

## BACHELOR OF PHARMACY SYLLABUS

### Semester I

Code	Paper	Credit
PHA-UG-T101	History, Ethics & Scope of Pharmacy	4
PHA-UG-T102	Pharmaceutics-I (Dispensing Pharmacy)	4
PHA-UG-T103	Pharmaceutical Chemistry-I (Inorganic Chemistry-I)	4
PHA-UG-T104	Pharmaceutical Chemistry-II (Organic Chemistry-I)	4
PHA-UG-T105	Pharmacognosy-I	4
PHA-UG-T106	Anatomy Physiology & Health Education-I	4
PHA-UG-P102	Pharmaceutics-I (Dispensing Pharmacy)	2
PHA-UG-P103	Pharmaceutical Chemistry-I (Inorganic Chemistry-I)	2
PHA-UG-P104	Pharmaceutical Chemistry-II (Organic Chemistry-I)	2
PHA-UG-P105	Pharmacognosy-I	2
PHA-UG-P106	Anatomy Physiology & Health Education-I	2
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### Semester II

Code	Paper	Credit
PHA-UG-T201	Communicative English	4
PHA-UG-T202	Pharmaceutics-II ( Physical Pharmacy-I)	4
PHA-UG-T203	Pharmaceutical Chemistry-III (Organic Chemistry-II)	4
PHA-UG-T204	Pharmaceutical Chemistry-IV (Inorganic Chemistry-II)	4
PHA-UG-T205	Pharmacognosy-II	4
PHA-UG-T206	Anatomy Physiology & Health Education-II	4
PHA-UG-P202	Pharmaceutics-II ( Physical Pharmacy-I)	2
PHA-UG-P203	Pharmaceutical Chemistry-III (Organic Chemistry-II)	2

PHA-UG-P204	Pharmaceutical Chemistry-IV (Inorganic Chemistry-II)	2
PHA-UG-P205	Pharmacognosy-II	2
PHA-UG-P206	Anatomy Physiology & Health Education-II	2
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### Semester III

Code	Paper	Credit
PHA-UG-T301	Mathematics & Pharmaceutical Biostatistics	4
PHA-UG-T302	Pharmaceutics-III (Physical Pharmacy-II)	4
PHA-UG-T303	Pharmaceutical Chemistry-V (Pharmaceutical Analysis-I)	4
PHA-UG-T304	Pharmaceutical Microbiology	4
PHA-UG-T305	Ethnomedicine & Biodiversity	4
PHA-UG-T306	Computer Application in Pharmacy	4
PHA-UG-P302	Pharmaceutics-III ( Physical Pharmacy-II)	2
PHA-UG-P303	Pharmaceutical Chemistry-V (Pharmaceutical Analysis-I)	2
PHA-UG-P304	Pharmaceutical Microbiology	2
PHA-UG-P305	Ethnomedicine & Biodiversity	2
PHA-UG-P306	Computer Application in Pharmacy	2
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### Semester IV

Code	Paper	Credit
PHA-UG-T401	Eastern Himalayan Studies	4
PHA-UG-T402	Pharmaceutics –IV (Pharmaceutical Technology-I)	4
PHA-UG-T403	Pharmaceutical Chemistry-VI (Biochemistry)	4
PHA-UG-T404	Chemistry of Natural Product	4
PHA-UG-T405	Pharmaceutical Biotechnology	4
PHA-UG-T406	Pharmacology-I (Pathophysiology)	4
PHA-UG-P402	Pharmaceutics –IV (Pharmaceutical Technology-I)	2

PHA-UG-P403	Pharmaceutical Chemistry-VI (Biochemistry)	2
PHA-UG-P404	Chemistry of Natural Product	2
PHA-UG-P405	Pharmaceutical Biotechnology	2
PHA-UG-P406	Pharmacology-I (Pathophysiology)	2
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### Semester V

Code	Paper	Credit
PHA-UG-T501	Environmental Studies	4
PHA-UG-T502	Pharmaceutics-V (Formulative & Industrial Pharmacy-I)	4
PHA-UG-T503	Pharmaceutical Chemistry-VII (Pharmaceutical Analysis-II)	4
PHA-UG-T504	Pharmaceutical Chemistry-VIII (Medicinal Chemistry-I)	4
PHA-UG-T505	Pharmacognosy-III	4
PHA-UG-T506	Pharmacology-II	4
PHA-UG-P502	Pharmaceutics-V (Formulative & Industrial Pharmacy-I)	2
PHA-UG-P503	Pharmaceutical Chemistry-VII (Pharmaceutical Analysis-II)	2
PHA-UG-P504	Pharmaceutical Chemistry-VIII (Medicinal Chemistry-I)	2
PHA-UG-P505	Pharmacognosy-III	2
PHA-UG-P506	Pharmacology-II	2
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### Semester VI

Code	Paper	Credit
PHA-UG-T601	Pharmaceutical Regulatory Affairs-I	4
PHA-UG-T602	Pharmaceutics-VI (Formulative & Industrial Pharmacy-II)	4
PHA-UG-T603	Pharmaceutical Chemistry-IX (Medicinal Chemistry-II)	4
PHA-UG-T604	Pharmaceutics –IV (Pharmaceutical Technology-II)	4

PHA-UG-T605	Pharmacognosy-IV	4
PHA-UG-T606	Pharmacology-III	4
PHA-UG-P602	Pharmaceutics-VI (Formulative & Industrial Pharmacy-II)	2
PHA-UG-P603	Pharmaceutical Chemistry-IX (Medicinal Chemistry-II)	2
PHA-UG-P604	Pharmaceutics –IV (Pharmaceutical Technology-II)	2
PHA-UG-P605	Pharmacognosy-IV	2
PHA-UG-P606	Pharmacology-III	2
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### Semester VII

Code	Paper	Credit
PHA-UG-T701	Pharmaceutical Regulatory Affairs-II	4
PHA-UG-T702	Pharmaceutics-VIII (Biopharmaceutics & Pharmacokinetics)	4
PHA-UG-T703	Pharmaceutics-IX (Formulative & Industrial Pharmacy-III)	4
PHA-UG-T704	Pharmaceutical Chemistry-X (Medicinal Chemistry-III)	4
PHA-UG-T705	Pharmacognosy-V (Indigenous Medicine & Drug Evaluation)	4
PHA-UG-T706	Pharmacology-IV	4
PHA-UG-P702	Pharmaceutics-VIII (Biopharmaceutics & Pharmacokinetics)	2
PHA-UG-P703	Pharmaceutics-IX (Formulative & Industrial Pharmacy-III)	2
PHA-UG-P704	Pharmaceutical Chemistry-X (Medicinal Chemistry-III)	2
PHA-UG-P705	Pharmacognosy-V (Indigenous Medicine & Drug Evaluation)	2
PHA-UG-706	Pharmacology-IV	2
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### Semester VIII

<b>Code</b>	<b>Paper</b>	<b>Credit</b>
PHA-UG-T801	Pharmaceutical Management	4
PHA-UG-T802	Pharmaceutics-X (Advances in Drug Delivery System)	4
PHA-UG-T803	Pharmaceutical Chemistry-XI (Pharmaceutical Analysis-III)	4
PHA-UG-T804	Pharmaceutical Chemistry-XII (Drug Design)	4
PHA-UG-T805	Pharmacognosy-VI (Industrial Pharmacognosy)	4
PHA-UG-T806	Pharmacology-V (Hospital & Clinical Pharmacy)	4
PHA-UG-P802	Pharmaceutics-X (Advances in Drug Delivery System)	2
PHA-UG-P803	Pharmaceutical Chemistry-XI (Pharmaceutical Analysis-III)	2
PHA-UG-P804	Pharmaceutical Chemistry-XII (Drug Design)	2
PHA-UG-P805	Pharmacognosy-VI (Industrial Pharmacognosy)	2
PHA-UG-P806	Pharmacology-V (Hospital & Clinical Pharmacy)	2
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### **PHA-UG-101: HISTORY ETHICS AND SCOPE OF PHARMACY**

#### **Theory**

1. Historical background and development of profession of pharmacy.
2. Builders and awareness creators of Indian Pharmacy.
3. Development content of Indian Pharmacopoeia and Indian National Formulary, BP, USP and others.
4. Pharmacy profession: Pharmacy as a career.
5. Pharmaceutical Education present and future, Registration as a Pharmacist, Evolution of Pharmacy profession- earlier period, middle ages, modern, European and American Pharmacy
6. Indian Pharmacopoeia commission, National Institute of Pharmaceutical Sciences and its professional issues
7. History of drugs and pharmacy statutes, the pharmacopoeial history of colonial India, the overseas drug trade of colonial India, Rural Pharmacy, apothecaries and hospital assistants in colonial India, Pharmacy in colonial India, History if modern pharmacy in India.

### Reading List:

1. Carter. S.J. 1987. Cooper and Gunn's, General Pharmacy. New Delhi: CBS Publishers & Distributors.
2. Singh. H. 2005. History of Pharmacy in India and Related Aspects. New Delhi: Vallabh Prakashan.
3. 1996, 2007. Indian Pharmacopoeia. New Delhi: Controller of Publications.
4. Remington. 2007. The Science & Practice of Pharmacy. USA: Lipincott Williams & Wilkins.
5. Any other relevant Pharmacopoeias and formularies like British Pharmacopoeia, British National Formulary.

## PHA-UG-102: PHARMACEUTICS-I (Dispensing Pharmacy)

### Theory

1. **SI and imperial systems**, inter conversions, Weighing- selection and care of weights and balances. Sensitivity and minimum weighable quantities.
2. **Prescription:** Handling of prescription, source of errors in prescription, care required in dispensing procedures including labeling of dispensing products, Latin terms used in prescription.
3. **Pharmaceutical calculations:** Posology, factors determining doses of drug, calculation of doses for infants, adults and elderly patients, enlarging and reducing recipes, percentage solutions, alligation, alcohol dilution, spirit, isotonic solution, displacement values.
4. **Incompatibilities:** Physical Chemical and therapeutic incompatibilities definition, reasons and correction of Incompatibilities, role of Pharmacist in overcoming such incompatibilities in prescription.
5. **Introduction to different types of processes:** Fusion, dessication, sublimation, exsiccation and ignition. Definition of evaporation, distillation and drying. Various types of baths; water bath, steam bath, oil bath, solvent bath, sand bath etc.
6. **Galenicals:** definition, equipment for different extraction processes; expression infusion, decoction, maceration and percolation, method of preparation of spirits, tinctures, extracts, soxhelt extraction.
7. **Powders and granules:** classification, advantages and disadvantages, compound powders, insufflations, dusting powders, eutectic and explosive powders, tooth powders and effervescent powders.
8. **Monophasic dosage forms:** theoretical aspects including commonly used vehicles, essential adjuvants like stabilizers, colorants, and flavors with examples. Study of following monophasic liquids like gargles, mouth washes, throat paints, eardrops, nasal drops, liniments and lotions, enemas, colloidions, syrups, elixirs, solution and mixture.
9. **Biphasic dosage forms:****Suspensions:** definition and classification, diffusible and indiffusible suspensions, advantages and disadvantages. **Emulsions:** definition, types of emulsions, identification tests, emulsifying agents, creaming and cracking of emulsions.
10. **Suppositories and pessaries:** definition, advantages and disadvantages, types of bases, method of preparation, displacement value.

### Practical

1. Syrups: Simple syrup IP, Syrup of ephedrine hydrochloride NF, Orange syrup
2. Elixirs: Paracetamol paediatrics elixir BPC
3. Linctuses: Simple linctus BPC, Paediatric simple linctus BPC
4. Solutions: Solution of cresol with soap IP, Aqueous iodine solution IP, Iodine solution IP
5. Liniments: Liniment of turpentine IP, Liniment of Camphor BPC

6. Suspensions: Calamine lotion IP
7. Emulsions: Liquid paraffin emulsion, Castor oil emulsion, Cod liver emulsion
8. Powders: Eutectic powder, Effervescent powder, Dusting powder, Effervescent granules
9. Suppositories: Zinc Oxide suppository
10. Colloidion: Salicylic acid colloidion
11. Gargle: Potassium chlorate gargle
12. Mouthwash: Antiseptic mouthwash

### Reading List:

1. Remington. 2007. The Science & Practice of Pharmacy. USA: Lipincott Williams & Wilkins.
2. Carter. S.J. 1987. Cooper and Gunn's, General Pharmacy. New Delhi: CBS Publishers & Distributors.
3. Ansel, Popovich, Allen. 1995. Pharmaceutical Dosage Forms and Drug Delivery Systems. New Delhi: B.I. Waverly Pvt Ltd.
4. 1996, 2007. Indian Pharmacopoeia. New Delhi: Controller of Publications.
5. Any other relevant Pharmacopoeias and formularies like British Pharmacopoeia, British National Formulary.

## PHA-UG-103: PHARMACEUTICAL CHEMISTRY- I (Inorganic Chemistry-I)

### Theory

1. Method of preparation, assay, identification tests, test for purity official preparations, storage conditions and uses of inorganic compounds listed in I.P. belonging to the following categories.
2. **Gastrointestinal agents and related compounds:** i) **Acidifiers:** Dilute hydrochloric acid, Sodium phosphates, Ammonium chloride ii) **Antacids:** Classification, properties, side effects, advantages, combination therapy, acid neutralizing capacity, sodium bicarbonate, Potassium citrate, Aluminum hydroxide gel, Dried Aluminum phosphate, Magnesium trisilicate, Dimethicone, Magaldrate, Bismuth carbonate. iii) **Adsorbents and protective:** Light kaolin, heavy kaolin, Activated Charcoal. iv) **Saline cathartics:** Magnesium hydroxide, magnesium sulphate, magnesium carbonates and Sodium phosphate
3. **Topical Agents:** i) **Protective:** Talc, Zinc Oxide, Calamine, Zinc Sterate, Titanium Dioxide, Kaolin, Silicon Polymers and Dimethicone. ii) **Astringents:** Alum, Zinc Sulphate and Zinc Chloride. iii) **Antimicrobials:** Hydrogen Peroxide, Potassium Permanganate, Chlorinated Lime, Iodine, Boric Acid, Silver Nitrate, Povidone-Iodine, Selenium Sulphate.
4. **Dental Products:** i) **Anti-caries Agents:** Role of Fluorides as anti-caries agents, Sodium fluoride. ii) **Dentifrices:** Calcium carbonate, Dibasic calcium phosphate, Zinc chloride.
5. **Major intra and extra cellular electrolytes:**  
 i) Physiological role of chloride, Phosphate, Bicarbonate, Sodium, Potassium, Calcium and Magnesium. ii) Electrolytes used for replacement therapy; Sodium chloride, potassium chloride, calcium chloride, calcium gluconate. iii) Physiological acid-base balance and its importance; Electrolytes used in the Acid-base therapy: Sodium acetate, Potassium acetate, Sodium lactate, ammonium chloride. Electrolyte combination therapy, Compound sodium chloride injection and Oral rehydration salts.

## Practical

1. Test For Purity For The Following:
  - a) Swelling Property of Bentonite
  - b) Acid Neutralizing Capacity of Aluminium Hydroxide Gel
  - c) Ammonium Salts Inpotash Alum
  - d) Adsorption Power In Heavy Kaolin
  - e) Presence of Iodates In Potassium Iodide
  - f) Ferric Ion And Reducing Sugars In Ferrous Gluconate

## Reading List:

1. Atherden, L.M. 1999. Bentley and Driver's Textbook Of Pharmaceutical Chemistry (8<sup>th</sup> Edition). New Delhi: Oxford University Press.
2. Block, J.H. 1986. Inorganic Medicinal And Pharmaceutical Chemistry (Indian Edition). Bombay: Varghese Publishing House.
3. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
4. Lee, J.D. 1996. Concise Inorganic Chemistry (5<sup>th</sup> Edition). Australia: Blackwell Science Ltd.
5. Beckett, A.H. Stenlake, J.B. 1997. Practical Pharmaceutical Chemistry (Vol. I & II, 4<sup>th</sup> Edition). New Delhi: CBS Publishers & Distributors.

