Examination Scheme			
		L	T	P		ISE	ESE	ICA	Total
4.8.1	Novel Drug Delivery Systems	3	-	-	3	30	70	-	100
4.8.2	Pharmaceutical Business Management	3	-	-	3	30	70	-	100
4.8.3	Medicinal Chemistry-IV	3	-	-	3	30	70	-	100
4.8.4	Pharmaceutical Analysis-VI	3	-	-	3	30	70	-	100
4.8.5	Pharmacology-IV	3	-	-	3	30	70	-	100
4.8.6	Herbal Technology	3	-	-	3	30	70	-	100
	Total	**18**	**-**	**-**	**18**	**180**	**420**	**-**	**600**
Practical									
4.8.7	Novel Drug Delivery Systems	-	-	3	1.5	-	70	30	100
4.8.8	Medicinal Chemistry-IV	-	-	3	1.5	-	70	30	100
4.8.9	Pharmaceutical Analysis-VI	-	-	2	1	-	70	30	100
4.8.10	Pharmacology-IV	-	-	3	1.5	-	70	30	100
4.8.11	Herbal Technology	-	-	3	1.5	-	70	30	100
	Total	**-**	**-**	**14**	**7**	**-**	**350**	**150**	**500**
	Grand Total	**18**	**-**	**14**	**25**	**180**	**770**	**150**	**1100**

Abbreviations: **L**- Lectures, **T**- Tutorials, **P**-Practicals

ISE - In Semester Exam., **ESE** - End Semester exam, **ICA** - Internal Continuous Assessment

Note : ISE -Three Tests , **ESE** - University Theory paper shall be of 70 marks of 3 hrs. duration

Final Year B.Pharmacy

Semester-VII

4.7.1 Sterile Dosage Forms

1. **Parenteral Products**
   History of parenterals, conceptual origin, advantages and disadvantages, various parenteral routes of administration, essential characteristics like sterility, freedom from particulate matter and apyrogenicity
2. **Preformulation Study**
   Detailed study of formulation parameters like volume, solvents, official monograph of solvents used for parenterals, osmotic pressure and adjustment of isotonicity, pH, maintenance of sterility, solubility, stability and other parameters
3. **Design of Production Facilities for Parenterals**
   Design of facilities in sterile area, examples of plant layout, change room design, windows, doors and services, laminar flow benches and their efficiency tests, sources of contamination, personnel, environmental control, cleanliness classes, air handling (HVAC) system, HEPA filters, regulatory guidelines for the manufacture of parenterals
4. **Processing of Formulations Parenterals**
   Classification, manner of labeling, solutions, suspensions, emulsions and sterile solids, total parenteral nutrition (TPN).
   Different documents used in processing; aseptic and non-aseptic approaches of manufacturing, cleaning, filling and sealing of parenterals, applications of different methods of sterilization, validation of sterilization and environment
5. **Packaging of Parenterals**
   Packaging components and types, specifications, quality control tests for packaging materials, factors influencing choice of containers, prefilled syringes, form-fill-seal technique, labeling requirements
6. **Quality Control Tests for Parenterals**
   Test for sterility, pyrogen/endotoxin test, test for particulate matter, leaker test and other tests, quality assurance aspects of parenterals
7. **Ophthalmic Products**
   Anatomy of eye, ocular bioavailability, formulation of ophthalmics such as solutions, suspension, ointments, packaging, quality control tests, labeling requirements, contact lens care solutions
8. **Pilot Plant Scale-up Techniques**
   Introduction, process considerations, scientific principle of scale-up, general considerations including personnel, space requirements, raw materials, pilot plant scale up considerations for solid, liquid oral, semi solid formulations, relevant documentation, SUPAC guidelines, overview of Technology Transfer

Reference Books:

1. Avis K.A., Lachman L. and Liberman H.A., Pharmaceutical Dosage Forms: Parenteral Medications, Vol. I, II & III, Latest Edotion, Marcel Dekker Inc., New York.
2. Swarbrick J. and Boylan J., Encyclopedia of Pharmaceutical technology, 2nd Ed., Marcel Dekker, 2002.
3. Turco S. and King R.E., Sterile Dosage Forms, 3rd Ed., Lea & Febiger, Philadelphia, 1985.
4. Banker G.S. and Rhodes C.T., Modern Pharmaceutics, 4th Ed., Marcel Dekker Inc., 2002.

5. Pelczar M.J., Reid R.D. and Chan E.C.S., Microbiology, 5th Ed., Tata McGraw Hill Publishing Co., New Delhi.
6. Carter S.J., Cooper and Gunn's Dispensing for Pharmaceutical Students, Latest Edition, Pitman Medical Publishing Co., New Delhi.
7. Gennaro A.R., Remington: The Science and Practice of Pharmacy, Vol-I & II, Lippincott Williams & Wilkins, New York.
8. Hugo W.B. and Russel A.D., Pharmaceutical Microbiology, Latest Edition, Blackwell Scientific Publications, London.
9. Aulton M. E., Pharmaceutics: The Science of Dosage Form Design, 2nd Ed., Churchill Livingstone, 2002.
10. Lachman L., Liberman H.A. and Kanig J.I., The Theory and Practice of Industrial Pharmacy, 3rd Ed., Verghese Publishing House, 1987.
11. Mitra A.K., Ophthalmic Drug Delivery, Latest Edition, Marcel Dekker INC., New York.
12. Akers M.J., Quality Control of Parenterals, Latest Edition, Marcel Dekker Inc., New York.
13. Alen L.V., Popovich N.G. and Ansel H.C., Pharmaceutical Dosage Forms and Drug Delivery Systems, 7th Ed., Lippincott Williams and Wilkins, London.
14. Carleton F.J. and Agalloco J.P., Validation of Pharmaceutical Sterile Products, 2nd Ed., Mercel Dekker, New York, 1999.
15. Levin M., Pharmaceutical Process Scale-Up, 2nd Ed., Vol.157, CRS Press, New Delhi, 2006.
16. Mitra A.K., Ophthalmic Drug Delivery System, 1st Ed., Vol-58, Marcel Dekker, 1993.
17. Rey L. and May J.C., Freeze Drying / Lyophilization of Pharmaceutical & Biological Products, Marcel Dekker, New York.
18. Ansari A.M., Naik S.R., Advances in Formulation and Technology of Sterile Products, Latest Edition, Nirali Prakashan, Pune.

