

Pharm.D. Courses
FIRST PROFESSIONAL
2nd SEMESTER

PHG-312
General Pharmacognosy
Cr. Hrs. 3

1. Historical Development and Scope of Pharmacognosy in Modern Medicine

Introduction and history of Pharmacognosy with special reference to the contribution of Muslim scientists (Hunayn bin Ishaq, Ali Ibn Sahl at-Taberi, Al-Razi, Al-Biruni, Ibn Sina, Ibn al-Baitar, Al-Nafis, Al-Idrisi, Al-Kindi) to the profession of Pharmacy. Introduction to herbal pharmacopoeias and prospects of Pharmacognosy in modern medicine, Complementary and Alternative Medicine (CAM).

2. Crude Drugs

Introduction to crude drugs, classifications of crude drugs: alphabetical, morphological, taxonomical, chemical and therapeutic classification, their preparation and commerce. Official and un-official drugs.

3. Drugs of Natural origin

Plant Drugs: Source, chemical nature, medicinal and pharmaceutical uses of *Ephedra sinica*, *Glycyrrhiza glabra*, *Cassia angustifolia*. *Laminaria* spp., *Sargassum* spp.,

Animal drugs: Source, chemical nature and medicinal/ pharmaceutical uses of honey, gelatin, shellac, musk, civet, ambergris, cod liver oil, cantharides and spermaceti.

Mineral drugs: Sulphur, Alum, Borax, Magnesium salts, Aluminium hydroxide, Sodium bicarbonate.

Natural Fibers: Sources, classification of fibers as vegetable, animals and mineral fibers and their identification tests. Source, chemical nature and uses of cotton, wool, cellulose and catgut.

4. Biologics

Introduction to biologics and their types: vaccines, blood and its components, antisera, toxins, antitoxins, venoms, antivenins, cells, allergens, genes, tissues, and recombinant protein.

Types of Vaccines: Live-attenuated, inactivated, subunit, recombinant, polysaccharide and conjugated.

Preparation and uses of: tuberculosis, poliomyelitis, diphtheria, tetanus, pertussis, hepatitis B, haemophilus influenzae type b (Hib), pneumonia, meningitis, measles mumps and rubella (MMR), diarrhea, chicken pox, herpes zoster, human papillomavirus (HPV), rabies, typhoid, Covid-19 vaccines, toxins, antitoxins, venoms, antivenins, antisera.

The Expanded Program on Immunization (EPI) in Pakistan.

5. Quality Control and Standardization of Plant Drugs

Introduction to quality control and standardization of plant drugs. Difference between standardized crude drug and standardized crude extract. Types of quality control methods: physical, chemical and biological. Types of adulteration, inferiority, spoilage, admixture, sophistication and substitution of crude drugs. WHO guidelines for standardization of plant drugs and its significance.

Books Recommended

- Trease and Evans' Pharmacognosy (16th ed.), William C. Evans, George E. Trease, Daphne Evans, Elsevier (2009).
- Fundamentals of Pharmacognosy and Phytotherapy (3rd ed.), Michael Heinrich, Elizabeth M. Williamson, Simon Gibbons, Joanne Barnes, Jose Prieto-Garcia, Elsevier Health Sciences (2018).
- Remington: The Science and Practice of Pharmacy (Remington: The Science and Practice of Pharmacy (23rd ed.), Adeboye Adejare (Ed.), Academic Press; 2020.
- Pharmacognosy: Fundamentals, Applications and Strategies (1st ed.), Rupika Delgoda (Author), Simone Badal McCreath (Ed.) Academic Press, 2016.
- Pharmacognosy (9th ed.), Tyler V.E., Brady L.R. and Robbers J.E., Lea and Febiger, Philadelphia (1988).
- ABC of Complementary Medicine. Volume 92 of ABC Series (2nd ed.), Catherine Zollman, Andrew J. Vickers, Janet Richardson (Eds.), John Wiley & Sons (2009).
- Dictionary of Natural Products: Terms in the Field of Pharmacognosy Relating to Natural Medicinal and Pharmaceutical Materials and the Plants, Animal and Minerals from Which They are Derived (2nd ed.), George MacDonald Hocking, Plexus Publication (1997).
- The Evolution of Drug Discovery: From Traditional Medicines to Modern Drugs. Enrique Ravina, Hugo Kubinyi, John Wiley & Sons (2011).
- Evidence-Based Validation of Herbal Medicine, Pulok K. Mukherjee, Elsevier, (2015).
- Biologics in General Medicine, Wolf- Henning Boehncke, Heinfried H. Radeke, Springer, (2007).