## PHA-UG-104: PHARMACEUTICAL CHEMISTRY- II (Organic Chemistry I)

### Theory

1. Structures and properties: molecular orbital theory, molecular bonding, anti-bonding orbitals, unshared pair of electrons and hybrid orbital's. Intra-molecular and inter-molecular forces, their effect on solubility, boiling point, melting point, hydrogen bonding, covalent bond, polarity of the bonds, polarity of molecules, dipole moment, bond dissociation energy, energy of activation. Inductive effect, electromeric effect, mesomeric effect, resonance effect, resonance, tautomerism, conjugation, hyper conjugation, types of bonds fission, electrophiles and nucleophiles. IUPAC nomenclature.
2. Structures, nomenclature, preparation and reactions of alkanes, alkenes, alkynes, cycloalkanes and dienes with special emphasis on the following: mechanism of halogenations of alkenes, Saytzeff's rule, peroxide effect, ozonolysis, Bayer' strain theory, mechanism of Diel's-Alder reaction and addition reaction of conjugation dienes.  
Reactive intermediates: carbocations, carbanions, carbenes, free radicals, generation and
3. relative stability and application. properties of  $\alpha$  and  $\beta$  unsaturated carbonyl compounds. preparation and synthetic utility of aceto-acetic esters, Grignard's reagents and diazonium salts.  
General structure, nomenclature, preparation and reaction mechanism of alkyl and aryl
4. halides (mechanism of Sn1 Sn2 E1 and E2), alcohols, aldehyde, ketone, ethers, carboxylic acid and amines.
5. Benzene Kekule structure, heat of hydrogenation and stability, c-c bond length in benzene, resonance structure of benzene, orbital picture, aromatic character, Huckel's rule, mechanism of electrophilic and nucleophilic substitution, theory of effect of substituent on reactivity and orientation.



## Practical

1. Introduction to the various laboratory techniques through demonstration involving synthesis of the following compounds (atleast 8 compounds to be synthesized).  
Acetanilide/aspirin (acetylation), Benzanilide/phenyl benzoate (benzoylation), P-bromo acetanilide/2,4,6 tri bromo aniline. (bromination), Dibenzylidene acetone (condensation), 1-phenylazo-2-naphthol (diazotization), Benzoic acid/salicylic acid (hydrolysis of ester), M-dinitro benzene (nitration), I,j-anthraquinone (oxidation of anthracene)/preparation of benzoic acid from toluene or benzaldehyde, M-phenlenediamine (reduction of m-dinitrobenzene)/aniline from nitrobenzene, Benzophenone oxime (oxime formation), Nitration of salicylic acid, Preparation of picric acid, Preparation of o-chloro benzoic acid from o-chloro toluene
2. Identification of organic compounds belonging to the following classes by systematic qualitative organic analysis including preparation of derivatives.  
Phenol, Amides, Carbohydrates, Amines, Carboxylic acids, Aldehydes and ketones, Alcohols, Esters, Hydrocarbons, Anilides, Nitro compounds

## Reading list:

1. Morrison, R.L. Boyd, R.N. 1999. Organic chemistry (6<sup>th</sup> ed.). New Delhi: Prentice-hall of India Pvt Ltd.
2. Finar, I.L. 1973. Organic chemistry-the fundamental principle (6<sup>th</sup> ed.). New York: Addison-Wesley.
3. Bahl, B.S. Bahl, A. 1998. Textbook of organic chemistry (15<sup>th</sup> ed.). New Delhi: S. Chand & Company Ltd.
4. Atherden, L.M. 1999. Bentley and driver's textbook of pharmaceutical chemistry (8<sup>th</sup> ed.). New Delhi: Oxford University press.
5. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
6. Brain, S.F. 1989. Vogel's textbook of practical organic chemistry (15<sup>th</sup> ed.). England: ELBS with Longman.
7. Ernest, E.L. 1975. Stereo chemistry of organic compounds. New Delhi: Tata Mcgraw Hill publishing company Ltd.

## PHA-UG-105: PHARMACOGNOSY-I

### Theory

1. Definition, history, presents status, scope & development of Pharmacognosy.
2. Classification of crude drugs – alphabetical, morphological, Taxonomical, chemical, pharmacological, Cchemotaxonomical and Serotaxonomical. approaches for classification of drugs.
3. Detailed studies of organized and unorganized drugs. Sources, cultivation, collection, preparation, storage, diagnostic characters (morphological and microscopical characters), chemical constituents, identification test, uses and adulterants/substituents of following group of drugs.  
Organized drugs- Senna, Rauwolfia, Ephedra, Cinnamon, Clove, Nux vomica  
Unorganised drugs- Agar,Tragacanth, Pale catechu, Black catechu, Castor oil, Beeswax, Gelatin.
4. Study of plant fibers used in surgical dressings and related products.
5. Cultivation, collection, Processing and storage of crude drugs.
6. Adulteration and drug evaluation- Adulteration of crude drugs and their detection by organoleptic, microscopic, chemical, physical and biological methods of evaluation.

## Practical

1. Morphological and microscopical characters of crude drugs listed in theory.
2. Test for identification of / adulterants in Castrol oil, Shark Liver oil, Wool fat, Bees wax, sesame oil
3. Chemical tests for identification of the following drugs and adulterants in them Acacia, Agar, Tragacanth, Starch, Honey, Gelatin

## Reading Lists:

1. Trease, G.E & Evans, W.C. 2002. Pharmacognosy. U.K: Bailliere Tindall, Eastbourne.
2. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
3. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.
4. Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentlas of Pharmacognosy and Phytotherapy. London, UK: Churchill Livingstone.
5. Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.
6. M.A. Iyengar, M.A & Nayak, S.G.K. 2001. Anatomy of Crude Drugs. Manipal: Manipal Power Press.

## PHA-UG-106: ANATOMY PHYSIOLOGY AND HEALTH EDUCATION–I

### Theory

- 1 **Introduction:** Scope of anatomy, physiology and basic terminology.
- 2 **Cells:** Structure and function of cell with special emphasis on plasma membrane, mitochondria, endoplasmic reticulum, nucleus, ribosome, and ion channels. General concept on action potential generation and transmission.
- 3 **Tissues:** Epithelial, connective, muscular and nervous tissues, their types, characteristics and functions. Muscular and neuronal electrophysiology.
- 4 **Blood and Lymph:** Composition and functions of blood. Blood grouping and its significance. Mechanism of coagulation. Formation of lymph and its composition. Reticulo-endothelial system and its function. Blood disorders.
- 5 **Cardiovascular System:** Anatomy and physiology of heart, blood circulation and cardiac cycle, blood pressure regulation and maintenance, ECG and heart sounds. CVS disorders.
- 6 **Digestive System:** Gross anatomy of the GIT with special reference to liver. Digestion of protein, carbohydrate, and fat.
- 7 **Endocrine System:** Basic anatomy and physiology of pituitary with relation to hypothalamus (HPA axis), thyroid, adrenal and pancreas.
- 8 **Health Education and Community Pharmacy:** Concepts of health and disease. Pharmacist as a healthcare provider, drug delivery systems, dispensing of medication, patient compliance, and patient counseling.
- 9 **Nutrition:** Balanced diet. Deficiency disorders of various nutrients, their prevention and treatment.

### Practical

1. Study of different anatomical terminology of human body.
2. Study of different parts and standard operating procedure of compound microscope.
3. Histological study of isolated epithelial and connective tissues.
4. Determination of blood groups and blood pressure.
5. Determination of Hemoglobin content of blood.

6. Determination of RBC content of blood.
7. Estimation of WBC content of blood.
8. Determination of differential leukocyte count of blood.
9. Determination of bleeding time and clotting time.

**Reading List:**

1. Ross, A.W. and Wilson, A.G. 2014. Anatomy and Physiology in Health and Illness 11<sup>th</sup> Edition. London: Churchill Livingstone.
2. Choudhury, S.K. 2012. Concise Medical Physiology. Calcutta: New Central Book Agency.
3. Guyton, A.C. and Hall, J.E. 2013. Text Book of Medical Physiology 12<sup>th</sup> Edition. Pennsylvania: Saunders Company.
4. Chatterjee, C.C. 2014. Human Physiology. Calcutta: Medical allied agency.
5. Tortora, G.J.; Grabowski, S.R.; Anagnodokos, N.P. 2013. Principles of Anatomy & Physiology 13<sup>th</sup> Edition. New York: John Wiley & Sons Inc.
6. Gandhi, P and Goyal, R.K. 2012. Dorasari and Gandhi's Elements of Human Anatomy, Physiology and Health Education 10<sup>th</sup> Edition. Pune: B.S. Shah Prakashan.
7. Atmaram, P. 2014. Handbook of Community Pharmacists. Pune: Career Publications.
8. West, J.B. 2013. Best and Taylor's Physiological Basis of Medical Practice. New Delhi: Waverly Pvt Ltd.
9. Park, K. and Park, J.E. 2011. Text Book of Preventive and Social Medicine. India: Banarasidas Bhanot.
10. Muruges, N. 2013. Health Education and Community Pharmacy. Tamilnadu: Sathya Publishers.

**PHA-UG-201: COMMUNICATIVE ENGLISH**

**Theory**

**1. Technical Communication**

- a. Verbal and non-verbal spoken and written
- b. Language functions-descriptive, expressive and social
- c. Bias-free and plain English
- d. Formal and informal style

**2. Communicative Grammar**

- a. Time, tense and aspect
- b. Verbs of states and events
- c. Statements, questions and responses
- d. Expressing emotion and attitude, hope, pleasure, disappointment, regret, approval, surprise.

**3. The Sounds of English**

- a. Length of vowels-Long vowels//l; a ;), U; 3: / as in feel, card, court, food and first respectively.
- b. Short vowels / e, x, n / as in pen, bag, and sun respectively
- c. Consonants / f, v, Q, x, s, z, / as in fine, vast, thought, them, song, zoo, shame, pleasure and judge respectively.
- d. Stress pattern

**4. Doing things with words**

- a. To ask for information, help, permission
- b. To instruct, command, request, accept, refuse, prohibit, persuade, promise.

c. Friendly communication-greeting, farewells, introduction, thanks, apologies, regrets, good wishes, congratulations, condolences, offers

### **5. Formal Letter writing**

- a. Curriculum vitae
- b. Difference and inter relation between biodata, CV, resume
- c. Report Writing
- d. Paragraph writing
- e. Research papers and articles

### **Reading List**

1. Geoffrey Leach and Jan Svartvik, Longman, A communicative Grammar of English
2. J.D. O'Connor, Better English Pronunciation, ELBS
3. J.K. Chand and B.C. Das, A Millennium Guide to writing and Speaking English, Friends' Publishers
4. John Sealy, Oxford guide to writing and speaking.

## **PHA-UG-202: PHARMACEUTICS II (Physical Pharmacy I)**

### **Theory**

1. **Physical properties of drug molecules:** Refractive index, dissociation constant, determination & application.
2. **pH, buffer, & isotonic solution:** pH determinations (electrometric & calorimetric), applications, buffer equation, buffer capacity, buffer in biological & pharmaceutical systems, buffered isotonic solutions.
3. **Matter, properties of matter:** Vapor pressure, Sublimation-critical point, Eutectic mixtures, Aerosols-inhalers, Liquid complex, Liquid crystals, Solid-Crystalline, Amorphous & Polymorphism.
4. **Solutions:** Solubility, factors affecting solubility, dissolution & drug release, Diffusion principles in biological systems, isotonic solution.
5. **Colloids:** Introduction, types of colloidal system, optical properties, kinetic properties, electric properties of colloids, Pharmaceutical application of colloids, Purification of colloids.
6. **Coarse Dispersion:** Suspension, Interfacial properties of suspended particles, settling in suspensions, formulation of suspensions, emulsions & theories of emulsification. Physical stability of emulsions, preservation of emulsions, rheological properties of emulsion, phase equilibria & emulsion formulation, special emulsion systems.

### **Practical**

1. Preparation of various types of suspensions & their evaluation.
2. Preparation of various types of emulsion & their evaluation.
3. Preparation & stability studies of emulsion.
4. Physical stability of suspension.
5. Preparation of pharmaceutical buffers & determination of buffer capacity.
6. Experiments involving tonicity adjustment.
7. Determination of optical rotation by using Polari meter.

### **Reading List**

1. Martin, Swarbrick, Cammarata. 2010. Physical Pharmacy. Bombay: Varghese Publishing

- House.
2. Carter. S.J. 1987. Cooper and Gunn's, Tutorial Pharmacy. New Delhi: CBS Publishers & Distributors.
  3. Liberman, Riogor, Banker. 1998. Pharmaceutical dosage forms disperse systems. New York: Marcel Dekker Inc.
  4. Manavalan, R. and Ramasamy, C.2011. Physical Pharmaceutics. Chennai: Vignesh Publishers.
  5. Remington. 2007. The Science and Practice of Pharmacy. Lipincott Williams & Wilkins.

### PHA-UG-203: PHARMACEUTICAL CHEMISTRY III (Organic Chemistry-II)

#### Theory

1. **Stereochemistry: Optical Isomerism:** Stereoisomerism, Definition, Tetrahedral Carbon, Chirality, Relative and Absolute Configuration and Sequence Rule. Convention Used on Stereochemistry. Racemic Modification, Properties, Resolution of Racemic Modification And Conformational Analysis. Asymmetric Synthesis, Stereo-Specific and Stereo-Selective Synthesis.
2. **Geometrical Isomerism:** Nature, Rotation about a Carbon- Carbon Double Bond. Modern Theory of Double Bonds, Nomenclature of Isomers and Determination of Configuration, Stereochemistry of Cycle Compounds.
3. **Stereochemistry Of Biphenyl Compounds And Nitrogen Compounds:** Walden Inversion, Nature, Factors Affecting, Mechanism of Asymmetric Synthesis and Configuration of Optical Activity, Biphenyl Molecules. Stereochemistry of Nitrogen Compounds-
4. **Amines.**  
**Synthetic Tools and Name Reactions:** Catalytic Hydrogenation, Dehydrogenation, Birch Reduction, Clemmenson's Reduction. Meerwin Pondroff Reduction, Beckmann Rearrangement,
5. Schmidt Rearrangement, Hoffman's Degradation, Mannich Reaction.  
**Heterocyclic Chemistry:** Classification of Heterocyclic Compounds, Nature And Nomenclature. Preparation and Important Reactions of Pyrrole, Furan, Thiophene, Pyrazole, Imidazole, Isoxazole
6. Thiazole, Pyrimidine, Indole, Quinoline, Isoquinoline, Acridine, Phenothiazine.  
**Polynuclear Hydrocarbons:** Synthesis (Haworth's and Diels Adler) Properties and Reaction of Naphthalene, Phenanthrene and Anthracene.

#### Practical

1. Synthesis of at Least Five Compounds Involving Heterocyclic Ring Systems
2. Exercise Involving Stereo Selective Synthesis of Compounds.
3. Workshop on Molecular Modelling of Elements of Symmetry, Optically Active Compounds and Geometrical Isomers.
4. Workshop on Molecular Modelling of Primary, Secondary and Tertiary Structure of Proteins.
5. Molecular Modelling on Double Helical Structure of Nucleic Acid Showing Hydrogen Bonding.
6. Qualitative Analysis of Mixture of Organic Compounds Containing Two Compounds Methods of Separation and Analysis.
7. Determination of Number of Functional Groups.
8. Determination of Melting Point and Boiling Point.

### Reading List:

1. Morrison, R.L. Boyd, R.N. 1999. Organic chemistry (6<sup>th</sup> ed.). New Delhi: Prentice-hall of India Pvt Ltd.
2. Finar, I.L. 1973. Organic chemistry-the fundamental principle (6<sup>th</sup> ed.). New York: Addison-Wesley.
3. Bahl, B.S. Bahl, A. 1998. Textbook of organic chemistry (15<sup>th</sup> ed.). New Delhi: S. Chand & company Ltd.
4. Atherden, L.M. 1999. Bentley and driver's textbook of pharmaceutical chemistry (8<sup>th</sup> ed.). New Delhi: Oxford University press.
5. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
6. Brain, S.F. 1989. Vogel's textbook of practical organic chemistry (15<sup>th</sup> ed.). England: ELBS with Longman.
7. Ernest, E.L. 1975. Stereo chemistry of organic compounds. New Delhi: Tata McGraw Hill publishing company Ltd.