4.7.7 Sterile Dosage Forms

1. Perform the microbiological validation of aseptic area.
2. Perform validation of aseptic filling.
3. Preparation, filling, sealing, sterilization and evaluation of the following injections:
   a. Sodium chloride Injection I.P.
   b. Dextrose Injection I.P.
   c. Calcium gluconate Injection I.P.
   d. Ascorbic acid Injection I.P.
   e. One injection in suspension form
   f. One injection with the use of co-solvents
   g. Intravenous fat emulsion for TPN
4. Preparation, filling, sealing, sterilization and evaluation of the eye drops and eye ointment (one each).
5. Evaluation of marketed parenteral suspension and emulsion for parameters like particle size, sterility and rheological parameters.

4.7.2 Pharmaceutical Jurisprudence

1. **Pharmaceutical Legislations in India:**
   A brief review

2. **Pharmacy Act 1948:**
   Objective, Definitions
   Constitution and Functions of Central and State Pharmacy Councils,
   Education Regulations and Approval of Courses and Institutions
   Registration of Pharmacists, Preparation of Registers and qualifications for entry into register
   Offences and Penalties

3. **Drugs and Cosmetic Act 1940 & Rules 1945:**
   Definitions
   Administrative Bodies:
   Advisory: Constitution and function of Drugs Technical Advisory Board (DTAB) and Drug Consultative Committee (DCC),
   Analytical: Central Drug Laboratory (CDL), Drug Control Laboratories, Government Analyst
   Executive: Drug inspectors, Licensing Authorities, Controlling Authorities and Customs Collectors
   Provisions Governing Import, Manufacture and Sale of Drugs
   Labeling and Packaging of Drugs
   Provisions applicable to manufacture and Sale of Ayurvedic Drugs
   Provisions governing Import, Manufacture and Sale of Homeopathic Drugs
   Various offences and corresponding Penalties
   Broad content of various Schedules of the Drugs and Cosmetic Act and Rules

4. **Drugs and Magic Remedies (Objectionable Advertisements) Act 1954 & Rules 1955:**
   Objectives, Definitions, Official's duties, Classes of Prohibited Advertisement, Classes of Exempted Advertisement, Offences & Penalties

5. **Narcotic Drugs and Psychotropic Substances Act 1985:**
   Definitions
   Narcotics Commissioner and other officers
   Illicit Traffic and measures to prevent illicit traffic of opium
   Offences and Penalties

6. **Prevention of food adulteration act 1954:**
   Definitions , central committee for food standards, central food laboratory; composition & functions, public analyst; qualification & duties, food inspectors; qualification, powers duties & sampling procedures, offences & penalties.

7. **Drug (Price Control) Order 1995:**
   Object, Definitions, Retail price of formulation, Drugs Prices Display Rule 1961 and other relevant orders

Reference Books:

1. “Forensic Pharmacy”, Kuchekar and Kadtare and Itkar, Nirali Prakashan, 5 th edition, 2005.
2. “Textbook of Forensic Pharmacy” N. K. Jain, Vallabh prakashan, 4 th edition, 1999.
3. D & C Acts, 1940 and Rules, 1945, S. W. Deshpande and Nilesh Gandhi, Sumit Publishers, 2006, Mumbai.
4. Govt. of India Publication of above Acts and Rules.
5. ‘Text Book of Forensic Pharmacy’, Mithal B.M. 7th ed, National Book Centure, Calculta, 1985.
6. Jain N.K., ‘A Text Book of Forensic Pharmacy (Pharmaceutical Jurisprudence)’, Vallabh Prakashan, Pune, 1989.
7. Kuchekar B.S. & Khandatare A.M., Forensic Pharmacy including Industrial and Labour Laws. Nirali Publication, Pune, 1989.
8. ‘Code of Pharmaceutical Ethics’, Pharmacy Council of India (P. B. No. 337), New Delhi Year.
9. Current Government of India Publications of all Drugs Acts and Rules.

4.7.3 Medicinal Chemistry-III

The following classes of drugs should be discussed in relation to:

A) Introduction to the rational development (if any)
B) Detailed Classification of each class
C) Chemical nomenclature
D) Structure-activity relationship
E) Mechanism of action
F) Synthesis of compounds with asterisk

1. **Drugs acting on central nervous system:**
   a. **Anxiolytics, Hypnotics and Sedatives:**
   Benzodiazepines: Diazepam*, Oxazepam, Nitrazepam, Midalzolam, Alprazolam.
   Barbiturates: Phenobarbital, Amobarbital, Pentobarbital*;
   Miscellaneous : Glutethimide, Meprobamate
   b. **Anticonvulsants:**
   Hydantoins: Phenytoin*, Mephenytoin.
   Oxazolidinediones: Trimethadione, Paramethadione;
   Succinimides: Phensuximide, Ethosuxmide;
   Barbiturates: Mephobarbital;
   Benzodiazepines: Clonazepam;
   Ureas: Carbamazepine, Oxcarbazepine;
   Miscellaneous: Primidone, Phenacemide, Sodium Valproate.
   c. **Psychotherapeutic Agents:**
   Phenothiazines: Chlorpromazine*, Triflupromazine, Fluphenazine, Thioridazine Thiothixene;
   Fluorobutyrophenones: Haloperidol .
   Benzodiazepines: chlorodiazepoxide, Flurazepam, diazepam, Lorazepam, Clonazepam.
   Tricyclic Antidepressants: Imipramine, Desipramine, Amitriptyline, Nortriptyline, Doxepin, Maprotiline;
   MAO inhibitors: Phenelzine, Tranylcypromine;
   Selective Serotonin reuptake inhibitors: Fluoxetine, paroxetine,
   β-aminoketones: Molindone.
   d. **CNS Stimulants:**
   Analeptics: Pentylenetetrazole;
   Central Sympathomimetic agents: Amphetamine, Methamphetamine, Fenfluramine, Phenmetrazine;
   Methylxanthines: Caffeine, Theophylline