## PHA-UG-204: PHARMACEUTICAL CHEMISTRY-IV (Inorganic Chemistry-II)

### Theory

1. **Essential And Trace Ions:** Definition, Physiological Role of Iron, Copper, Zinc, Chromium, Manganese, Selenium, Molybdenum, Sulphur and Iodine. Ferrous Fumarate, Ferrous Sulphate, Iron, Ammonium Citrate, Zinc Chloride and Potassium Iodide.
2. **Pharmaceutical Aids:** Sodium Bisulphate, Sodium Metabisulphate, Sulphurdioxide, Bentonite, Magnesium Sterate, Zinc Sterate, Aluminium Sulphate, Sodium Benzoate, Sodium Carboxy Methyl Cellulose, Sodium Formaldehyde Sulphoxlate, Sodium Methylparaben, Sodium Lauryl Sulphate, Purified Water for Injection, Sterile Water for Injection and Inc Chloride.
3. **Sclerosing Agent:** Hypertonic Saline, Sodium Tetra Decyl Sulphate. **Expectorant:** Ammonium Chloride, Potassium Iodide. **Sedative:** Potassium Bromide. **Antidotes:** Sodium Nitrite, Sodium Thiosulphate, Charcoal. **Respiratory Stimulants:** Ammonium Carbonates.
4. **Quality Control And Test For Purity:** Sources of Impurities in Pharmaceutical Substances.
5. **Radiopharmaceuticals:** Nuclear reaction, Nomenclature, units and measurements of radioactivity, clinical applications and dosage, hazards and precautions, preparation and standardization of Iodine-131(I131).

### Practical

1. Preparation of the following inorganic pharmaceuticals and their identification tests and other tests given in I.P.  
Aluminium Hydroxide, Zinc Oxide, Barium Sulphate, Calcium Carbonate, Potassium Citrate, Boric Acid, Magnesium Sulphate, Ferrous Sulphate
2. Systematic qualitative analysis of inorganic mixtures up to two acid radicals and two basic radicals.
3. Limit test for chlorides, sulphates, iron, heavy metals, arsenic and modified procedure for limit test for chlorides, sulphate on potassium permanganate, sodium bicarbonate.

### Reading List:

1. Atherden, L.M. 1999. Bentley and driver's textbook of pharmaceutical chemistry (8<sup>th</sup> ed.). New Delhi: Oxford University press.

- Block, J.H. 1986. Inorganic Medicinal and Pharmaceutical Chemistry (Indian Edition). Bombay: Varghese Publishing House.
- Sonic, T.O., Wilson, C.O. Roger's Inorganic Pharmaceutical Chemistry.
- Beckett, A.H. Stenlake, J.B. 1997. Practical Pharmaceutical Chemistry (Vol. I & II, 4<sup>th</sup> Edition). New Delhi: CBS Publishers & Distributors.
- Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
- Agarwal, O.P. Organic Chemistry Reactions and Reagents.

## **PHA-UG-205: PHARMACOGNOSY II**

### **Theory**

- Introduction to plant constituents, definition, classification, properties, biogenesis and chemical tests for carbohydrates, proteins, lipids, alkaloids, glycosides, tannins, flavonoids, resins, volatile oil.
- General methods of isolation of alkaloids, glycosides, flavonoids, volatile oils, tannins.
- Alkaloid containing drugs – Biological sources, geographical source, morphological and microscopical characters, chemical constituents, uses, identification tests, cultivation and collection: Tropane alkaloids-Datura, Belladonna, Cocoa; Isoquinoline and quinoline alkaloids-Opium, cinchona; Indole alkaloids-Ergot; Glyco alkaloids- Solanum.
- Glycoside containing drugs - Biological sources, geographical source, morphological and microscopical characters, chemical constituents, uses, identification tests, cultivation and collection:- Cardiac glycosides- Digitalis, Squill Saponins- Liquorice; Anthraquinones- Aloe, Rhubarb.
- Volatile oils and fixed oils - Biological sources, geographical source, morphological and microscopical characters, chemical constituents, uses, identification tests, cultivation and collection: Clove oil, mentha oil, citronella oil, neem oil, castor oil, cod-liver oil, shark liver oil.
- Tannin containing drugs - Biological sources, geographical source, morphological and microscopical characters, chemical constituents, uses, identification tests, cultivation and collection: Myrobalan, arjuna, amla
- Study of Natural pesticides: Neem, pyrethrum, tobacco.

### **Practical**

- To identify the drugs macroscopically and microscopically mentioned in Chapter 3, 4, 5.
- Analysis of fats and oils – acid value, ester value, acetyl value, iodine value.
- Chemical test for the crude drugs listed in Chapter 3, 4, 5.

### **Reading List:**

- Trease, G.E & Evans, W.C. 2002. Pharmacognosy. Bailliere Tindall, Eastbourne.
- Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
- Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.
- Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentlas of Pharmacognosy and Phytotherapy. London: Churchill Livingstone.
- Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.
- M.A. Iyengar, M.A & Nayak, S.G.K. 2001. Anatomy of Crude Drugs. Manipal: Manipal Power Press.

## PHA-UG-206: ANATOMY PHYSIOLOGY AND HEALTH EDUCATION–II

### Theory

- 1 **Respiratory System:** Anatomy of respiratory tract. Mechanism of respiration. Lung volumes. Transport of oxygen and carbon dioxide.
- 2 **Central Nervous System:** Structure and functions of cerebrum, cerebellum, medulla oblongata, cranial nerves and spinal cord.-
- 3 **Autonomic Nervous System (ANS):** Neurotransmitters. Anatomy, physiology and divisions of ANS. Pre- and post-ganglionic nerves and their functions.
- 4 **Urinary System:** Structure and functions of Kidney and Urinary Tract. Physiology of urine formation and acid base balance.
- 5 **Reproductive System:** Structure and functions of male and female reproductive system. Sex hormones. Phases of female reproductive cycle. Overview of family planning.
- 6 **Sense organs:** Physiology of Vision, Audition and Skin.
- 7 **Communicable diseases:** Causative agents, mode of transmission and prevention of: Chicken pox, Measles, Diphtheria, Tuberculosis, Malaria, Poliomyelitis, Filariasis, Rabies, Tetanus, STD and AIDS.
- 8 **Non-Communicable diseases:** Cancer, diabetes, Hypertension, Atherosclerosis, Stroke.
- 9 **Health Education and Community Pharmacy:** Self-medication, rationale use of antibiotics, storage of medicines, and medication errors.

### Practical

1. Histological study of isolated muscular and nervous tissues.
2. Study of various anatomy models and specimens.
3. Study of different bones and joints.
4. Study of contraceptive devices and pills.
5. Measurement of peak expiratory flow rate (PEFR) using a peak flow meter.
6. Qualitative determination of normal urine constituent's (urea, uric acid, chloride, creatinine, glucose etc.).
7. Workshop on self-medication and medication errors with case studies.
8. Microscopical/Specimen study of female estrous cycle.
9. Study of slides of causative agents of communicable diseases.

### Reading List:

1. Ross, A.W. and Wilson, A.G. 2014. Anatomy and Physiology in Health and Illness. 11<sup>th</sup> Edition. London: Churchill Livingstone.
2. Choudhury, S.K. 2012. Concise Medical Physiology. Calcutta: New Central Book Agency.
3. Guyton, A.C. and Hall, J.E. 2013. Text Book of Medical Physiology 12<sup>th</sup> Edition. Pennsylvania: Saunders Company.
4. Chatterjee, C.C. 2014. Human Physiology. Calcutta: Medical allied agency.
5. Tortora, G.J.; Grabowski, S.R.; Anagnodokos, N.P. 2013. Principles of Anatomy & Physiology 13<sup>th</sup> Edition. New York: John Wiley & Sons Inc.
6. Gandhi, P and Goyal, R.K. 2012. Dorasari and Gandhi's Elements of Human Anatomy, Physiology and Health Education 10<sup>th</sup> Edition. Pune: B.S. Shah Prakashan.
7. Atmaram, P. 2014. Handbook of Community Pharmacists. Pune: Career Publications.
8. West, J.B. 2013. Best and Taylor's Physiological Basis of Medical Practice. New Delhi: Waverly Pvt Ltd.



9. Park, K. and Park, J.E. 2011. Text Book of Preventive and Social Medicine. Banarasidas Bhanot.
10. Muruges, N. 2013. Health Education and Community Pharmacy. Sathya Publishers.

### **PHA-UG-301: MATHEMATICS AND PHARMACEUTICAL BIOSTATISTICS**

#### **Theory**

1. Differential calculus: Continuity, limit, differentiation, derivability and derivative, R.H. derivative, L.H. derivative.
2. Integral calculus: Integration as on inverse process of differentiation, definite integral, integration by parts, integration by substitution, indefinite integral.
3. Differential equation: Formation of differential equation, order and degree, solution of first order differential equation.
4. Introduction to Biostatistics
5. Visual aids, diagrams, charts and graphs.
6. Measure of central tendency: Mean, Median & Mode
7. Dispersion including standard deviation
8. Regression and correlation.
9. Probabilities.
10. Statistical evaluation: Para metric (student t-test), non-parametric (ANOVA)

#### **Reading List:**

1. Kapoor and Saxena, Mathematical statistics.
2. Shantinayyan, Differential and Integral Calculus.
3. SP Gupta, Statistical Methods.
4. Grewal, Engineering mathematics.
5. 10+2 Science Text Book of Mathematics, CBSC.
6. BM Sreenivasa Rao & S Nagraj, A Text book of Mathematics for Pre University.

### **PHA-UG-302: PHARMACEUTICS III (Physical Pharmacy II)**

#### **Theory**

1. Surface & Interfacial Phenomena: Surface tension & its determination. Surfactant & drug action surfactant & Pharmaceutical products.
2. Adsorption: Factors influencing adsorption, types of adsorption.
3. Kinetics: Rate & order of reaction. Influence of temperature & other factors on rate, kinetics in the solid state, accelerated stability analysis & kinetics of drug transport in *in vivo* & *in vitro* both.
4. Micromeritics: Particle characteristics, Powder characteristics. Methods of determining particle size, particle shape, surface area & pore size, derive properties of powders. Latest instrumental development in the area of micromeritics.
5. Rheology: Viscosity, Newtonian & Non Newtonian fluids, thixotropy, its application, rheology of disperse system & viscometers.
6. Complexation & protein binding: Metal Complexes, organic molecular complexes, inclusion compounds, methods of analysis, protein binding, Complexation & drug action, crystalline structure of complexes.

### Practical

1. Determination of flow properties of powders by angle of repose.
2. Calibration of eye piece micrometer & determination of particle size & size distribution by microscopy.
3. Determination of particle size and size distribution by Andreasen Pipette.
4. Determination of half-life, rate constant & order of reaction.
5. Determination of bulk density.
6. Determination of surface tension.
7. Determination of viscosity.

### Reading List:

1. Martin, Swarbrick, Cammarata. 2010. Physical Pharmacy. Bombay: Varghese Publishing House.
2. Carter. S.J. 1987. Cooper and Gunn's, Tutorial Pharmacy. New Delhi: CBS Publishers & Distributors.
3. Liberman, Riogor, Banker. 1998. Pharmaceutical dosage forms disperse systems. New York: Marcel Dekker Inc.
4. Manavalan, R. and Ramasamy, C. 2011. Physical Pharmaceutics. Chennai: Vignesh Publishers.
5. Remington. 2007. The Science and Practice of Pharmacy. Lipincott Williams & Wilkins.

## PHA-UG-303: PHARMACEUTICAL CHEMISTRY- V (Pharmaceutical Analysis-I)

### Theory

1. **Introduction to Pharmaceutical Analysis:** Importance of pharmaceutical analysis in quality control, Different techniques of analysis, Computation of Analytical Results, Significant Figures, Concept of Error, Precision, Accuracy, Analytical balance and its reliability of measurements. Fundamental of Volumetric Analysis, Methods of Expressing Concentrations, Primary and Secondary Standards.  
**Acid-Base Titrations:** Acid-Base Concepts, Relative Strength of Acids and Bases, Ionization, Law of Mass Action, Common Ions Effect, Ionic Product of Water, pH, Henderson-Hasselbalch Equation, Buffer Solution, Theory of Indicators, Neutralization Curves, Choices of Indicators, Mixed and Universal Indicators  
**Redox Titrations:** Concepts of oxidation and reduction, Redox reactions, strengths and equivalent weights of oxidizing and reducing agents, Theory of redox titrations, Redox indicators, Measurement of electrode potential, Oxidation-reduction curves, Iodimetry and Iodometry, Titrations involving potassium permanganate, potassium dichromate, ceric ammonium sulphate
4. **Complexometric Titrations:** Complexation, chelation, Werner's co-ordination number, stability of complexes, titration curves, types of complexometric titration, methods of end point detection, masking and demasking agents.  
**Precipitation Titrations:** Principals of precipitation titrations, solubility product, effect of acids, temperature and solvent on the solubility of precipitate. Argentometric titration and titrations involving ammonium or potassium thiocyanate, Adsorption indicators, Gay Lussac method, Mohr's method, Volhard's method and Fajan's method.
6. **Gravimetric Analysis:** Basic concepts, precipitation techniques, co-precipitation, post precipitation. Various steps involved in gravimetric analysis. Pharmaceutical applications, Ex- Determination of

7. barium as barium sulphate, aluminum as aluminum oxide, calcium as calcium oxalates and magnesium as magnesium pyrophosphate  
**Non-Aqueous Titration:** Theoretical Basis, Solvents used and indicators, Acidimetry and Alkalimetry in non-aqueous solvents with special reference to Pharmacopoeial compounds.

### **Practical**

1. Handling of Analytical balance and calibration of fractional weights.
2. Preparation and Standardization of 0.1 N Sodium Hydroxide & 0.1 N Hydrochloric Acid.
3. Assay of Sodium Hydroxide I.P, Glacial Acetic Acid I.P, Sodium carbonate I.P, Sodium bicarbonate I.P, Phosphoric acid I.P.
4. Estimation of Carbonate and Hydroxides in the given sample solution.
5. Estimation of Carbonate and Bicarbonate in the given sample solution.
6. Preparation and Standardization of 0.1 N Potassium Permanganate Solution, 0.1 N Sodium Thiosulphate Solution, 0.1 N Iodine Solution, 0.1 N Silver Nitrate Solution & 0.1 N Ammonium Thiocyanate Solution.
7. Assay of Ferrous Sulphate I.P & Copper Sulphate I.P, Sodium Chloride I.P, Sodium Sulphate I.P. & Potassium Permanganate I.P./B.P.

### **Reading List:**

1. Beckett, A.H. Stenlake, J.B. 1997. Practical Pharmaceutical Chemistry (Vol. I & II, 4<sup>th</sup> Edition). New Delhi: CBS Publishers & Distributors.
2. A.L. Vogel. A Textbook of Quantitative Analysis.
3. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
4. Skoog, D.A., West, D.M. Fundamentals of Analytical Chemistry (6<sup>th</sup> Edition): West and James Holler.

## **PHA-UG-304: PHARMACEUTICAL MICROBIOLOGY**

### **Theory**

1. Introduction to Microbiology; functional anatomy of prokaryotic and eukaryotic cells; Microbial growth: requirement for microbial growth, culture media, methods obtaining pure culture, growth of bacterial cultures, methods of measurement of microbial growth; Virus: methods of isolation, cultivation and identification and multiplication.
2. Microbial Biotechnology: structure of genetic material, Genetic transfer - transformation, transduction, conjugation in bacteria.
3. Control of microbial growth: terminology of microbial growth, Physical methods of microbial control and Chemical methods of microbial growth: principles of effective disinfection, evaluation of disinfection and types of disinfectants.
4. Microbial assays including sensitivity testing with reference to antibiotic and vitamins.
5. Immunology: Introduction, types of immunity, antigens and antibodies, Antigen-antibody reactions, structures and functions of MHC, antigen recognition and presentation, Hypersensitivity responses. Immunization- Definition, types, preparation, application, storage conditions and stability of official vaccines.
6. Sterilization: Various methods of sterilization and their importance in pharmacy

7. Production of antibiotics and vitamins by microbial techniques like penicillin, streptomycin, Vit B<sub>12</sub>.

### **Practical**

1. Microscopy: Microscopic examination of stained preparation, Microbial examination of living bacterial preparation, Microscopic measurement of microorganism.
2. Cultivation techniques and isolation: Preparation of various types of culture media, Sub culturing of different microorganism by different methods like Slants, Stabs, Culture plates and Isolation of pure culture by streak plate techniques, simple and multiple streaking techniques.
3. Staining methods: Simple staining, Gram staining, Capsule staining, Flagella staining. Minimum inhibitory concentration of antibiotics by serial dilution and gradient plate techniques.
4. Motility Study: Motility study on microorganism by hanging drop techniques. Evaluation of disinfectants Phenol co-efficient test.

### **Reading list:**

1. Pelczar Reid. Microbiology. 5<sup>th</sup> Edition, Tata MC Graw- Hill Publishers Company, 1993.
2. Judy Kandal. Essential and applications of Microbiology.
3. David Freifeider. Microbial Genetics.
4. RY Stanier. General Microbiology.
5. Stainer. General Microbiology. 5<sup>th</sup> Edition, Wheelies & Painter, 1987.
6. Ivan Roitt. Immunology. 4<sup>th</sup> Edition, Harwood Academic Publishers, London, 1997.

## **PHA-UG-305: ETHNOMEDICINE & BIODIVERSITY**

### **Theory**

1. Historical overview of Indian system of medicine – Ayurveda, Siddha, Unani.
2. General concepts on complementary and alternative medicine: Ayurveda, Siddha, Unani, Homeopathic system of medicine – History, Basic principles, components, treatments and development.
3. Ethnobotany – Herbal drug evaluation, impact of Ethnobotany in traditional medicine, ethnobotanical survey and documentation of medicinal plants.
4. Ethnopharmacology – Drug discovery from natural products, Issues in medicinal plant research.
5. Biological diversity, Indian biodiversity rules and guidelines. Conservation of medicinal plants.
6. Global scenario of traditional medicine. Limitation of traditional system of medicine. Local food plants of North East India.

### **Practical**

1. Preparation of herbarium from local medicinal plants.
2. Documentation of medicinal plants of specific area.
3. Interaction with people engaged with traditional medicine system and report.

### **Reading list:**

1. Trease, G.E & Evans, W.C. 2002. Pharmacognosy. Bailliere Tindall, Eastbourne.
2. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
3. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.
4. Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentlas of Pharmacognosy and Phytotherapy. London, Churchill Livingstone.

5. Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.
6. M.A. Iyengar, M.A & Nayak, S.G.K. 2001. Anatomy of Crude Drugs. Manipal: Manipal Power Press.
7. Gurung, B. The Medicinal Plants of the Sikkim Himalaya.

## **PHA-UG-306: COMPUTER APPLICATION IN PHARMACY**

### **Theory**

1. Introduction to computers: Basic components of computers, types of computers, characteristics and hardware aspects of computer.
2. Operating systems: Definition, Types of operating systems, MS-DOS, UNIX, LINUX, Memories: RAM ROM and Secondary memory, CPU scheduling.
3. Algorithm and Flow chart concept.
4. Language of computer: Introduction to programming languages: Character set - C token-Keyword, Flowchart and Identifier's - Assigning values to variables -Defining symbolic constants- Arithmetic, Relational, Logical Assignment, conditional, bitwise, special increment and decrement operators - Reading and writing a character.
5. Decision making and Branching - Decision making with IF statements (simple IF statement, IF-ELSE statement, Nesting of IF-ELSE, the ELSE, IF Ladder) - Switch statement.
6. Decision making and looping: Which statement - the Do statement - For statement, Arrays - String handling functions - user defined functions.
7. Concept of Database Management System.
8. Computer Packages: MS Office - MS Word, MS Excel, MS Power Point, MS Access.
9. Introduction to computer Networks: Definition, LAN, MAN, WAN, Advantages& Disadvantages, Topologies, Internet, World Wide Web, OSI and TCP/IP Model.
10. Computer Graphics: Definition, Display devices, Graphical input and output devices, multimedia - definition and application.
11. Computer applications in pharmaceutical and clinical studies.

### **Practical**

1. Basic components of computer.
2. Operating Systems: MS DOS, UNIX, MS Windows.
3. Study of software package: MS-Office (Word, Excel, Access, Power Point).
4. Study of simple C programs as follows:
  - Get a character and display the same using getch and putchar
  - Printing the reverse of an integer
  - Printing the odd and even series of N
  - Get a string and convert the lowercase to uppercase and vice-versa using getch and putchar.
  - Finding the occurrence of a particular character in a string.
  - Accept N words and make it as a sentence by inserting blank spaces and a full at the end.
  - Finding the first N terms of Fibonacci sequence.
  - Printing and Multiplication tables of 2 matrices.
  - Printing and subtractions of two matrices.
  - Converting a hexadecimal number into its binary equivalent.

### **Reading List:**

1. E. Balaguruswamy. Programming in ANSIC. Tata McGraw Hill, 1997.

2. C. Nellai Kannan. MS-office.
3. N. Hunt, J. Shelly. Computers and Commonsense. Prentice Hall of India, New Delhi.
4. Popst, Perrum. Computer Aided Drug Design. Academic Press, New York.
5. Tanen Baum. Computer Networks.

### **PHA-UG-401: EASTERN HIMALYAN STUDIES**

#### **Theory**

Paper-I: Introduction to Eastern Himalayan Region with particular emphasis on Sikkim and Darjeeling

1. Definition and Demarcation of the Eastern Himalayas:
  - a. R.L. Singh 1961 (Geographical Regionalization)
  - b. Planning Commission of India (agro-climatic regionalization)
  - c. Others.

Geographical Background: Geo-setting, Relief, Soil –Biodiversity and Bio- Resources.

Climate-Drainage of the Eastern Himalaya with emphasis on Sikkim and Darjeeling Himalaya.

2. A Brief history of Sikkim and Darjeeling since 17<sup>th</sup> century.

Relations with neighbours- Tibet, Bhutan and Nepal.

3. Communities and their Culture, Traditional Healing Practices.

Economy: Agriculture, Industry (Tea and Tourism)

4. Political Developments in Darjeeling till 1947
  5. Political Development in Sikkim- Legislative , Executive, Judiciary
- Role of Bureaucracy in the Development of Sikkim

#### **Reading List;**

1. Anonymous. 1989. Agro-Climatic regional planning: An overview (unpublished). New Delhi: Planning Commission
2. Bell, Charles. Tibet Past and Present.
3. Bose, S.C. 1968. Land and people of the Himalaya. Bhutan and India, A Study in Frontier Political Relations. Calcutta: Indian Publications.
4. Chaube, S.K. 1985. The Himalayas: From Modernization and Adaptation. New Delhi: Sterling,
5. Das, S.T. 1978. People of the Eastern Himalayas: New Delhi: Sagar
6. Datta, K. 2006. Urbanization in the Eastern Himalayas: Emergence and Issues. New Delhi: Serial Publication.
7. Dekens, J. 2007. 2008. Localising disaster response. Himal South Asian: Online web Accessed.

### **PHA-UG-402: PHARMACEUTICS IV (Pharmaceutical Technology-I)**

#### **Theory**

Mathematical derivations and numerical problems to be avoided

1. **Material of Construction:** General study of composition, corrosion, resistance, Properties and applications of the materials of construction with special reference to stainless steel and glass.
2. **Industrial Hazards and Safety Precautions:** Mechanical, Chemical, Electrical, fire and dust hazards. Accident record.
3. **Water systems:** Raw water, soft water, purified water, water for injection, quality requirement and treatment of water.

4. **Fluid flow:** types of flow, Reynold's number, viscosity, concept of boundary layer, basic equation of fluid flow, valves, flowmeters, manometers and measurement of flow and pressure
5. **Filtration and centrifugation:** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary press, rotary filter, edge filter etc, factors affecting filtration ,optimum cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters.
6. **Crystallization:** Characters of crystals like purity, size, shape, geometry, habit forms, size and factors affecting them. Solubility curves and calculation of yields .Material and heat balances around Swenson walker crystallizer, Supersaturation theory, its limitations ,nucleation mechanism and crystals and its prevention
7. **Dehumidification and humidity control:** Basic concepts, Definitions, wet bulb and adiabatic saturation temperatures, psychometric chart and measurement of humidity, application of humidity measurement in pharmacy. Equipments for dehumidification operations.

### Practical

Experiments based upon the principles covered in the syllabus shall be performed.

### Reading List:

1. Badger.W.J.1955. Introduction to chemical engineering. McGraw Hill Series.
2. Carter. S.J. 1987. Cooper and Gunn's, General Pharmacy. New Delhi: CBS Publishers & Distributors.
3. Lachman. Theory and practice of Industrial Pharmacy
4. Remington. 2007. The science and practice of pharmacy. Lippincott Williams &Wilkins.
5. Macabe, Smith. 2005. Unit operations of chemical engg., London: McGraw Hill.

## PHA-UG-403: PHARMACEUTICAL CHEMISTRY-VI (Biochemistry)

### Theory

1. Biological organization of the cell and transport process across cell membrane.
2. **Biological Oxidation:** Electron Transport Chain and Oxidative phosphorylation
3. **Carbohydrates:** Classification and their properties, metabolism of carbohydrates- glycolysis, pentose phosphate pathway, glycogenesis, glycogenolysis and gluconeogenesis.
4. **Proteins and Amino acids:** Classification and properties, essential amino acids, metabolism of amino acids and protein including Urea cycle.
5. **Lipid:** Classification and properties, essential fatty acids, oxidation of fatty acids, eicosanoids, biosynthesis of ketone bodies.
6. **Vitamins:** Classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme
7. **Enzymes:** Nomenclature, classification and their properties, mechanism of action, enzymes kinetics, enzyme inhibition, clinical importance of enzymes.
8. **Nucleic acid:** Different types of nucleic acids & their composition, DNA & the Watson - Crick Model & its features. Different types of RNAs with their special features & functions. Central dogma of molecular genetics & the processes like Replication of DNA, Transcription & Translation.

### **Practical**

1. Identification of Carbohydrates (Scheme and Identification) (Glucose, Fructose, Lactose, Maltose, Sucrose)
2. Identification of Protein (Scheme and Identification) (Casein, Albumin, Gelatin, Peptone)
3. Quantification Estimation of Carbohydrates (Any One Method) DNS Reagent, Anthrone Reagent
4. Quantitative Estimation of Proteins (Any One Method): Biuret Reagent, Lowry's Reagent.

### **Reading List:**

1. Lehninger. 1998. Biochemistry (2<sup>nd</sup> Ed.) New Delhi: Kalyani Publication.
2. Murray, R.K. 1993. Harper's Biochemistry (23<sup>rd</sup> Ed.) Prentice-Hall International Inc.
3. Lubert, S. 1995. Biochemistry (4<sup>th</sup> Ed.) USA: W.H. Freeman & Company.
4. RamaRao, A.V.S.S. 2002. A Textbook of Biochemistry (9<sup>th</sup> Ed.) New Delhi: UBS Publishers Pvt Ltd.
5. Deb. A.C. 1998. Fundamentals of Biochemistry (7<sup>th</sup> Ed.) Kolkata: New Central Book Agency Pvt Ltd.
6. Plummer, D.T. 1998. An Introduction Of Practical Biochemistry (3<sup>rd</sup> Ed.) New Delhi: Tata McGraw Hill Publishing Company Ltd.
7. Harold, V. 1988. Practical Clinical Biochemistry (4<sup>th</sup> Ed.) New Delhi: CBS Publishers & Distributors.

## **PHA-UG-404: CHEMISTRY OF NATURAL PRODUCTS**

### **Theory**

1. **Natural Pigments:** Introduction, classification, chemistry, isolation, general characters and general methods of elucidation and biosynthesis of Carotenoids, Anthocyanins, Flavone and Quercetin.
2. **Antibiotics:** Introduction, history of discovery, importance of antibiotics, classification and chemistry. General structural elucidation and biosynthesis from the derivatives of Penicillins, Streptomycin, Chloramphenicol and Tetracycline.
3. **Steroids and Hormones:** Introduction, nomenclature and stereochemistry of Steroids, general structural elucidation and biosynthesis of Sterols, Cholesterol, Progesterone.
4. **Essential oils:** Introduction, classification, chemistry, isolation, general characters and general methods of elucidation and biosynthesis of essential oils.
5. **Resins:** Introduction, classification, chemistry, isolation, general characters and biosynthesis.
6. **Tannins:** Introduction, classification, chemistry, isolation, general characters and general methods of elucidation and biosynthesis.
7. **Carbohydrates:** Introduction, classification, chemistry, isolation, general characters and general methods of elucidation and biosynthesis of Monosaccharides, Disaccharides and Polysaccharides.

### **Practical**

1. Isolation, identification of certain natural constituents like – Eugenol, Curcumin, Sennoside, Hesperidine, Embeline, Solanine, Pectin, Azylic acid, Piperine, Lycopene.
2. Chromatographic analysis of several phytoconstituents and their quantitative estimation

### **Reading List:**

1. Trease, G.E & Evans, W.C. 2002. Pharmacognosy. U.K: Bailliere Tindall, Eastbourne.
2. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.



3. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.
4. Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentals of Pharmacognosy and Phytotherapy. London, Churchill Livingstone.
5. Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.
6. M.A. Iyengar, M.A & Nayak, S.G.K. 2001. Anatomy of Crude Drugs. Manipal: Manipal Power Press.

## **PHA-UG-405: PHARMACEUTICAL BIOTECHNOLOGY**

### **Theory**

1. Introduction to molecular biology: structure of DNA and RNA, replication, transcription and translation process.
2. Genetic engineering: Basic step involved in recombinant DNA technology, study of vectors, restriction endonucleases, cloning strategies and gene expression.
3. Application of rDNA technology and genetic engineering in production of below mentioned-
  - a. Regulatory protein- interferons
  - b. Vaccines- Hepatitis
  - c. Hormones- Insulin
4. Bioprocess technology: Basic principles of fermentation, isolation and screening of industrially important Microbes. Study, design and operation of fermenter and study of different parameters.
5. Production of methyl alcohol, ethyl alcohol by industrial microbial processes
6. Enzyme biotechnology: introduction, classification, isolation, purification and uses. Enzyme immobilization, methods of enzyme immobilization and applications.
7. Immuno assay including ELISA, RIA.

### **Practical**

#### **Molecular Biology and Biotechnology**

1. Isolation and estimation of DNA by spectroscopy
2. Isolation and estimation of RNA by spectroscopy
3. Isolation of chloroplast
4. Immobilization of cells and enzymes
5. Sterility testing of pharmaceuticals (powders and liquids)
6. Isolation of Bromolain

### **Reading List:**

1. S.B. Primrose. Principles of Gene Manipulation.
2. Stanbury. Textbook of Fermentation Technology.
3. L.E. Casida. Industrial Microbiology.
4. Webb, Steel. Biochemical Engineering.
5. Pepler. Microbial Technology. Vol.I & II.
6. Bengamin Lewin. Genes V and VI.
7. S.B. Primrose. Molecular Biology.
8. J.D. Watson. Recombinant DNA Technology.