2. **Narcotic Analgesic Agents:**
   Morphine and related compounds: Morphine, Codeine, thebaine, ethylmorphine, dihydroxycodeine, Heroin*, Levorphanol, Dextromethorphan, Meperidine*, Bemidone, anilaridine, Methadone*, Fentanyl, dextropropoxyphene and pentazocine;
   Morphine antagonist: Nalorphine, Naloxone, Naltrexone

3. **Analgesics, Antipyretics and Anti-inflammatory agents (NSAIDS) :**

Salicylic acid derivatives: Aspirin*;
Aryl acetic acid derivatives: Indomethacin, Naproxen, Ketoprofen, Ibuprofen*, Diclofenac, Sulindac, Ketorolac, Nimesulide, piroxicam;
***p*-aminophenol derivatives**: Acetaminophen*;
Pyrazolidinedione derivatives: Phenylbutazone, Oxyphenbutazone;
***N*-arylanthranilic acid**: Mefenamic acid,
Selective COX-2 inhibitors: Rofecoxib, Valdecoxib;
Antigout-Allopurinol, Probenecid

4. **Antihistaminics, Antiemetics and antiulcer drugs:**
   H_1 antagonist drugs: Diphenhydramine*, Doxylamine, Triprolidine, Pheniramine, chloropheniramine*, Promethazine, Tripelenamine*, Cyclizine, Meclizine, Cyproheptadine, Terferadine, Cetirizine;
   H_2 antagonist drugs: Cimetidine; Famotidine,
   Proton pump inhibitors: Omeprazole, Lansoprazole, Ranitidine, Rabeprazole, Pentaprazole;
   Antiemetic drugs: Ondansetron, Domperidone.

5. **Steroids:**
   Adrenocorticoids: Cortisol, Hydrocortisol acetate, Fludrocortisone acetate, Dexamethasone, Betamethasone, Flucinolone acetonide, Triamcinolone, Prednisone, Prednisolone, Aldosterone.
   Androgens and Anabolic Steroids: Testosterone, Fluoxymesterone, Oxymesterone.
   Estrogens: Estrone , Ethinyl estradiol, Estriol, Menstranol, chlorotrianisene, , Dienesterol, Diethylstilbesterol .
   Progestational agents: Progesterone, Norethinodrel, Norgestrel, Medroxyprogesterone acetate, Dimethisterone,
   Oral contraceptives-Mestranol, Lynestrenol

Reference Books:

1. Chemistry by Ashutosh Kar, 1st edition, New Age International Publications.
2. Vogel's Elementary M.E. Wolf:Burger's Medicinal Chemistry, John Wiley and Sons, New York.
3. R.F. Doerge, Wilson & Gisvold's: Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott.
4. W.O.Foye: Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
5. D.Lednicer and L.A. Mitschier: Ale Organic Chemistry of Drug synthesis Vol. 1, II & III John Wiley and Sons, New York.
6. S.N.Pandeya: A Textbook of Medicinal chemistry, Vol-I, S.G.Publishers, Varanasi.
7. Ashutosh Kar: Medicinal Chemistry, Wiley Eastern, Ltd., New Delhi
8. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry by Wilson and Gisvold, J. Lippincot Co. Philadelphia.
9. Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press New York, Oxford.

10. Antibacterial Chemotherapeutic Agents by SL Dax, Blackie Academic and Professional Publications, Chapman and Hall, 1997.
11. Principles of Medicinal Chemistry by Kadam SS, Mahadik KR, Bothara KG, Vol. I & II, 10 th Edition, Nirali Prakashan.
12. Introduction to Medicinal Chemistry' – How Drugs Act and Why by Alex Gringauz,
13. Willey-VCH Publication 1997.
14. Practical Organic Chemistry by Mann FC & Saunders BC, The English Language
15. Book Society and Longman Group Limited, London.
16. Vogel's A Text book of Practical Organic Chemistry by Vogel, 3rd edition, The English language book society and Longman group limited, London.
17. Advanced practical Medicinal Practical Organic Chemistry Small Scale Preparation by Arthur I.,2nd Edition, Part-I, CBS Publication.

4.7.8 Medicinal Chemistry-III

Synthesis, M.P. & TLC of following drugs & intermediates:

1) Aspirin
2) Paracetamol
3) Phenoxyacetic acid
4) Phenytoin
5) Barbituric acid
6) Benzhydrol

4.7.4 Pharmaceutical Analysis-V

Chromatography:

Definition & classification of chromatography, Terminology- Retention time, Retention volume, Adjusted retention time & volume, height equivalent to theoretical plate (HETP), temperature programming, resolution, column performance, derivatization, detection.

1. **Paper Chromatography:**
   Introduction, papers used, development techniques & applications.

2. **Thin Layer Chromatography :**
   Introduction, selection of adsorbent, preparation of the chromatoplate, sample spotting, development of chromatogram, detection of compound, qualitative & quantitative measurements and applications.
   HPTLC-introduction, theory & applications.

3. **Column Chromatography:**
   Introduction & classification
   a. Adsorption chromatography- theory, adsorbents used and applications.
   b. Partition chromatography- theory & applications.
   c. Ion-exchange chromatography – introduction, principle, types of ion exchange resins, applications.
   d. Gel chromatography – theory & principle, gels used, applications.

4. **Gas Chromatography :**
   Introduction(GLC & GSC), carrier gas, columns, sample injection system, Detectors- Flame ionization detector (FID), Thermal conductivity detector,(TCD), Electron Capture detector (ECD), Atomic emission Detector (AED),Thermionic detector (TID), Nitrogen Phosphorous detector (NPD), Photoionisation detector (PID), Flame photometric detector(FPD) & Applications.