## PHA-UG-406: PHARMACOLOGY I (Pathophysiology)

### Theory

- 1 Cell injury & Cellular Adaptation:** Introduction to pathology, pathophysiology and related basic terminology. Basic principle, cause, pathogenesis and morphology of cell injury. Intracellular alterations in lipids, proteins and carbohydrates. Cellular adaptations- atrophy, hypertrophy, hyperplasia, metaplasia and dysplasia.
- 2 Inflammatory Process & Repair:** Mechanism of inflammatory process- Vascular events (vascular permeability & blood flow, haemodynamic changes) and Cellular events (migration of WBCs & phagocytosis). Acute and chronic inflammation. Mediators of inflammation. Brief outline of the process of repair.
- 3 Pathophysiology of Common Diseases:**
  - CVS Disorders:** Hypertension, Congestive heart failure (CHF), Ischaemic heart disease (Angina, Myocardial Infarction) and Atherosclerosis.
  - CNS Disorders:** Parkinson's disease, Schizophrenia, Depression and Mania.
  - Metabolic Disorders:** Diabetes mellitus, Obesity, Hepatic cirrhosis.
  - GI Disorders:** Peptic ulcer, Inflammatory bowel disease
  - Kidney Disorders:** Acute and chronic renal failure
  - Respiratory Disorders:** Chronic obstructive pulmonary diseases (COPD), Asthma
- 4 Hypersensitivity:** Hypersensitivity type I, II, III, and IV. Biological significance of hypersensitivity. Allergy due to food, chemicals, and drugs.
- 5 Auto-Immunity and Diseases of Immunity:** Mechanism of autoimmunity. Classification of autoimmune diseases in man. Transplantation and allograft reactions, mechanism of rejection of allograft. Acquired immune deficiency syndrome (AIDS).
- 6 Neoplastic Diseases:** General biology of tumors, differences between benign and malignant tumors. Classification of tumors. Etiology, pathogenesis and genetic determinant of cancer. Invasions, metastasis, patterns of spread of cancer.

### Practical

1. Study of some instruments used in the detection of disease pathophysiology: Microscope, Student's organ bath, Glucometer, Semi auto-analyser.
2. Study of slides and specimen of normal and cirrhotic liver.
3. Study of blood smear under microscope.
4. Study of pathophysiological characteristics of cancerous cell using specimen.
5. Study of pathophysiological characteristics of respiratory disorders using specimen.
6. Study of pathophysiological characteristics of GI disorders using specimen.
7. Study of pathophysiological characteristics of atherosclerosis using specimen.
8. Study of serum glucose in different samples.

### Reading List:

1. Robins, C.K. 2013. Text Book of Robins Pathology Basis of Disease 9<sup>th</sup> Edition. New Delhi: Prism Indian Edition.
2. Harsh, M. 2012. Textbook of Pathology. New Delhi: Jaypee Brothers.
3. Russell, J.G. and Harris, N.D. 2011. Pathology & Therapeutics for Pharmacy 4<sup>th</sup> Edition. London: Pharmaceutical Press.
4. Bhondankar, S.L. and Yyawahare, N.S. 2005. Textbook of Pathophysiology. Pune: Nirali Prakashan.
5. Devlin, T.M. 2012. Text Book of Biochemistry with Clinical Correlations. London: McGraw Hills.
6. Zdanowicz, M.M. 2010. Essentials of Pathophysiology for Pharmacy. London: CRC Press.

## PHA-UG-501: ENVIRONMENTAL STUDIES

### Theory

1. **General:** Introduction , components of the environment, environmental degradation
2. **Ecology:** Elements of Ecology; Ecological balance and consequences of change, principles of environmental impact assessment.
3. **Air Pollution and Control:** Atmospheric composition, energy balance, climate, weather, dispersion, sources and effects of pollutants, primary and secondary pollutants, greenhouse effect, depletion of ozone layer, standards and control measures.  
Noxious gases and vapours (CO, Benzene, Gasoline, Kerosene)
4. **Water Pollution and Control:** Hydrosphere, natural water, pollutants: their origin and effects, river / lake / ground water pollution, standards and control (Specifically arsenic, lead & mercury).
5. **Land Pollution:** Lithosphere, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes); their origin and effects, collection and disposal of solid waste, recovery and conversion methods.
6. **Noise Pollution:** Sources, effects, standards and control.

### Reading List:

1. Masters, G.M., 1991. Introduction to Environmental Engineering and Science. Prentice –Hall of India Pvt. Ltd.
2. Nebel, B.J. 1987. Environmental Science. Prentice –Hall Inc.
3. Odum, E.P. Ecology: The Link between the natural and social sciences. New Delhi: Publishing Com.

## PHA-UG-502: PHARMACEUTICS V (Formulative & Industrial Pharmacy I)

### Theory

1. **Preformulation studies:** Study of physical properties of drugs like physical form, polymorphism, solubility, salt formation, dissolution and partitioning effects and their influence on formulation, stability and bioavailability of products. Study of chemical properties like hydrolytic degradation, oxidation, reduction, racemization, polymerization etc and their influence on formulation and stability of products.  
Stabilization and stability testing protocol for various pharmaceutical products.
2. **Liquid Dosage forms:** Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubiliser, colours, flavours, manufacturing and equipments as stirrers, homogenizers, colloid mill, packaging and evaluation of clear liquids, suspensions and emulsions
3. **Semisolid Dosage Forms: Semisolids:** Properties of drugs, semisolid bases and additives, Selection of bases and additives for ointment, cream, paste and gels. Percutaneous absorption. Formulation and development, manufacturing of Ointment, Cream, Paste and Gels. Processing equipments for ointment, cream, paste and gels. In process quality control & quality control parameters, skin irritation test, packaging & labeling.

4. **Pharmaceutical Aerosols:** Definition, applications, components of aerosol package: Propellants, container, valve, general formulation, manufacturing and filling methods, evaluation.
5. **Bio Products: Sutures & Ligatures-** Definition, classification, catgut manufacturing & processing details, other absorbable sutures (brief), Non absorbable types silk, linen, polyamides, polyesters, polyolefins, metallic wires, Q.C. testing of sutures & ligatures.
6. **Blood products & plasma substitutes-** Collection, processing and storage of whole human blood, concentrated human RBCs, dried human plasma, human fibrinogen, human thrombin, human normal immunoglobulin, human fibrin foam, plasma substitutes, ideal requirements of PVP, dextran, etc. Control of blood products as per IP.

### Practical

Experiments to illustrate preparation, stabilization, physical and biological evaluation of pharmaceutical products belonging to the class of liquids, semisolids etc. Experiments based on preformulation.

### Reading List:

1. Banker and Rhodes. 1990. Modern Pharmaceutics. New York: Marcel Dekker, Inc.
2. Lachman, Lieberman, Kanig J.L. 1987. Theory and Practice of Industrial Pharmacy. Bombay: Varghese Publishing House.
3. Martin, Swarbrick, Cammarata. 2010. Physical Pharmacy. Bombay: Varghese Publishing House.
4. Lieberman, Leon Lachman, Schwartz. Pharmaceutical Dosage Forms- Tablets. New York: Marcel Dekker, Inc.
5. Avis, Lachman, Lieberman. Pharmaceutical Dosage Forms – Parenteral Medications. M. New York: Marcel Dekker, Inc.

## PHA-UG-503: PHARMACEUTICAL CHEMISTRY VII (Pharmaceutical Analysis-II)

### Theory

1. **General Chromatography:**
  - a. Theory, instrumentation, elution techniques and applications in pharmacy of the following analytical techniques – Column Chromatography, Thin Layer Chromatography (TLC), Preparative TLC, Paper Chromatography, Gel Filtration Chromatography, Ion Exchange Chromatography, Counter Current Chromatography.
  - b. Theory, instrumentation and applications of Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC) and High Performance Thin Layer Chromatography (HPTLC).
2. **Atomic Absorption and Flame Emission Spectroscopy:**  
Principle, instrumentation and applications in Pharmacy of both the techniques. Interferences in flame emission spectroscopy. Comparison of Atomic absorption spectrometry with Flame emission spectroscopy.
3. **Electrometric Methods:**
  - a. **Potentiometry:** General principles, instrumentation and pharmaceutical applications of potentiometry.
  - b. **Conductometry:** General principles, instrumentation and pharmaceutical, applications of conductometry.

- c. **Turbidometry:** General principles, instrumentation and pharmaceutical applications of turbidometry.
- d. **Nephelometry:** General principles, instrumentation and pharmaceutical applications of Nephelometry.

### **Practical**

1. Separation and identification of amino acids by Paper Chromatography, Thin Layer Chromatography
2. Separation and identification of alkaloids by Thin Layer Chromatography, Paper Chromatography
3. Separation and identification of suitable samples by Radial Paper Chromatography
4. Determination of Paracetamol, Caffeine using HPLC
5. Determination of Paracetamol, Caffeine using HPTLC
6. Conductometric Titration of Benzoic Acid with NaOH.
7. Potentiometric Titration of HCl with NaOH.
8. Determination of Na<sup>+</sup> and K<sup>+</sup> ion using Flame Photometer/ Atomic absorption spectrometer in the given sample.
9. Determination of various ions such as Chloride, Sulphate by Nephelo-turbidimetric analysis.

### **Reading List:**

1. Hobarth, W. 2002. Instrumental Methods of Analysis (6<sup>th</sup> Ed.). New Delhi: CBS Publishers.
2. Vogel, A.I. Text Book of Quantitative Chemical Analysis. London: ELBS Longman.
3. Kenneth, A., Connors, A. 1982. Text Book of Pharma Analysis. (3<sup>rd</sup> Ed.). New York: John Wiley & Sons.
4. Gurdeep Chatwal. Instrumental Methods of Analysis.
5. Stahl, E. Thin Layer Chromatography- A Handbook. Berlin: Springer Verlag.
6. Garratt, D.C. 2001. Quantitative Analysis of Drugs (3<sup>rd</sup> Ed.). New Delhi: CBS Publishers & Distributers.
7. Beckett, A.H. Stenlake, J.B. 2005. Practical Pharmaceutical Chemistry (4<sup>th</sup> Ed.). London: The Athlone Press.
8. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
9. British Pharmacopoeia (Vol I & II) 1993. London: HMSO Publication Center.
10. USP & National Formulary. 2000. Asian Ed., US Pharmacopoeial Convention, Rockville, MD.

## **PHA-UG-504: PHARMACETICAL CHEMISTRY VIII (Medicinal Chemistry-I)**

### **Theory**

- 1 Basic principles of medicinal chemistry, history and development of medicinal chemistry.
- 2 Drug metabolism; general pathway of drug metabolism (different types of reaction in phase-i and phase-ii with examples), factors affecting drug metabolism including stereo chemical aspects, significance of drug metabolism in medicinal chemistry, prodrugs.  
*Study of classification, metabolism of action (biochemical and molecular basis) and structure activity relationship including stereo chemical aspect, physiochemical properties and synthesis of selected drugs on the following categories of drugs.*
- 3 **Drugs Action on CNS:**  
**Sedatives and Hypnotics:** Chlordiazepoxide, Diazepam, Oxazepam, Alprazolam, Barbitol, Phenobarbital, **Antipsychotics:** Prochlorperazine Maleate, Chlorpromazine, Haloperidol.  
**Anticonvulsants or Antiepileptics:** Phenytoin, Barbiturates, Trimethadione, Valporic Acid And Clonazepam. **CNS Stimulants and Psychodelics:** Nikethamide, Dextroamphetamine Sulphate, Amitriptyline Hydrochloride, Imipramine Hcl, Desipramine Hydrochloride, Doxepin Hydrochloride.
- 4 **Drugs Acting on ANS: Adrenergic Neurotransmitters:** Structure and Physiochemical Properties. Sympathomimetic agents: Adrenergic receptor hypothesis, Epinephrine, Norepinephrine, Dopamine, Phenylephrine, Salbutamol, Ephedrine, Pseudoephedrine, Methyl dopa, Isoproterenol.  
**Adrenergic antagonists:** Tolazoline, Phentolamine, Prazosin, Ergotamine, Methysergide, Propranolol, Atenolol, Metoprolol, and Labetolol. **Cholinergic Receptors Drugs and Related Agents:** Cholinergic Receptors, Biochemical Effects of Muscarinic Stimulation, Cholinergic Neurochemistry and Stereochemistry of Cholinergics. Acetylcholine, Carbachol, Methacholine, Pilocarpine, Physostigmine, Pyridostigmine. **Cholinergic Blockin Agents:** Atropine Sulphate, Hyoscyamine Sulphate, Propantheline Bromide, Procyllidine Hydrochloride and Isopropamide Iodide. **Ganglionic Blocking Agents and Neuromuscular Blockers:** Nicotine, Mecamylamine Hydrochloride, Decamethonium Bromide and Pancuronium Bromide.
- 5 **Drugs Action on CVS:** Anti-Anginal: Vasodilators and Cardiotonics: Amylnitrate, Nitroglycerin, Isosorbide Dinitrate Verapamil, Diltiazem Hydrochloride, Nifedipine, Amlodipine, Digoxin, Digitoxin.  
**Anti-Arrhythmic Drugs:** Quinidine Sulphate, Procainamide Hydrochloride, Disopyramide Phosphate, Lidocaine hydrochloride, Phenytoin sodium. **Anti-Hypertensive Agents:** Captopril, Clonidine Hydrochloride, Hydralazine Hydrochloride, Sodium Nitroprusside, Minoxidil. **Anti-**
- 6 **Hyperlipidemic Agents:** Clofibrate, Dextrothyroxine Sodium, Probucol. **Anti-Coagulants and Anti-Thrombolytics:** Protamine Sulphate, Docoumarol, Warfarin Sodium.  
**Hormones and Related Drugs:** Insulin and its Preparation. Hypoglycemic Agents: Synthetic Hypoglycemic Agents. Oxytocin and Vasopressin. Thyroid and Anti-Thyroid Drugs.

### Practical

1. Monograph Analysis of the following compounds: Aminophylline; Aspirin; Atropine Sulphate; Caffeine; Paracetamol; Phenobarbitone; Phenytoin.
2. Assay of medicinally useful compounds (In Solid Dosage Form): Ibuprofen & Diclofenac by Alkalimetry; Ephedrine Hydrochloride by Non-Aqueous Titration; Phenobarbitone Sodium by Non Aqueous Titration.
3. Preparation of Medicinally Useful Compounds: Phenytoin from Benzoin, Benzocaine from P-Amino Benzoic Acid, 4-Hydroxy Coumarin from Resorcinol, Mefenamic Acid from Anthranillic Acid, Degradation of Ephedrine to Benzoic Acids, Degradation of Caffeine to dimethyl Alloxan and Methyl Urea.

**Reading List:**

1. Burger's Medicinal Chemistry (6<sup>th</sup> Ed.). Vol-I & II. The Basis of Medicinal Chemistry. John Wiley
2. Block, J.H., Beale, J.M. 2004. Wilson & Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry (11<sup>th</sup> Ed.). Lippincott Williams & Wilkins
3. Foye, W.A. Medicinal Chemistry.
4. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.

**PHA-UG-505: PHARMACOGNOSY III****Theory**

1. Plant products: Introduction to plant bitters, and sweeteners colouring and flavouring agent.
2. Pharmaceutical aids: Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin.
3. Biological source, preparation and uses of the following enzymes: diastase, papain, bromelain, pepsin.
4. Animal products: Biological sources, chemical constituents, adulterants and uses of Shellac, cochineal, cantherides, honey and musk.
5. Chemotaxonomy of medicinal plants.
6. Chromatographic methods: Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.
7. World-wide trade in medicinal plants and derived products with special reference to diosgenin, taxol, digitalis and cinchona.
8. Marine Drugs: Introduction, importance, classification of following class of drugs: Cytotoxic and antineoplastic agents, Cardiovascular drugs, Marine toxins, Antimicrobial drugs, and Antibiotic substances.
9. Natural allergens and photosensitizing agents and fungal toxins.
10. Herbs as health foods.

**Practical**

1. Extraction and Chemical evaluation of Papain.
2. Assay of drugs and bioactive substances using paper chromatography and TLC.
3. Study pharmaceutical aids.
4. Specific identification tests for some crude drugs
5. Determination of leaf constants such as Stomatal index, Stomatal number, Vein islet number,

**Reading List:**

1. Trease, G.E & Evans, W.C. 2002. Pharmacognosy. Bailliere Tindall, Eastbourne.
2. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
3. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febieger.
4. Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentlas of Pharmacognosy and Phytotherapy. London, Churchill Livingstone.
5. Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.
6. M.A. Iyengar, M.A & Nayak, S.G.K. 2001. Anatomy of Crude Drugs. Manipal: Manipal Power Press.
7. Gurung, B. The Medicinal Plants of the Sikkim Himalaya.

## PHA-UG-506: PHARMACOLOGY II

### Theory

#### 1 General Pharmacology:

Introduction to pharmacology. Sources of drugs. Dosage forms and routes of drug administration.

Mechanism of drug action- Receptors, types of receptors and theory of drug-receptor interaction.

Tolerance and dependence. Absorption, Distribution, Metabolism and Excretion of drugs. Adverse drug reactions. Drug interactions. Discovery and development of new drugs.

#### 2 Pharmacology of Peripheral Nervous System:

Neurohumoral transmission (Autonomic and Somatic). Parasympathomimetics, Parasympatholytics, Sympathomimetics, Sympatholytics. Adrenergic receptor and neuron blocking agents. Ganglionic blocking agents. Neuromuscular blocking agents.

#### 3 Pharmacology of Cardiovascular System:

Anti-hypertensive drugs, Antianginal drugs, Congestive heart failure, Antiarrhythmic drugs, Antihyperlipidaemic drugs

#### 4 Drugs acting on Urinary System:

Fluid and electrolyte balance. Diuretics and Anti-diuretics.

#### 5 Free Radical Pharmacology:

Generation of free radicals and role of free radicals in various diseases.

Protective activity of certain important antioxidants.

### Practical

1. Common laboratory animals and animal welfare *viz.* animal handling and care as per CPCSEA guidelines.
2. Different routes of drug administration in animals.
3. Mydriatic effect of drug (Atropine) on rabbit's eye.
4. Miotic effect of drug (Pilocarpine) on rabbit's eye.
5. Calculation of LD<sub>50</sub>, ED<sub>50</sub> and Therapeutic index (TI) [on the basis of provided data].
6. Calculation of Volume of distribution (Vd) [Plasma concentration and dose data will be provided] and factors affecting Vd.
7. Estimation of serum Triglyceride level in supplied sample.
8. Estimation of serum Cholesterol level in supplied sample.

### Reading List:

1. Tripathi, K.D. 2014. Essentials of Medical Pharmacology 7<sup>th</sup> Edition. New Delhi: Jaypee Publication.
2. Kulkarni, S.K. 2011. Hand Book of Experimental Pharmacology 3<sup>rd</sup> Edition. Pune: Vallabh Prakashan.
3. Seth, S.D. 1999. Textbook of Pharmacology. New Delhi: Churchill Livingstone.
4. Goodman, G. and Gilman, E. 2013. The Pharmacological Basis of Therapeutics 12<sup>th</sup> Edition. London: McGraw-Hill.
5. Rang, H.P. and Dale, M.M. 2013. Pharmacology 7<sup>th</sup> Edition. Churchill Livingstone.
6. Katzung, B.G. 2012. Basic and Clinical Pharmacology 12<sup>th</sup> Edition. London: Lange.
7. Lippincotts, W. 2012. Illustrated Pharmacology 4<sup>th</sup> Edition. London: Lange.
8. Bary, H. and Gutteridge, J. 2013. Free Radicals in Biology and Medicine. London: Oxford Press.
9. Ghosh, M.N. 2008. Fundamentals of Experimental Pharmacology. Kolkata: Hilton and Company.



10. Longo, D.; Fauci, A.; Kasper, D.; Hauser, S.; Jameson, J. and Loscalzo, J. 2011. Harrison's Principles of Internal Medicine. New York: McGraw-Hill.

### **PHA-UG-601: PHARMACEUTICAL JURISPRUDENCE**

#### **Theory**

1. Pharmaceutical Oath.
2. Pharmaceutical Ethics: Introduction, Code of pharmaceutical ethics, Pharmacist in relations to his job, pharmacist in relations to medical profession, Pharmacist in relation to his profession.
3. Pharmaceutical Legislation: Introduction, Development during the 19<sup>th</sup> and 20<sup>th</sup> century, Drug Enquiry Committee, The Drug Act and other Legislations Pharmacy.
4. Pharmacy Act-1948: Introduction, The Pharmacy Act, Pharmacy Council of India, The Education Regulations, State Pharmacy Council, Registration of pharmacist, Offences and penalties.
5. Drug and Cosmetics Act-1940 and Rules-1945: Introduction, Important definitions, the drug rules, The Drug Technical Advisory Board (DTAB), The Central Drug Laboratory, The Drug Consultative Committee, Schedules.
6. Medicinal and Toilet preparation (Excise Duties) Act-1955 and Rules-1976: Introduction, Necessity of the Act, Manufacture in bond, The Bonded Laboratory, Manufacture of alcoholic preparations, Duty on medicinal and toilet preparations, offences and penalties.
7. The Narcotic Drugs and Psychotropic substances Act 1955: A brief study of the Act with special reference to its objectives, offences and punishment.
8. Drug and Magic Remedies Act (Objectionable Advertisements) Act 1954 and Rules 1955: Introduction, Prohibited advertisement, Prohibited of import and export of advertisements, Exempted advertisement, offences and penalties.
9. Medical Termination of Pregnancy Act-1971 and Rules-1975: Introduction, Medical termination of pregnancy, offences and penalties.

#### **Reading List:**

1. Pharmaceutical jurisprudence, B.S. Kuchekar
2. Pharmaceutical jurisprudence, S.P. Agarwal
3. Forensic pharmacy, CK Kokate, SB Gokhale
4. Forensic pharmacy, NK Jain
5. Pharmaceutical jurisprudence, Dr.B.S. Kuchekar.
6. Pharmaceutical juresprudence, N. Murugesh.
7. Pharmaceutical regulatory affairs, C.V.S Subrahmanyam, J. Thimmasetty.
8. Forensic Pharmacy, NK Jain

### **PHA-UG-602: PHARMACETICS VI (Formulative and Industrial Pharmacy-II)**

#### **Theory**

1. Parenteral Products: Preformulation Factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment.
2. Formulation details, containers and closures and selection. Prefilling treatment, washing of containers and closures, preparation of solution and suspension, filling and closing of ampoules,

vials, infusion fluids, lyophilisation and preparation of sterile powders, equipment for large-scale manufacture and evaluation of parenteral products.

3. Aseptic techniques: Source of contamination, methods of prevention, design of aseptic area, laminar flow bench services and maintenance.
4. Introduction, Definition of cosmetics. Basic knowledge of the skin, classification of cosmetics.
5. General aspects of cosmetic preparations: Colouring agents in cosmetics, Preservatives and antioxidants and other additives used in cosmetics.
6. An approach to the formulation, ingredients, use, method of manufacturing, packing, labeling and quality control of the following cosmetics:  
Face Preparations: Vanishing creams, Cleansing creams, Face powders and lipsticks.  
Eye Preparations: Mascaras, Eye liners, Eye shadows.  
Baby Specialities: Baby powder, Baby oils, Baby lotions and Baby shampoos.  
Preparation for Skin: Bleaching preparations, Body lotions and Body creams.  
Preparations for Nails: Nail layers and Nail polish removers.  
Body cosmetic preparation: Deodorants, Antiperspirants and Talcum powders.  
Shaving Preparations: Pre-Shave and after-shave lotion, Shaving creams and Soaps.  
Preparations for the Hair: Shampoos, Hair Conditioners, Hair Straightners, Hair creams, Hair dyes, Depilatories and Epilatories.  
Dental Preparation: Tooth powders and pastes, Mouth washes.

### **Practical**

1. Formulation of various types of cosmetics for skin, hair, dentrifices and manicure preparations.
2. Preparation of the following products:
  - a. Cleansing creams
  - b. Vanishing creams
  - c. Shaving creams
  - d. Tooth paste
  - e. After shave lotion
  - f. Hand lotion
  - g. Baby lotion
  - h. Face powder/ talcum powder/ tooth powder/ baby powder
  - i. Nail paint/ Lipstick
  - j. Nail paint remover
  - k. Deodorant formulation.

### **Reading List:**

1. Banker and Rhodes. 1990. Modern Pharmaceutics. New York: Marcel Dekker, Inc.
2. Lachman, Lieberman, Kanig J.L. 1987. Theory and Practice of Industrial Pharmacy. Bombay: Varghese Publishing House.
3. Martin, Swarbrick, Cammarata. 2010. Physical Pharmacy. Bombay: Varghese Publishing House.
4. Rieger. 2000. Harrys cosmeticology. Revere: Chemical Publishing company.
5. Remington. 2007. The Science and Practice of Pharmacy.USA: Lipincott Williams & Wilkins.

**PHA-UG-603: PHARMACEUTICAL CHEMISTRY IX  
(Medicinal Chemistry-II)**

**Theory**

1. **Local Anaesthetics:** Benzocaine, Procaine, Lignocaine, Etidocaine, Dibucaine  
**General Anaesthetics:** Halothane, Methoxyflurane, Methohexital Sodium, Thiopental Sodium, Ketamine Hydrochloride.
2. **Diuretics:** Acetazolamide, Dichlorphenamide, Chlorthiazide, Hydrochlorthiazide, Furosemide, Bumetamide, Ethacrynic Acid, Spironolactone, Triamterene, Amiloride and Mannitol.
3. **Antihistaminic Agents:** H<sub>1</sub>, H<sub>2</sub> And H<sub>3</sub> Receptors. Termination of Histamine Action, Diphenhydramine HCl, Dimenhydrinate, BromoDiphenhydramine HCl, Doxylaminesuccinate, Carbinoxaminemaleate, Clemastinefumarate, DiphenylpyralineHCl, Chlorcyclizine, Pheniraminemaleate, Chlorpheniraminemaleate, Triprolidine, PromethazineHCl, CyproheptadineHCl, Astemizole, Loratadine, Cetirizine, Cimetidine, Famotidine, Ranitidine, Nizatidine, Omeprazole and Lansoprazole.
4. **Prostaglandins And Other Eicosanoids:** Eicosanoids, Drug Action Mediated By Eicosanoids, Design Of Eicosanoid Drugs, Anticosanoids
5. **Analgesics, Antipyretics And Anti-Inflammatory Drugs:** Morphine And Related Drugs: Morphine Sulphate, Codeine Phosphate. Hydromorphone HCl, Oxycodone HCl, Apomorphine HCl, Meperidine HCl, Diphenoxylate HCl, Loperamide HCl, Fentanylcitrate, Pentazocine, Nalorphine HCl, and Naloxone HCl.
6. **AntiInflammatory Agents:** Sodiumsalicylate, Aspirin, Indomethacin Sulindac, Salsalare, Tolmetinsodium, Zomoperce Sodium, Diclofenac Sodium, Ibuprofen, Naproxen, Flurbiprofen, Piroxicam, Acetaminophen, Phenylbutazone and Oxyphenbutazone.
7. **Anticancer Drugs:** Nitrogen Mustard, Anti-Metabolites, Folic Acids Antagonist, Quinazolone Analogs.

**Practical**

**(Multiple Step Organic Synthesis)**

1. Synthesis of Lignocaine.
2. Synthesis of Sulphanilamide.
3. Synthesis of 7-Hydroxy-4-Methyl Coumarin.
4. Paracetamol From P-Nitro Phenol.

**Reading List:**

1. Burger's Medicinal Chemistry (6<sup>th</sup> Ed.). Vol-I & II. The Basis Of Medicinal Chemistry. John Wiley
2. Block, J.H., Beale, J.M. 2004. Wilson & Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry (11<sup>th</sup> Ed.). Lippincott Williams & Wilkins
3. Foye, W.A. Medicinal Chemistry.
4. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
5. Remington. The Science and Practice of Pharmacy. 21<sup>st</sup> Edition, Lippincott Williams & Wilkins, 2007, Vol-I & II.

## **PHA-UG-604: PHARMACEUTICS VII (Pharmaceutical Technology-II)**

### **Theory**

#### **Mathematical derivations and numerical problems to be avoided**

1. Evaporation: Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and
2. Distillation: Raoult's law, phase diagram, volatility, simple steam flash distillation, principles of rectification, Azeotropic and Extractive distillation
3. Drying: Moisture content, mechanism of drying, rate of drying, time of drying, classification, types of dryers used in pharmaceutical industries, special drying methods
4. Size reduction and Size separation: Definition, objective of size reduction, factors affecting size reduction, laws governing energy and power requirements of mills, including ball mill, hammer mill, fluid energy mill etc
5. Mixing and homogenisation: theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments
6. Heat Transfer: Heat transfer by conduction, problems on steady state heat conduction; heat transfer by convection, heat transfer coefficient, heat exchangers, problems on convection, heat transfer by radiation, Stefan's and Kirchoff's Laws, pharmaceutical applications.
7. Automatic process control systems: Process variables (temperature, pressure flow, level and vacuum) and their measurement; Elements of automatic process control and introduction automatic process control systems.

### **Practical**

Experiments based upon the principles covered in the syllabus shall be performed

### **Reading List:**

1. Badger.W.J.1955. Introduction to chemical engineering. USA: McGraw Hill Series.
2. Carter. S.J. 1987. Cooper and Gunn's, General Pharmacy. New Delhi: CBS Publishers & Distributors.
3. Lachman. Theory and practice of Industrial Pharmacy
4. Remington. 2007. The science and practice of pharmacy. Lippincott Williams &Wilkins.
5. Macabe, Smith. 2005. Unit operations of chemical engg., London: McGraw Hill.

## **PHA-UG-605: PHARMACOGNOSY IV**

### **Theory**

- 1 Plant Tissue culture: Introduction, Historical development, types of culture, Nutritional requirement, Plant growth regulators,
2. Types of culture, Principle and application of
  - a. Organ Culture: leaf culture, Root culture, Meristem culture, whole flower culture, isolated ovary, isolated ovule culture
  - b. Callus culture
  - c. Cell Suspension culture
  - d. Organogenesis
  - e. Somatic embryogenesis- Synthetic Seeds
  - f. Somoclonal variation

- g. Micropropagation
  - h. Multiple shoot culture
  - i. Protoplast culture: isolation of protoplast and protoplast fusion
  - j. Hairy root culture
- 3 Methods of improving quality of crops and their application:
    - a. Mutation
    - b. Hybridization
    - c. Polypoidy
  4. Production of Secondary metabolites – Strategies involving use of Precursor, Growth regulators & Elicitors: Production of Shikonin.

### **Practical**

1. Isolation of caffeine from tea leaves
2. Isolation of quinine from Cinchona bark
3. Isolation of casein from milk
4. Isolation of citric acid from lemon
5. TLC of caffeine
6. TLC of quinine
7. Isolation of clove oil from clove flower buds
8. Estimation of eugenol from clove oil
9. Physical parameter of evaluation: Extractive value, Ash value, Moisture content of powdered drug
10. Estimation of Swelling factor

### **Reading List:**

1. Trease, G.E & Evans, W.C. 2002. Pharmacognosy. Bailliere Tindall, Eastbourne.
2. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
3. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.
4. Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentlas of Pharmacognosy and Phytotherapy. London, UK: Churchill Livingstone.
5. Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.
6. M.A. Iyengar, M.A & Nayak, S.G.K. 2001. Anatomy of Crude Drugs. Manipal: Manipal Power Press.
7. Anonymous. 2001. Medicinal plants of India. New Delhi: Indian Council of Medical Research.

## **PHA-UG-606: PHARMACOLOGY III**

### **Theory**

- 1 **Pharmacology of Central Nervous System:**  
 General anaesthetics. Sedatives and Hypnotics.  
 Anti-epileptic, Anti-anxiety, and muscle relaxants.  
 CNS Stimulants, Anti-psychotic and Anti-depressant agents.  
 Non-steroidal anti-inflammatory and analgesics.  
 Narcotic analgesics and antagonists. Antiparkinson's drugs.
- 2 **Local Anaesthetics:**  
 Classification, mechanism of action, types, uses and adverse effects.
- 3 **Drugs acting on Gastrointestinal Tract:**  
 Antacids and Anti-secretory agents.