5. **High Performance Liquid Chromatography :**
   Introduction, scope, principle & Instrumentation-
   Mobile phase reservoirs- solvent treatment systems, Isocratic Elution, Gradient Elution.
   Pumps-Reciprocating pump, Displacement pump & Pneumatic pump.
   Injection system- sample loop system, stop flow etc.
   Columns-Analytical columns, Guard columns, column thermostats, Types of column packing, Column packing material.
   Detectors-solute property detector & solvent property detector (Absorbance detectors, IR detector, Fluorescence detectors, Refractive index detectors, Evaporative light scattering detector, electrochemical detectors)

Reference Books:

1. H. Beckett, J. B. Stenlake, practical pharmaceutical chemistry, 4th edition, CBS publications.
2. Vogel's textbook of quantitative chemical analysis, J Mendham, R.C. Denney, D. Barnes, M. Thomas, B, Sivasankar, VI th edition, pearson.
3. Principles of instrumental analysis, 4th edition, Skoogh, Holler, Nieman, Thomson
4. Gurdeep R. Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalay Publishing House.
5. Indian pharmacopoeia.
6. Handbook of Modern Pharmaceutical Analysis. Edited by Satinder Ahuja, Stephen Scypinski
7. Handbook of Pharmaceutical Analysis by HPLC. Edited by Satinder Ahuja, Michael Dong
8. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
9. Willard H. H., L. L. Merritt & John Dean Instrumental Method of Analysis, 6th edition,
10. Dr. B. K. Sharma Instrumental Methods of Chemical Analysis

4.7.9 Pharmaceutical Analysis-V

1. Separation of mixture using Thin-layer chromatography (two).
2. Separation of mixture using ascending and radial paper chromatography (two from each).
3. Demonstration of HPLC
4. Chromatographic analysis of Pharmaceutical dosage forms containing combinations (three).
5. Column chromatographic separations of two component mixtures (one).
6. Isolation of compounds using preparative chromatography (one)

4.7.5 Pharmacology-III

Classification, pharmacokinetics, mechanism of action, pharmacological actions, adverse effects, contraindications, therapeutic uses, drug interaction, dosage, symptoms and treatment of poisoning of drugs acting on following categories:

I. **Central Nervous System:** General considerations- study of neurotransmitters and their mechanisms
   1. Alcohols: Ethyl alcohol, aldehyde dehydrogenase inhibitors and methyl alcohol poisoning and treatment
   2. General anaesthetics: comparison between local and general anaesthetics, stages of anaesthesia, properties of an ideal anaesthetic, complications of general anaesthesia and preanaesthetic medications
   3. Antiepileptics: definition of epilepsy, seizures and convulsions and types of epilepsy
   4. Sedatives, hypnotics and anxiolytics
   5. Antipsychotic and antimanic drugs
   6. Antidepressant and antianxiety drugs
   7. CNS stimulants and cognition enhancers
   8. Neurodegenerative disorders: antiparkinsonian drugs

II. **Drugs used for Pain Management:**
   1. Opioid analgesics: opioid receptors, opioid antagonists, endogenous opioid peptides
   2. Antipyretic-analgesics
   3. Nonsteroidal anti-inflammatory drugs

III. **Immunopharmacology**
   1. Immunostimulants
   2. Immunosuppressant

   Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

IV. **Hormone and related drugs**
   1. Diabetes mellitus and antidiabetic drugs: definition, types and symptoms of diabetes mellitus, comparison between type-I and type-II diabetes mellitus, insulin and oral hypoglycaemic agents
   2. Thyroid and antithyroid drugs,
   3. Androgens and drugs for erectile dysfunction
   4. Estrogens, progestins and contraceptives
   5. Oxytocin and other drugs acting on uterus

Reference Books:

1. Satoskar R.S. and Bhandarkar S.D.: Pharmacology & Pharmacotherapeutics, Popular Prakashan, Bombay.
2. Tripathi K.D.: Essentials of Medical Pharmacology, Jaypee Brothers, Medical Publishers, New Delhi.
3. Goodman and Gillman: Pharmacological Basis of Therapeutics, McGraw-Hill, Medical Publishing Division, NewYork.
4. Rang H.P. and Dale M.M.: Pharmacology, Churchill Livingstone, Edinbergh.
5. Katzung B.G.: Basic and Clinical Pharmacology, Lange Medical Publications, California.
6. Craig C.R. and Stitzel R.E.: Modern Pharmacology, Little Brown and Co., Boston.
7. Bowman W.C. and Rand M.J.: Textbook of Pharmacology, Blackwell Scientific Publications, Oxford.
8. P.N Bennett & M J Brown: Clinical Pharmacology, Churchill Livingstone, Edinburgh.

4.7.10 Pharmacology-III

Discussion of the following aspects

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Study of various anaesthetics and techniques of euthanasia used in experimental pharmacology.
6. Study of different routes of drugs administration in mice/rats.
7. Introduction to *in-vitro* pharmacology and physiological salt solutions.

Experiments:

1. Record and interpret the concentration response of acetylcholine/histamine using suitable isolated tissues.
2. Study of synergism and antagonism using isolated tissues.
3. Effect of drugs on rabbit eye (miotic, mydriatic and local anaesthetic).
4. Effects of skeletal muscle relaxants using rota-rod apparatus.
5. Effect of drugs on locomotor activity using actophotometer (CNS stimulant/depressant).
6. Anticonvulsant effect of drugs by MES and PTZ method.
7. Study of analgesic activity of drugs using Eddy's hot plate/tail-flick/tail immersion method.
8. Effect of drugs on isolated frog heart.