- Laxative and Anti-diarrheal drugs.  
Emetics and Anti-emetics.
- 4 **Drugs acting on Haemopoietic System:**  
Haematinics, Anticoagulants, Vitamin K and Haemostatic agents.  
Fibrinolytic and Anti-platelet drugs.
- 5 **Chemotherapy:**  
General principles of chemotherapy.  
Antimicrobial agents:
- Antibacterials: Sulfonamides and Cotrimoxazole, Penicillins, Cephalosporins, Tetracyclines, Chloramphenicol, Macrolides (Erythromycin), Aminoglycosides, Quinolones, and drugs for Urinary Tract Infections (UTI).
  - Chemotherapy of Tuberculosis and Leprosy.
  - Antifungal drugs.
  - Antiviral drugs.
- Chemotherapy of Cancer.

### **Practical**

1. Study of the Analgesic effect of drug (e.g. Morphine) using Eddy's hot-plate.
2. Study of the Analgesic effect of drug (e.g. Morphine) using Tail-flick response.
3. Study of the Analgesic effect of drug (e.g. Aspirin) using Writhing response.
4. Study of antibacterial activity of supplied drug.
5. Effect of local anaesthetic on rabbit cornea/skin.
6. CNS stimulant (e.g. Caffeine) and depressant (e.g. Diazepam) activity of drug using photoactometer.
7. Anticonvulsant activity of drug (e.g. Phenytoin) using Maximal Electro-Shock (MES) method.
8. Muscle relaxant activity of drug (e.g. Diazepam) using rota-rod apparatus.

### **Reading List:**

1. Tripathi, K.D. 2014. Essentials of Medical Pharmacology. 7<sup>th</sup> Edition. New Delhi: Jaypee Publication.
2. Kulkarni, S.K. 2011. Hand Book of Experimental Pharmacology. 3<sup>rd</sup> Edition. Pune: Vallabh Prakashan.
3. Seth, S.D. 1999. Textbook of Pharmacology. New Delhi: Churchill Livingstone.
4. Goodman, G. and Gilman, E. 2013. The Pharmacological Basis of Therapeutics. 12<sup>th</sup> Edition. London: McGraw-Hill.
5. Rang, H.P. and Dale, M.M. 2013. Pharmacology. 7<sup>th</sup> Edition. USA: Churchill Livingstone.
6. Katzung, B.G. 2012. Basic and Clinical Pharmacology 12<sup>th</sup> Edition. London: Lange.
7. Lippincotts, W. 2012. Illustrated Pharmacology. 4<sup>th</sup> Edition. London: Lange.
8. Bary, H. and Gutteridge, J. 2013. Free Radicals in Biology and Medicine. London: Oxford Press.
9. Ghosh, M.N. 2008. Fundamentals of Experimental Pharmacology. Kolkata: Hilton and Company.
10. Longo, D.; Fauci, A.; Kasper, D.; Hauser, S.; Jameson, J. and Loscalzo, J. 2011. Harrison's Principles of Internal Medicine. New York: McGraw-Hill.

## PHA-UG-701: PROJECT REPORT

A project report, with not more than 5 students in a group based on any of the core branches of pharmacy or interdisciplinary areas of which one is pharmacy, has to be completed and the report must be submitted under the guidance of a supervisor of the parent institute.

### Scheme of examination: 100 marks

Project Report	: 50 marks
Seminar	: 30 marks
Viva Voce	: 20 marks

## PHA-UG-702: PHARMACEUTICS VIII (Biopharmaceutics & Pharmacokinetics)

### Theory

- 1 Bio-Pharmaceutics and pharmacokinetics: Introduction, General Principle & Application.
- 2 Bio-pharmaceutics: Rate of drug absorption after administration, drug concentration in blood, biological factors in drug absorption, physicochemical factors, dosage form consideration for gastrointestinal absorption, drug distribution
- 3 Pharmacokinetics: Compartment models, a brief study of parameters like biological half-life, apparent volume of distribution, renal clearance, total body clearance, absorption, elimination rate constant and significance of the data.
- 4 Bioavailability and bio-equivalency testing: Definitions, dosage forms, dissolution rate and bio-equivalency testing.
- 5 Dosage Regimens: concept of loading dose, maintenance dose and accumulation index.
- 6 Pharmacokinetics Variability: body weight, age, sex, genetic factors, pharmacokinetic variability in disease, states of renal, liver and dosage adjustment in the above conditions.

### Practical

Bioavailability testing and other experiments to illustrate topics mentioned in theory.

### Reading List:

1. Gibaldi, M. 1991. Biopharmaceutics and Clinical Pharmacokinetics. Philadelphia: Lea and Febiger.
2. Shargel, L and Yu, A.B.C. 1985. Applied Biopharmaceutics and Pharmacokinetics. Connecticut: Appleton Century Crofts.
3. Swarbrick, J. 1970. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics. Philadelphia: Lea and Febiger.
4. Rowland. M and Tozen. T.M. 1995. Clinical Pharmacokinetics, Concepts and Applications. Philadelphia: Lea and Febiger.
5. Abdou H.M. 1989. Dissolution, Bioavailability and Bioequivalence. Pennsylvania: Mack Publishing Company.

## PHA-UG-703: PHARMACEUTICS IX (Formulative & Industrial Pharmacy III)

### Theory

- 1. Tablets:** Classification, tablet excipients, granulation technology by various techniques, physics of tablet making including Compaction– its scope, measurement of Punch forces, transmission of force through powders, distribution of forces in powder mass, effect of pressure on relative volume, lubrication of diewall, adhesion and cohesion of particles, factors effecting strength of granules and strength of tablets, different types of tablet compression machinery and equipments, processing problems of tablets and evaluation of tablets.
- 2. Coating of tablets:** Types, film forming materials, formulation of coating solutions, equipments for coating, film defects and evaluation of coated tablets.
- 3. Introduction to BCS and dissolution study:** Definition, Dissolution mechanisms, Factors affecting dissolution, Intrinsic dissolution rate measurement, Dissolution apparatus for various dosage forms, Dissolution profile comparison using model independent method (similarity factor, dissimilarity factor).
- 4. Capsules:** advantages, disadvantages, material for production of hard gelatin capsules, size of capsules and method of capsule filling. Soft gelatin capsules, capsule shell and content, importance of base absorption, quality control, stability testing and storage of capsules.
- 5. Microencapsulation:** types, importance, preparation by various techniques and evaluation.
- 6. Packaging of Pharmaceutical Products:** Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing.
- 7. Pilot Plant Scale up techniques:** Manufacture of pharmaceuticals, evaluation of formula, equipment, raw materials, process optimization, personnel requirements, factorial designs.

### Practical

Experiments to illustrate preparation, stabilization, physical and biological evaluation of pharmaceutical products like capsules, tablets, coated tablets, microcapsules etc.

### Reading List:

1. Bently's Textbook of pharmaceuticals edited by E.A. Rawlins
2. The Theory and Practice of Industrial Pharmacy by Lachmann, Libermann and Kanig
3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, Allen and Popovich
4. REMINGTON : The Science and Practice of Pharmacy, 20<sup>th</sup> Edition
5. Pharmaceuticals : The Science of Dosage Form Design by Aulton

## PHA-UG-704: PHARMACEUTICAL CHEMISTRY X (Medicinal Chemistry-III)

### Theory

- 1 Anti-Fungal Agents:** Clotrimazole, Econoazole Nitrate, Butoconazole Oxyconazole Nitrate, Miconazole, Ketoconazole, Itraconazole, Fluconazole, Naftifine Hydrochloride, Tolnaftate, Cyclopiroxolamine, Amphotericin-B, Nystain, Natamycin And Girseofulvin.
- 2 Synthetic Antibacterial Agents:** Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin, Lomefloxacin, Sparfloxacin, Furazolidine, Nitrofurantoin and Methanamine. **Anti-Tubercular Agents:** INH, Ethionamide, Pyrazinamide, Para-Amino Salicylic Acid Rifampicin, Cycloserine



- and Capreomycin Sulphate. **Anti-Protozoal Agents:** Metronidazole, Diloxanide, Idoquinol, Pentamidine Isothionate, Dimercaprol. **Anthelmintics:** Piperazine salts, DEC, Thiabendazole, Mebendazole, Albendazole, Niclosamide, Oxamniquine, Praziquantal and Ivermectin. **Anti-Scabies And Anti-Pedicular Agents:** Benzyl Benzoate, Lindane\*(Gamaxene), Crothamiton and
- 3 Permethrin.
- Sulphonamides And Sulphones:** Historical Development, Chemistry and Nomenclature, Reducing Crystalluria by Lowering Pka, Synergism Of Sulfonamides and Folate Reductase Inhibitors, sulphamethizole, Sulfioxazole, Sulpadiazine, Mixed Sulfonamides, Mefenide Acetate,
- 4 Silver Sulpfadiazine, Sulfasalazine dapsone and Solapsona.
- Antimalarials:** History and Development of Quinine Sulphate, Chloroquine Phosphate, Hydroxyl Chloroquine Sulphate, Amodiaquine Hydrochloride, Primaquine Phosphate, Mefloquine,
- 5 Pyrimethamine, Trimethoprim, Cycloguanil Pomoate and Sulfadoxine.
- Antibiotics:** History, Background, Current Status of Penicillins and Cephalosporins, Aminoglycosides, Tetracyclines, Macrolides, Lincomycins, Polypeptides. **Unclassified**
- 6 **Antibiotics:** Chloramphenicol and Its Prodrugs, Novobiocin Sodium And Mupirocin.
- Antiviral Agents:** Amantadine Hydrochloride, Rimantadine Hydrochloride, Idoxuridine Trifluoride, Acyclovir, Gancyclovir, Foscarnet Sodium, Zidovudine, Zalcitabine, Lamivudine,
- 7 Ribavirin, Indinavir and Ritonavir.
- Steroids And Related Drugs:** Glucocorticoids, Mineralocorticoids, Oestrogens, Progestrogens,
- 8 Androgens, Chemistry Of Nature Hormones And Synthetics Derivatives Including Contraceptives.
- Diagnostics Drugs And Reagents:** Congo Red, Evans, Blue, Methacolin Chloride, Erythrosine Sodium, Benzyl Penicilloyl Poly Lysine, Locetamide Acid, Lodipamide Meglumine, Tyropanoate Sodium, Pentagastrin, Phenol Sulphophthalein, Indocyanin Green, Fluorescein Sodium, Bentiromete, Diatrizoic Acid, Lotalamic Acid, Propyl Iodone.

### Practical

Synthesis of important ten compounds from above mentioned theory chapters

### Reading List

1. Burger's Medicinal Chemistry (6<sup>th</sup> Ed.). Vol-I & II. The Basis Of Medicinal Chemistry. John Wiley
2. Block, J.H., Beale, J.M. 2004. Wilson & Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry (11<sup>th</sup> Ed.). Lippincott Williams & Wilkins
3. Foye, W.A. Medicinal Chemistry.
4. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
5. Remington. 2007. The Science And Practice Of Pharmacy (21<sup>st</sup> Edition Vol-I&II). Lippincott Williams & Wilkins.

## PHA-UG-705: PHARMACOGNOSY V (Indigenous Medicine Development and Evaluation)

### Theory

1. Standardization of herbal drugs. Development of standardization parameters: Determination of ash values, solvent extractive values, total solids, crude fibre, moisture content, etc.
2. Determination of microbial infestation, bitterness value, haemolytic activity, swelling index, foaming index, tannins, arsenic and heavy metals, pesticides etc.

3. Morphological examination: Organoleptic evaluation, macro morphological evaluation, cytomorphological evaluation of herbal drugs. Sampling procedures and determination of foreign matters.
4. Microscopical evaluation, instruments for microscopical study, evaluation of crude drugs in microscopy, microscopical methods quantitative analytical microscopy.
5. Modern techniques used for evaluation of natural products such as: HPTLC, HPLC and GC.
6. Factors affecting herb quality: quality standards of herbal products, factors relating to quality of herbal drugs, ecological factors, quality assurance of herbal drugs.
7. Synergism and polyvalence, its impact on development of indigenous medicine.
8. Safety, efficacy of herbal medicinal products (HMPs)
9. Regulations governing herbal medicines production in India, Good manufacturing practice for production of phytomedicine

### **Practical**

1. Determination of Ash value.
2. Determination of Extractive value.
3. Determination of moisture content.
4. Determination of volatile oil content.
5. Determination of heavy metals.
6. Pharmacognostic evaluation of crude drugs.

### **Reading List:**

1. Choudhury, R.D. 1996. Herbal Drug Industry. New Delhi: Eastern Publisher.
2. Anonymous. 1998, 2000. Indian Herbal Pharmacopoeia. RRL, IDMA.
3. Rajpal, V. 2002. Standardisation of botanical. New Delhi: Eastern Publishers.
4. Verpoortee, R & P.K. 2003. GMP for botanicals - regulatory and quality issues on phytomedicines. New Delhi: Business Horizons.
5. Anonymous. 2000. PDR for Herbal Medicines. New Jersey: Medicinal Economic Company.
6. Ikan, R. 1991. Natural products. Alab guide. 2nd Edition: Academic Press.
7. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
8. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.
9. Heinich, M, Barns, J, Gibbons, S & Williamsons, E.M. 2005. Fundamentals of Pharmacognosy and Phytotherapy. London, Churchill Livingstone.
10. Kokate, C.K, A.P. Purohit, A.P & Gokhale, S.B. 2003. Pharmacognosy. Pune: Nirali Prakashan.

## **PHA-UG-706: PHARMACOLOGY IV**

### **Theory**

#### **1 Laboratory animals:**

Commonly used laboratory, transgenic and other genetically prone animal models (*viz.* nude mice, SH rats, etc.). Techniques of blood collection, anaesthesia and euthanasia of experimental animals. Venous routes of drug administration. Maintenance and breeding of laboratory animals.

#### **2 Autacoids:**

Histamine, 5-HT and their antagonists. Prostaglandins, Thromboxanes and Leukotrienes (Eicosanoids).

#### **3 Drugs acting on Respiratory System:**

- Anti-asthmatic drugs including bronchodilators. Anti-tussives and expectorants.
- 4 **Principles of Biological Standardization:**  
Overview of statistical analysis (Student's t-tests, ANOVA, Chi-square test) in biological experiments.  
Principles of Biological assays with certain examples. Methods of Biological assays.
  - 5 **Principles & Procedures for Safety Pharmacology:**  
General principles and safety pharmacology procedures for CNS, CVS, and respiratory system.
  - 6 **Principles of Toxicology:**  
Definition of poison and General principles of treatment of poisoning. Definition of acute, sub-acute and chronic toxicity; genotoxicity, carcinogenicity, teratogenicity and mutagenicity studies.
  - 7 **Drugs for Metabolic Disorders:**  
Anti-diabetic agents, anti-obesity agents and hepato-protective agents.

### **Practical**

1. Intravenous route of administration in animals
2. Barbiturate-induced sleeping time in animals (righting reflex).
3. Measurement of SGPT and SGOT level of serum sample.
4. Randomization technique.
5. Anxiolytic activity of drug (e.g. Diazepam) using Elevated Plus-maze.
6. Oral/i.v. glucose tolerance test in rabbit and effect of insulin.
7. Biological Standardization of drugs-acetylcholine.
8. Application of Graph Pad Prism software.

### **Reading List:**

1. Gupta, S.K.; Singh, U. and Velpandian, T. 2012. Analytical Toxicology for Poisoning Management and Toxicovigilance. New Delhi: Narosa Publication House.
2. Wallace, H.A. 2012. Principles and Methods of Toxicology 11<sup>th</sup> Edition. (CRC)
3. Tripathi, K.D. 2014. Essentials of Medical Pharmacology 7<sup>th</sup> Edition. New Delhi: Jaypee Publication.
4. Kulkarni, S.K. 2011. Hand Book of Experimental Pharmacology 3<sup>rd</sup> Edition. Pune: Vallabh Prakashan.
5. Goodman, G. and Gilman, E. 2013. The Pharmacological Basis of Therapeutics 12<sup>th</sup> Edition. London: McGraw-Hill.
6. Rang, H.P. and Dale, M.M. 2013. Pharmacology 7<sup>th</sup> Edition. USA: Churchill Livingstone.
7. Katzung, B.G. 2012. Basic and Clinical Pharmacology 12<sup>th</sup> Edition. London: Lange.
8. Prakash, M. and Arora, C.K. 1998. Methods in Toxicology. New Delhi: Anmol Publications Pvt. Ltd.
9. Ghosh, M.N. 2008. Fundamentals of Experimental Pharmacology. Kolkata: Hilton and Company.
10. Longo, D.; Fauci, A.; Kasper, D.; Hauser, S.; Jameson, J. and Loscalzo, J. 2011. Harrison's Principles of Internal Medicine. New York: McGraw-Hill.