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Reference Books/Softwares:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Software: X-Pharma, X-cology

4.7.6 Pharmacognosy-III

1. **Alkaloids:**
   Definition, occurrence, properties, General methods of Extraction, classification, chemistry & uses of Alkaloids. Source, constituents, uses, adulterants & substitutes of following drugs:
   a. Indole – Ergot*, Rauwolfia, Nux-vomica, Vinca
   b. Tropane – Datura*, Coca
   c. Quinoline – Cinchona
   d. Isoquinoline – Opium*, Ipecac
   e. Pyridine/ Piperidine – Lobelia
   f. Quinazoline – Vasaka
   g. Amino alkaloids –Ephedra*
   h. Steroidal – Ashwagandha
   *Biosynthetic pathway to be studied

2. **Glycosides:**
   Introduction, definition, occurrence, properties, classification, chemistry, uses along with their hydrolysis product. General methods of extraction
   a. Anthraquinones – Senna, Aloe
   b. Cardioactive - Digitalis, Squill
   c. Saponins – Liquorice
   d. Bitters - Kalmegh, Chirata
   e. Cynogenetic – Bitter almond
   f. Isothiocyanate – Mustard

3. **Marine Drugs:**
   Sources and Pharmacological activities of newer medicinal agents of Marine source with special reference to Anti-inflammatory, Cardiovascular and anticancer agents.

4. **Proteins and Enzymes:**
   Papain, Bromelin, Streptokinase, Serratiopeptidase and Urokinase.

5. **Bioflavonoids:**
   Introduction and their medicinal importance, Green tea, Citrus peel, Gingko leaves and Soyabean.

Reference Books:

1. Trease and Evans, Pharmacognosy, Saunders company, London.
2. Tyler, Brady, and Robbers, Pharmacognosy, Lea Febiger, USA.
3. Wallis T. E., Text Book of Pharmacognosy, CBS publishers & distribution, Delhi.
4. Kokate, Purohit, Gokhale, Pharmacognosy, Nirali Prakashan, pune.
5. Rangari V.D., Pharmacognosy & Phytochemistry, Vol I, II, Career Publication,
6. E. Ramstad, Modern Pharmacognosy, Mc-graw hill Book Company.
7. Pridham J B, Swain T, Biosynthetic pathway in higher plants, Academic Press, New York.

8. Scheuer P G, Marine natural products, Academic Press, London.
9. Shah and Quadri Text Book of Pharmacognosy.
10. Ayurvedic Pharmacopoeia.
11. Ayurvedic Formulary.
12. Indian Pharmacopoeia.
13. British Pharmacopoeia.
14. Martindale Extra Pharmacopoeia.
15. Indian Herbal Pharmacopoeia.
16. Wagner, Plant drug analysis.
17. M. A. Iyengar, S. G. K Nayak "Pharmacognosy Lab Manual", Manipal Press.
18. M. A. Iyengar, "Anatomy of Crude Drugs", Manipal Press.
19. M. A. Iyengar, "Pharmacognosy of powdered crude drugs", Manipal Press.
20. Dr. Pulok K. Mukharjee, Quality control on Herbal Drugs, Business Horizon.
21. Kalia A. N., Industrial Pharmacognosy.
22. Mohd. Ali, "Pharmacognosy" CBS Publication. New Delhi.
23. Aushotosh Kar "Pharmacognosy & Pharmacobiotechnology" New Age International Publisher.

4.7.11 Pharmacognosy-III

1. Study of morphological, Histological(TS) characters, chemical microchemical tests for following crude drugs:
   Leaf – Vinca
   Root- Rauwolfia & Liquorice
   Bark – Cinchona
   Stem- Ephedra
   Seed – *Nux-Vomica*

2. Powder Analysis of following drugs:
   a) Vinca
   b) Rauwolfia
   c) Liquorice
   d) Cinchona
   e) Ephedra
   f) Nux vomica

3. Identification of crude drugs mentioned in theory syllabus by their Morphological and physical characteristic.
   a) Alkaloids- Vasaka, Aswagandha
   b) Glycosides- Kalmegh, Mustard, Chirata
   c) Bioflavonoids- Soybean, Citrus peel

4. General methods of extraction along with their identification test.
   Alkaloids and Glycosides

Semester-VIII

4.8.1 Novel Drug Delivery Systems

1. **Fundamentals of Novel Drug Delivery Systems:**
   Basic concepts, different terms used, classification, advantages and disadvantages, comparative study with conventional release monographs, commercial importance
2. **Polymer Science:**
   Introduction, classification, examples, properties, advantages and applications of polymers in formulation of controlled release drug delivery systems.
3. **Oral Modified Release Systems:**
   Introduction, historical development, pre-requisites of drug candidates, pertinent physiological parameters, biopharmaceutical considerations, dose calculation, various approaches to design sustained and controlled release, dissolution, diffusion controlled systems, matrix formulations, mechanisms of drug release from matrix, reservoir systems, ion exchange systems, osmotically controlled systems, gastroretentive systems, delayed release approaches like bioadhesive systems, colon targeting, different drug release kinetics and model fitting, official and unofficial methods of evaluation
4. **Recent Advances in Drug Delivery Systems:**
   Introduction, classification, principle involved, merits, demerits and applications of following systems excluding formulation aspects: targeted drug delivery systems, nanoparticles, liposomes, resealed erythrocytes transdermal drug delivery system, iontophoresis, sonophoresis, implants, intrauterine drug delivery system, naso-pulmonary systems, ocular delivery systems

Reference Books:

1. Chien Y.W., Controlled Drug Delivery: Fundamentals and Applications, 2nd Ed. Marcel Dekker Inc., New York.
2. Robinson J.R., Sustained and Controlled Drug and Delivery, Marcel Dekker Inc., New York.
3. Kydonieus A, Treatise on Controlled Drug Delivery: Fundamentals, Optimization and Applications. Latest edition, Marcel Dekker Inc., New York.
4. Jain N.K., Advances in Controlled and Novel Drug Delivery, 1st Ed., CBS Publication, New Delhi, 2001.
5. Rowe R.C., Handbook of Pharmaceutical Excipients, 5th Ed., Pharmaceutical Press, New York, 1991.
6. Tarcha P.J., Polymers for Controlled Drug Delivery, 1st Ed., CRC Press, New Delhi, 2006.
7. Benita S., Microencapsulation: Methods and Industrial Applications, 2nd Ed., Vol. 158, CRC Press, New Delhi, 2006.
8. Hadgraft J. and Guy R.H., Transdermal Drug Delivery, 1st Ed., Vol. 35, Marcel Dekker, New York, 1989.
9. Hillery A.M., Lloyd A.W. and Swarbrick J., Drug Delivery and Targeting for Pharmacists and Pharmaceutical Scientists, Latest Edition, Taylor & Francis, London.
10. Williams A.C., Transdermal and Topical Drug Delivery: From Theory to Clinical Practice, Latest Edition, Williams Pharmaceutical Press, New York.

11. Hillery A.M. and Lloyd A.W., Drug Delivery and Targeting, 1st Ed., Tylor and Franicis, London.
12. Banker G.S. and Rhodes C.T., Modern Pharmaceutics: Revised and Expanded, 4th Ed., Marcel Dekker Inc., New York, 2002.
13. Gennaro A.R., Remington: The Science and Practice of Pharmacy, Vol. I & II, Lippincott Williams & Wilkins, New York.
14. Aulton M. E., Pharmaceutics: The Science of Dosage Form Design, 2nd Ed., Churchill Livingstone, 2002.
15. Lachman L., Liberman H.A. and Kanig J.I., The Theory and Practice of Industrial Pharmacy, 3rd Ed., Verghese Publishing House, 1987.
16. Alen L.V., Popovich N.G. and Ansel H.C., Pharmaceutical Dosage Forms and Drug Delivery Systems, 7th Ed., Lippincott Williams and Wilkins, London.

4.8.7 Novel Drug Delivery Systems

1. Study of drug release requirements in different pharmacopoeias.
2. Formulation and evaluation of any one fast dissolving tablets.
3. Formulation and pre-compressional study of any one matrix tablets.
4. Evaluation of matrix tablets.
5. Formulation of any one multiparticulate oral sustained release formulation.
6. *In-vitro* drug release study of multiparticulate system.
7. Dissolution study of any one marketed products.
8. Formulation of a multiple emulsion.
9. Study on diffusion of drug through membranes.
10. Applications of software in modeling of drug release.

4.8.2 Pharmaceutical Business Management

1. **Introduction to the Concepts of Management:**
   Managerial work, functions of management-primary functions like planning, organizing, Staffing, directing & controlling. Secondary functions like decision making, leadership, Delegation of authority/responsibility.

2. **Introduction to Forms of Business Organization:**
   Forms of business Organization (in brief), Hindu Undivided family, Sole proprietorship, Partnership, Company and Cooperative Society.

3. **Channels of Distribution:**
   Need of distribution channels, various channels of distribution like carrying & forwarding agents, super stockist, Wholesale & retail sellers.

4. **The Pharmaceutical Product:**
   Market consideration in product development, marketing mix, product life cycle, modification of existing product, Marketing Generic drug, Branding- concept of brand, different types of brand, importance & reasons of branding.

5. **Pharmaceutical Marketing:**
   Meaning & scope of marketing, quantitative & qualitative aspect, size & composition of market, market segmentation, marketing research. Uniqueness of medical products marketing. Professional Sales Representative-qualities of PSR, duties of PSR, purpose of detailing, selection & training of PSR.

6. **Marketing Management:**
   Identifying and classifying market, understanding market behavior/consumer behavior, Pharmaceutical market in India, Pharmaceutical Industry Scenario.

Reference Books:

1. Koontz and O'Donnell., 'Principles of Management' by International Student edition of McGraw Hill.
2. Reddin. W. J., 'Effective Management', New Delhi, Tata M. C. Graw Hill,Publishing Co. Ltd.,
3. Peter Drucker, 'Practice of Management' Allied Publishers, New Delhi.
4. Principles and Practice of Drug store administration - Dr.Mahesh Burande [Nirali Prakashan
5. R. M. Mehta - Drug Store and Management [Vallabh prakashan]
6. Smith - Principles and methods of Pharmacy management
7. The practice of Management by Peter Dracket [Allied Publication, New Delhi.
8. Pharmaceutical Marketing Management – Mukhopadhya
9. Marketing Management by Philip Kotlar; Prentice-Hall of India Ltd., New Delhi.
10. Management and Organization by Louis A. Allen; McGraw Hill, Tokyo.
11. Marketing Management 2nd edition by Dr. Rajan Saxena.

4.8.3 Medicinal Chemistry-IV

The following classes of drugs should be discussed in relation to:
A) Introduction to the rational development (if any)
B) Detailed Classification of each class
C) Chemical nomenclature
D) Structure-activity relationship
E) Mechanism of action
F) Synthesis of compounds with asterisk

1. **Drugs Acting on Cholinergic Nervous System:**
   Biosynthesis and metabolism of Acetylcholine.
   Cholinergic receptor agonist: Acetylcholine, Bethanechol, Carbachol, Pilocarpine;
   Cholinesterases Reversible Inhibitors: Neostigmine, Physostigmine;
   Cholinesterases Irreversible Inhibitors: Echothiophate iodide, Isoflurophate, Parathione, Malathion;
   Anticholinergics: Atropine, Scopolamine, Hyoscyamine, Dicyclomine*, Cyclopentolate*, benztropine, procyclidine, Isopropamide, Papaverine;
   Ganglionic blocking agents: Mecamylamine;
   Neuromuscular blocking agents: d-Tubocurarine chloride, Succinyl choline chloride

2. **Drugs Acting on Adrenergic Nervous System:**
   Biosynthesis and metabolism of Epinephrine/norepinephrine.
   Drugs affecting catecholamine biosynthesis: Metyrosine;
   Drugs affecting catecholamine storage and release: Reserpine, Guanethidine;
   Adrenergic receptor agonists: Epinephrine, norepinephrine, dopamine, phenylephrine, Clonidine, methyldopa*, dobutamine, Isoproterenol, Metaraminol, Terbutaline, Ephedrine;
   Adrenergic receptor antagonists: tolazoline, Phenoxybenzamine, prazocin, Yohimbine, Propranolol*, Atenolol, Metoprolol, Labetolol, Phenylpropanolamine, Salbutamol*