## PHA-UG-801: PHARMACEUTICAL MANAGEMENT

### Theory

1. Concept of management: Administrative management (Planning, organizing, staffing, directing, controlling). Principles of management (Co-ordination, Communication, Motivation, Decision making, Leadership).
2. Pharmaceutical marketing: Function, Selling, Transportation, Storage, Finance, Channel of distribution, Wholesale, Retail sale, multiple shops, Mail order business.
3. Salesmanship: Principles of sales promotion, Advertising, recruitment training evaluation & compensation to the pharmacist.
4. Human resource management: Importance, objectives, human resource planning, Job analysis & design, Industrial relation.
5. Drug house management: site for a drug store, layout of a drug store, legal aspects of a drug store, codification of various items of drug store.
6. Documentation & records: Importance, Master formula records, control records, master production & control records, Equipment cleaning & use of log book, Records relating to container, closure & labeling.
7. Marketing concepts: Marketing strategy, market research.

### Reading List:

1. Kotler, P. 2009. Marketing Management. Millennium Edition. New Jersey: Prentice-Hall Pvt Ltd.
2. Subba Rao, S.V.R. 2000. Handbook of pharmaceutical marketing in India. Panther Publication.
3. Weirich, Koontz. 1994. Management A global Perspective. McGraw Hill International.
4. Subba Rao, S.V. 1997. Human resource management & industrial relations. Himalaya Publishing House.
5. Drucker, P.F. 1998. Management, Tasks, Responsibilities, Practices. Allied Publishers Ltd.

## PHA-UG-802: PHARMACEUTICS X (Advances in Drug Delivery Systems)

### Theory

- 1 Biological membranes and drug transport. Polymers & their applications in developments of NDDS.
- 2 Sustained released drug delivery systems (SRDDS).
- 3 Controlled released drug delivery systems including Oral controlled released drug delivery systems.
- 4 Transdermal drug delivery systems.
- 5 Mucoadhesive drug delivery systems.
- 6 Bone drug delivery systems.
- 7 Targeted drug delivery systems.
- 8 Ocular drug delivery systems.
- 9 Intra vaginal & Intrauterine drug delivery system.
- 10 Sterilization of Parenteral controlled release system.

## Practical

- 1 Preparation and evaluation of albumin microspheres.
- 2 Preparation and evaluation of microcapsule by different microencapsulation technique.
- 3 Preparation and evaluation of matrix tablets using various polymers.
- 4 Study on diffusion of drugs through various polymeric membranes.
- 5 Preparation and in vitro evaluation of buccal mucoadhesives.
- 6 Preparation and evaluation of transdermal flims.
- 7 Preparation and evaluation of hydrodynamically balanced tablets.
- 8 Study of in vitro dissolution of various sustained release formulation of marketed products.

## Reading List:

1. Chien, Y.W. 1992. Novel Drug Delivery Systems. New York: Marcel Dekker, Inc.
2. Robinson, J.R., Lee V.H.L.1992. Controlled Drug Delivery Systems. New York: Marcel Dekker, Inc.
3. Mathiowitz, E. 1999. Encyclopedia of controlled delivery. New York: Wiley Interscience Publication, John Wiley and Sons, Inc.
4. Banker and Rhodes. 1990. Modern Pharmaceutics. New York: Marcel Dekker, Inc.
5. Lachman, Lieberman, Kanig J.L. 1987. Theory and Practice of Industrial Pharmacy. Bombay: Varghese Publishing House.

## PHA-UG-803: PHARMACEUTICAL CHEMISTRY XI (Pharmaceutical Analysis-III)

### Theory

#### 1. Molecular Absorption Spectroscopy:

**UV-Visible Spectroscopy** including Nepheloturbidimetry: Brief review of electromagnetic spectrum and absorption of radiations. The chromophore concept, absorption law and limitations. Theory of electronic spectroscopy, absorption by organic molecules, choice of solvent and solvent effects, modern instrumentation – design and working principle. Applications of UV-Visible spectroscopy (qualitative and quantitative analysis), Woodward – Fischer rules for calculating absorption maximum.

**IR Spectroscopy:** Introduction, basic principles, vibrational frequency and factors influencing vibrational frequency, instrumentation, sampling techniques, interpretation and applications in Pharmacy. FTIR theory and applications.

**Nuclear Magnetic Resonance spectroscopy:** Theoretical aspects, basic instrumentation, elements of interpretation of  $^1\text{H}$ -NMR spectra and applications in pharmacy. Introduction of  $^{13}\text{C}$  NMR.

**Mass Spectroscopy:** Theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications in pharmacy.

#### 2. Quality Assurance

Concept of quality assurance, quality control, GMP, GLP, ISO 9000, Validation.

## Practical

1. Determination of  $\lambda_{\text{max}}$  of given sample using UV – Spectrophotometer
2. Assay of Paracetamol tablets using UV- Spectrophotometer
3. Assay of Aspirin tablets using UV- Spectrophotometer
4. Assay of Metronidazole intravenous infusion using UV- Spectrophotometer.
5. Assay of Nimesulide tablets using UV- Spectrophotometer
6. Assay of Frusemide tablets using UV- Spectrophotometer
7. Demonstration of I.R. Spectrophotometer
8. To study IR-Spectra of some of the given compound(s)
9. Estimation of Quinine Sulphate by Fluorimetry.
10. Estimation of Riboflavine by Fluorimetry .
11. Colorimetric estimation of Ferrous ions using 1, 10 Phenanthroline.
12. Colorimetric estimation of Sulphanilamide using N-1 Naphthyl ethylene diaminedihydrochloride
13. Assay of Dextrose Injection by Colorimetry.
14. Kinetics of Aspirin Hydrolysis.

## Reading List:

1. Hobbart Williard. Instrumental Methods of Analysis. 6<sup>th</sup> Edition, CBS Publishers, New Delhi, 2002.
2. Skoog, West. Pharmaceutical Analysis.
3. A.I. Vogel. Text Book of Quantitative Chemical Analysis. ELBS Longman. London.
4. Instrumental Methods of Analysis by Gurdeep Chatwal.
5. Kemp, W. Spectroscopy
6. Kenneth, A. Connors. 1982. Text Book of Pharma. Analysis. (3<sup>rd</sup> Ed.) New York: John Wiley & Sons.
7. D.C. Garratt. Quantitative Analysis of Drugs. 3<sup>rd</sup> Edn, CBS Publishers & Distributors, New Delhi, 2001.
8. C.E. Melean, R.W. Kiser. Problems and Experiments in Instrumental Analysis.
9. A.H. Beckett, J.B. Stenlake. Practical Pharmaceutical Chemistry, 4<sup>th</sup> Edn, Athlone Press, London, 2005.
10. Indian Pharmacopoeia. Controller of Publications, New Delhi, 1996, 2007, Vol I & II.
11. British Pharmacopoeia. HMSO Publication Center, London, 1993, Vol I & II.
12. U S P & National Formulary 2000. Asian Ed., US Pharmacopoeial Convention, Rockville, MD.
13. Silverstein, R.M. Spectrometric identification of organic compounds. New York: John Wiley & Sons.

## PHA-UG-804: PHARMACEUTICAL CHEMISTRY XII (Drug Design)

### Theory

1. **General Principles Of Drug Design and Discovery:** Drug like properties, Lipinski's Rule of Five, Drug Discovery Process, Computer Aided Drug Designing (CADD) And Molecular Modeling. Quantitative Structure Activity Relationship and Mechanism Based Approaches. Application of Quantum Mechanics and Dynamics.
2. **Quantitative Structure Activity Relationship:** History and Development of QSAR, Drug-Receptor Interactions. How Original Lead should be used in the Design of Analogs. Bioisosteric Replacements. Rigid Analogs, Ring Size, Alkyl Chain, Branching, Ring Position Isomers. Alterations of Stereochemistry and Stereo and Geometric Isomers. Physical Properties Related to

Potency. Calculation, Measurement and Meaning of Partition Coefficients. Theoretical Compartment Model for Relationship between Physical Properties and biological Activity (Hammett, Taft), Mathematical Methods for the Analysis QSAR. Refinement of Hansch Analysis. Application Of Free Wilson Analysis.

3. **New Approaches In Drug Discovery:** Combinatorial Chemistry, Pharmacogenomics, Proteomics, Molecular Docking, Modeling known and unknown receptor sites.
4. **Approaches To Rational Design Of Enzymes Inhibitors:** Introduction, General principles, Classification and Rational behind design of Non-Covalently Binding Enzymes Inhibitors.

### Practical

1. Chemdraw Ultra, Chem Biodraw -3D
2. Molecular Modeling using Pymol and Chimera
3. Molecular Modeling of Agonists and Antagonists
4. Demonstration of Docking studies
5. Demonstration Of QSAR Studies

### Reading List:

1. Burger's Medicinal Chemistry (6<sup>th</sup> Ed.). Vol-I & II. The Basis Of Medicinal Chemistry. John Wiley
2. Block, J.H., Beale, J.M. 2004. Wilson & Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry (11<sup>th</sup> Ed.). Lippincott Williams & Wilkins
3. Foye, W.A. Medicinal Chemistry.
4. Indian Pharmacopoeia (Vol. I & II). 1996, 2007. New Delhi: Controller of Publication.
5. Remington. The Science And Practice Of Pharmacy. 21<sup>st</sup> Edition, Lippincott Williams & Wilkins, 2007, Vol-I & II.

## PHA-UG-805: PHARMACOGNOSY VI (Industrial Pharmacognosy)

### Theory

1. Herbal preparations: Preparation of total extracts, exudates and tinctures. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India, Industrial production and utilization of phytoconstituents, i.e. Sennosides, Cardiac glycosides, Vinca, Menthol, Quinine, Citric acid, Podophyllotoxin, Diosgenin, Solasodine and Tropane alkaloids.
2. Isolation and estimation of phytopharmaceuticals: Different Methods (Including Industrial) for isolation and estimation of phytoconstituents from the following drugs:  
Acorus calamus-Asarone, Adhatoda Vasica-Vasicine, Curcuma longa-Curcumin, Glycyrrhiza glabra-Glycyrrhizic acid, Mucuna pruriens - L-Dopa, Piper nigrum -Piperine, Withania somnifera-Withanolide, Bacopa monnieri-Bacosides, Commiphora mukul-Guggulsterone, Andrographis paniculata-Andrographolide.
3. Processing, Equipment and analytical profiles of extracts of drugs listed in point (2) above.
4. Commerce: Indian and International trade in medicinal and aromatic plants.
5. Pharmacopoeial studies: Study of Herbal Pharmacopoeia, Indian Pharmacopoeia, Ayurvedic Pharmacopoeia, European Pharmacopoea, Chinese Pharmacopoeia & United State Pharmacopoeia for Herbal monographs.

6. Research: Needs, areas and current ongoing research. Quality assurance in Herbal Drug Industry Concept of TQM, GMP, GLP, ISO-9000 and HACCP in Traditional System of Medicine. Stability testing of herbal drugs.
7. Herbal Cosmetic: Raw materials of herbal origin used in cosmetics: Oil, Waxes, Gums, hydrophilic colloids, Colours, Perfumes, Protective agents, Bleaching Agents, Preservatives, Anti-oxidants & Other Ancillary Agents. Formulation aspects incorporating herbal extracts in various preparations like Skin care creams, Deodorants, Hair care preparations.
8. Preparation and standardization of Ayurvedic formulations i.e., Aristas, Asavas, Gutikas, Churna, Lehyas and Bhasmas.

### Practical

1. Successive extraction and qualitative test for different extract.
2. Isolation of phytoconstituents representing different types of constituents.
3. Assay of drugs and bioactive substances using HPLC, HPTLC and GLC etc.
4. Spectroscopic analysis of isolated compounds.
5. Evaluation of herbal extract.
6. Evaluation of Herbal formulation.

### Reading List:

1. Brain, K.R. & T.D. Turner, T.D. 1998. The Practical Evaluation of Phytopharmaceuticals. Bristol: Wright Scietechnical.
2. Kalia, A.N. Industrial Pharmacognosy.
3. Agarwal, S.S. Herbal Drug technology.
4. Choudhury, R.D. 1996. Herbal Drug Industry. New Delhi: Eastern Publisher.
5. Anonymous. 1998, 2000. Indian Herbal Pharmacopoeia. RRL, IDMA.
6. Rajpal, V. 2002. Standardisation of botanical. New Delhi: Eastern Publishers.
7. Verpoortee, R & P.K. 2003. GMP for botanicals - regulatory and quality issues on phytomedicines. New Delhi: Business Horizons.
8. Mukherjee, P.K. 2002. Quality Control of Herbal Drugs. New Delhi: Business Horizons.
9. Tyler, V.E & Brady, R. 1981. Textbook of Pharmacognosy. Philadelphia: Lea and Febiger.

## PHA-UG-806: PHARMACOLOGY V (Hospital and Clinical Pharmacy)

### Theory

- 1 **Organization and structure:** Organization of hospital. Hospital pharmacy and responsibilities of a hospital pharmacist, pharmacy and therapeutic committee.
- 2 **Hospital Formulary:** Contents, preparation and revision of formulary.
- 3 **Drug Distribution Systems in hospitals:**  
Distribution to out-patients and in-patients.
- 4 Introduction to Clinical pharmacy and scope.
- 5 Patient counseling, compliance, and monitoring
- 6 **Applied therapeutics for following diseases with special reference to the drugs of choice and role of pharmacists:** Hypertension, Angina, Atherosclerosis, Chronic obstructive pulmonary diseases (COPD), Tuberculosis, Urinary Tract Infections (UTI), Anaemia, Diabetes, Depression, Stroke, Peptic ulcer, Diarrhoea, Glaucoma, Eye infections.
- 7 Concepts of essential drugs and rational use of drugs



**8 Basic Concepts of Pharmacotherapy:**

Drug use during pregnancy, Drug interactions: drug-drug, drug-food, pharmacokinetic and pharmacodynamic drug interaction.

**9 Clinical Pharmacology:**

Basic concepts of Clinical trial-Phase-I, Phase-II, Phase-III, Phase-IV.

**Practical**

The students are required to be posted to various clinical wards for their exposure with therapeutic management and other clinical aspects. They are expected to have experience and do a tutorial as well as case presentation in the following clinical conditions. The students have to make at least 10 case presentations covering most common diseases found in the hospital to which the college is attached. The student should also submit a record of the cases presented. The cases may be selected from the diseases present in the theory.

**Reading List:**

1. Longo, D., Fauci, A., Kasper, D., Hauser, S., Jameson, J., Loscalzo, J. 2011. Harrison's Principles of Internal Medicine. New York: McGraw-Hill.
2. Laurence, D.R.; Bennett, P.N. and Brown, M.J. 2013. Clinical Pharmacology. 9<sup>th</sup> Edition. London: Churchill Livingstone.
3. Roger, W. and Edwards, C. 2012. Clinical Pharmacy & Therapeutics 3<sup>rd</sup> Edition. London: Churchill Livingstone.
4. West, J.B. 2013. Best and Taylor's Physiological Basis of Medical Practice. New Delhi: Waverly Pvt. Ltd.
5. Dipiro, J.T. 2012. Pharmacotherapy-a Pathophysiological Approach 7<sup>th</sup> Edition. New Delhi: McGraw-Hill.
6. Robins, C.K. 2013. Text Book of Robins Pathology Basis of Disease 9<sup>th</sup> Edition. New Delhi: Prism Indian Edition.
7. Guyton, A.C. and Hall, J.E. 2013. Text Book of Medical Physiology 12<sup>th</sup> Edition. Pennsylvania: Saunders Company.
8. Paradkar, A. R. and Chunawala, S.A. 2008. Hospital and Clinical Pharmacy. Pune: Nirali Prakashan.
9. Martin, S. 2000. Hospital Pharmacy. London: Pharmaceutical Press.