3. **Cardio Vascular Drugs:**
   Antianginal agents and vasodilators: Amyl nitrite, Nitroglycerin,isosorbide dinitrite;
   Calcium antagonists: Verapamil, Diltiazem, Nifedipine*, Amlodipine
   Antiarrhythmic drugs: Quinidine, Procainamide*, Flecainide, Amiodarone;
   Antihypertensive drugs: Enalapril, Captopril, Losartan, Telmisartan, Hydralazine, Diazoxide, minoxidil;
   Positive inotropic agents: Digitalis;
   Antihyperlipidemic drugs: Clofibrate, Gem fibrozil, atorvastatin, Provastatin, Lovastatin, Simvastatin, Cholestyramine

1. **Drug Design:**
   Computer Aided Drug Design (CADD)
   Quantitative Structure Activity Relationship (QSAR)- Introduction to various methods of QSAR – Physicochemical parameters – lipophilic, electronic and steric. Hansch LFER model and Free Wilson analysis.
   Prodrugs

Reference Books:

1. Chemistry by Ashutosh Kar, 1st edition, New Age International Publications.
2. Vogel's Elementary M.E. Wolf:Burger's Medicinal Chemistry, John Wiley and Sons, New York.
3. R.F. Doerge, Wilson & Gisvold's: Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott.
4. W.O.Foye: Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
5. D.Lednicer and L.A. Mitschier: Ale Organic Chemistry of Drug synthesis Vol. 1, II & III John Wiley and Sons, New York.
6. S.N.Pandeya: A Textbook of Medicinal chemistry, Vol-I, S.G.Publishers, Varanasi.
7. Ashutosh Kar: Medicinal Chemistry, Wiley Eastern, Ltd., New Delhi
8. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry by Wilson and Gisvold, J. Lippincot Co. Philadelphia.
9. Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press New York, Oxford.
10. Antibacterial Chemotherapeutic Agents by SL Dax, Blackie Academic and Professional Publications, Chapman and Hall, 1997.
11. Principles of Medicinal Chemistry by Kadam SS, Mahadik KR, Bothara KG, Vol. I & II, 10 th Edition, Nirali Prakashan.
12. Introduction to Medicinal Chemistry' – How Drugs Act and Why by Alex Gringauz,
13. Willey-VCH Publication 1997.
14. Practical Organic Chemistry by Mann FC & Saunders BC, The English Language
15. Book Society and Longman Group Limited, London.
16. Vogel's A Text book of Practical Organic Chemistry by Vogel, 3rd edition, The English language book society and Longman group limited, London.
17. Advanced practical Medicinal Practical Organic Chemistry Small Scale Preparation by Arthur I.,2nd Edition, Part-I, CBS Publication.

4.8.8 Medicinal Chemistry-IV

Synthesis, M.P. & TLC of following drugs & intermediates;

1) Diphenylmethane
2) Methyl salicylate
3) Benzocaine
4) N-phenylanthranilic acid
5) *o*-benzoylbenzoic acid
6) Methyl orange

4.8.4 Pharmaceutical Analysis-VI

1. **Mass Spectrometry:**
   Principle, theory, ion sources, mass analyzer, types of ions and applications.

2. **NMR Spectroscopy:**
   Basic principles, theory, chemical shift, factors affecting chemical shift, spin-spin coupling & applications.

3. **Quality Assurance & Quality Control:**
   Introduction to Q.A. & Q.C, Components of Q.A, Q.C & quality management. Documents and formats in Quality policy (quality manual & SOP).

4. **Analytical method development and validation** according to ICH for UV and HPLC and application in the analysis of API and formulations. Introduction to process and equipment validation

5. **Packaging Material Testing (PMT):**
   Quality Control test of packaging material used for pharmaceutical products-Glass bottles, Metals, Plastics, Aluminium foils, Rubber closure,Paper board cartons, Corrugated box.(Permeability of plastics, burst and tensile strength, cartons drop test, folding endurance test, hydrolytic resistance test, grammage, leakage test etc.)

6. **Bio-Statistics:**
   Statistics in quality control: Definition of terms- mean, median, mode, normal distribution. Standard deviations, t-test, f-test, Chi (ψ) square test, Linear regression & non-linear regression, ANOVA &.Statistical Quality Control Charts.

Reference Books:

1. A.H.Beckett, J.B.Stenlake, practical pharmaceutical chemistry, IVth edition,CBS publications.
2. Vogel's textbook of quantitative chemical analysis, J Mendham, R.C.Denney, J.D.Barnes, M.Thomas, B,Sivasankar, VI th edition, pearson.
3. Principles of instrumental analysis, Vth edition,Skoog, Holler, Nieman, Thomson
4. Gurdeep R. Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalay Publishing House.
5. Wlliam Kemp, Organic spectroscopy, ELBS.
6. Y.R.Sharma, elementary organic spectroscopy –principles & chemical applications,S.Chand & company Ltd.
7. Manohar A. Potdar, pharmaceutical quality assurance, nirali prakashan.
8. Remington Pharmaceutical Sciences,Vol-1
9. Theory & Practice of Industrial Pharmacy, Lachmann.
10. Walter Soroka, Fundamental's of Packaging technology.
11. D. A. Sawant, The Pharmaceutical sciences pharma pathway, Nirali Prakashan.
12. R M Silverstein and F X Webster, Spectrometric identification of organic compounds 6th Edition
13. Dixie A, Dean, Roy Evans, Ian Hall Pharmaceutical Packaging Technology

4.8.9 Pharmaceutical Analysis-VI

1. Determination of drug concentration in multicomponent drug formulation by simultaneous equation & absorption ratio methods (One each).
2. Development and validation methods using UV Visible and applications for assay of API and formulations (Demo).
3. Determination of grammage of packaging materials. (Two)
4. Determination of bursting strength of aluminum foil, corrugated box. (Two)
5. Q.C. test for plastic, rubber closure & glass as per IP. (Three)
6. Interpretation of NMR & Mass spectrum. (One each)
7. Calculation involving t-test (two)

4.8.5 Pharmacology-IV

Classification, mechanism of action, pharmacokinetics, pharmacological actions, adverse effects, contraindications, therapeutic uses, drug interaction, dosage, symptoms and treatment of poisoning of drugs acting on following categories:

I. Chemotherapy of Infection:

1. General principles
2. Antimicrobial resistance: introduction, types, mechanisms and its importance
3. Sulfonamides, cotrimoxazole and quinolones
4. Beta lactam antibiotics: penicillins, cephalosporins and carbapenems
5. Tetracycline and chloramphenicol
6. Aminoglycoside antibiotics
7. Macrolides
8. Antitubercular drugs
9. Antileprosy drugs
10. Antifungal drugs
11. Antiviral drugs
12. Antiprotozoal (antimalarial, antiamoebic etc.) drugs
13. Anthelmintic drugs

II. Chemotherapy of cancer

III. Drugs used in the disorders of eye, ENT and skin:

- Eye - Glaucoma, keratitis, conjunctivitis
- ENT- Allergic rhinitis, otitis media, vertigo, meneiers disease.
- Skin- Acne, candidiasis, erythema nodosum, eczema, contact dermatitis, pediculosis, psorasis, pyoderma, scabies, urticaria, pruritis.

Reference Books:

1. Satoskar R.S. and Bhandarkar S.D.: Pharmacology & Pharmacotherapeutics, Popular Prakashan, Bombay.
2. Tripathi K.D.: Essentials of Medical Pharmacology, Jaypee Brothers, Medical Publishers, New Delhi.
3. Goodman and Gillman: Pharmacological Basis of Therapeutics, McGraw-Hill, Medical Publishing Division, NewYork.
4. Rang H.P. and Dale M.M.: Pharmacology, Churchill Livingstone, Edinbergh.
5. Katzung B.G.: Basic and Clinical Pharmacology, Lange Medical Publications, California.
6. Craig C.R. and Stitzel R.E.: Modern Pharmacology, Little Brown and Co., Boston.
7. Melman K.I. and Morelli H.F.: Clinical Pharmacology: Basic Principles in Therapeutics, Macmillan Press, New York.
8. Pharmacopoeia of India (1985), Controller of publication, Delhi.

4.8.10 Pharmacology-IV

1. Introduction to general principles, types and applications of bioassays.
2. Introduction to cell based assay: definition, types, advantages, limitations of cell based assay and application to high throughput screening.
3. Bioassay of acetylcholine/ histamine using chick ileum by matching method.
4. Bioassay of acetylcholine/ histamine using chick ileum by interpolation method.
5. Bioassay of acetylcholine/ histamine using chick ileum by three point method.
6. Bioassay of atropine/mepyramine using chick ileum.

Simulated Experiments

7. Bioassay of heparin by sheep blood coagulation comparison method
8. To demonstrate bioassay of d-tubocurarine by rabbit head drop method
9. To demonstrate bioassay of insulin by rabbit blood sugar determination method
10. To demonstrate bioassay of oxytocin using rat uterus.
11. To demonstrate the diuretic activity in rats using metabolic cage.
12. To demonstrate the effect of anti-motility drugs using mice/rat.

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Reference Books/Softwares:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.
5. R.K.Goyal. Practicals in Pharmacology: B.S. Shah Prakashan, Ahmedabad.
6. Pharmacopoeia of India (1985), Controller of publication, Delhi.
7. Softwares: X-Pharma, X-cology.

4.8.6 Herbal Technology

1. **Introduction:**
   Role of natural products in herbal medicine, General status and importance of herbal medicine

2. **Processing of Herbs:**
   Methods of processing of herbs, Quality assessment, packing and storage of herbs.

3. **Herbal Formulations:**
   Introduction to herbal formulations, Principle, methods, single herb formulation, poly-herbal formulation & their merits and demerits.

4. **Regulatory Requirements of Herbal Medicines:**
   Safety and efficacy consideration, Regulatory control for Import and Export of herbal products, Herbal drug regulations in India (Brief)

5. **Introduction to Ayurvedic Dosage Forms:**
   Definition, Classification, method of preparation and evaluation of following formulations- Asava & Arista, Gutika, Taila, Bhasma, Churna & Leha.

6. **Herbal Cosmetics:**
   Introduction and brief history, Skin and hair care products, production and quality control thereof.

Reference Books:

1. Trease and Evans, Pharmacognosy, Saunders Company, London.
2. Shah and Quadri Text Book of Pharmacognosy.
3. Atal C K, Cultivation and utilization of medicinal and aromatic plant.
4. Chopra, Indigenous drug of India.
5. Wealth of India.
6. Nadkarni, Material Medica.
7. Shehnaz Husain's Beauty Book, Orient Press.
8. Jain Urjita, Beauty through herbs, Institute of Herbs.
9. Chaudhari R D, Herbal Drug Industry, Eastern publication
10. Dr. Pulok K. Mukharjee, "Quality control Herbal Drugs" Business Horizons,
11. Ayurvedic Pharmacopoeia.
12. British Pharmacopoeia.
13. Martindale Extra Pharmacopoeia.
14. Indian Herbal Pharmacopoeia.
15. Wagner, Plant drug analysis.
16. Mohd. Ali, "Pharmacognosy" CBS Publication. New Delhi.
17. Herbal Drug Technology by S.S. Agrawal & M. Paridhavi
18. Kirtikar and Basu Indian Medicinal Plant.

19. Kalia A. N., Industrial Pharmacognosy.
20. Modern Methods of Plant Analysis by Peach & Tracey

4.8.11 Herbal Technology

1. Preparation and Evaluation of Herbal Cosmetics:
   a) Hair Cosmetics (Any two)
   b) Skin Cosmetics (Any two)
2. Extraction and Isolation of following phytoconstituents:
   a) Caffeine
   b) Citric acid
   c) Eugenol from Clove oil
3. Study of following Health food with reference to morphology:
   Honey, Brahmi, Shatavari, Spirulina, Guggul, Shankpushpi, Bael fruit, Pipal fruit, Cucumber and Fenugreek
4. Evalution of marketed herbal and Ayurvedic Formulation: (Group Experiment)
   Any one herbal and Ayurvedic preparation.