SECOND PROFESSIONAL 1st SEMESTER

PHG-411

Pharmacognosy Lab-I

Cr. Hrs. 3

Herbal Quality Control

1. Physical Methods

a. Macroscopic / Organoleptic Evaluation

Plant Drugs

Organized Drugs

Seed:	<i>Cucumis melo, Datura stramonium, Lallementia royleana, Nigella sativa, Psoralea corylifolia, Ricinus communis, Strychnos nux-vomica</i>
Fruit:	<i>Aegle marmelos, Cassia fistula, Ficus carica, Phycotis ajowan, Terminalia chebula, Tribulus terrestris</i>
Pod:	<i>Cassia fistula, Helicteres isora, Moringa olifera, Papaver somniferum</i>
Flower:	<i>Catheranthus roseus, Hibiscus rosa-sinensis, Moringa olifera, Onosma bracteatum, Punica granatum, Viola odorata</i>
Leaf:	<i>Catharanthus roseus, Cinnamomum zeylanicum, Cordia myxa, Gymnema sylvester, Lawsonia innermis, Ocimum tenuiflorum, Onosma bracteatum</i>
Bark:	<i>Acacia nilotica, Azadirachta indica, Cinnamomum zeylanicum, Onosma echioides, Valeriana hardwickii, Saraca indica, Prosopis juliflora</i>
Root:	<i>Glycyrrhiza glabra, Valeriana officinalis</i>
Rhizome:	<i>Alpinia officinarium, Curcuma amada, Curcuma longa, Smilax china, Zingiber officinale</i>

Unorganized Drugs

Extracts:	<i>Aloe indica, Uncaria gambir, Rhus toxicodendron</i>
Exudates:	<i>Acacia arabica, Bambusa arundinacea, Ferula foetida, Styrax benzoin</i>

Animal Drugs

Apis melifera, Bombyx mori, Cantheris vesicatoria, Cervus elephus, Laccifer lacca, Ovis aries

Mineral Drugs

Alum, Borax, Sulphur, Ammonium chloride, Asphalt, Magnesium salts, Aluminium hydroxide, Sodium bicarbonate.

b. Microscopic Evaluation

Section Cutting

Transverse sections of the following crude drugs:

Stem:	<i>Ephedra sinica, Santalum album, Tinospora cordifolia</i>
Leaf:	<i>Cassia senna, Eucalyptus globulus, Mentha piperita</i>
Fruit:	<i>Piper nigrum, Foeniculum vulgare</i>
Seed:	<i>Myristica fragrans, Ricinus communis, Strychnos nux-vomica</i>
Bark:	<i>Azadirachta indica, Cinnamomum zeylanicum, Saraca indica</i>
Root:	<i>Glycyrrhiza glabra, Rauwolfia serpentina</i>
Rhizome:	<i>Curcuma longa, Zingiber officinale</i>
Flower Bud:	<i>Eugenia caryophyllus</i>

Powder Microscopy

Powder microscopy of the following crude drugs:

Bark:	<i>Acacia nilotica, Azadirachta indica, Cinnamomum zeylanicum</i>
Seed:	<i>Hyocyamus niger, Strychnos nux-vomica, Trigonella foenum-graecum</i>
Flower:	<i>Eugenia caryophyllus, Matricaria Chamomilla, Punica granatum</i>
Leaf:	<i>Cassia senna, Lawsonia innermis, Mentha piperita</i>
Fruit:	<i>Coriandrum sativum, Foeniculum vulgare, Illicium verum</i>
Root:	<i>Glycyrrhiza glabra, Rauwolfia serpentina, Valeriana officinalis</i>
Rhizome:	<i>Alpinia officinarium, Curcuma longa, Zingiber officinale</i>

c. Determination of stomatal index, Palisade ratio and type of stomata

Determine the stomatal index, Palisade ratio and type of stomata of the following leaf drugs:

Leaf: *Cassia senna, Eucalyptus globulus, Mentha piperita*

d. Determination of Foreign Matter, Moisture Content, Extractive Value, Ash Values

Determine the foreign matter, moisture content, extractive value and ash value of the following drugs:

Cassia senna leaf, *Glycyrrhiza glabra* root, *Trigonella foenum-graecum* seeds

2. Biological Testing

a. Determination of Swelling Index

Determine the swelling index of the following seed drugs:

Triognella foenum-graecum, Lallelantia royleana, Plantago ovata, [Linum usitatissimum](#)

b. Determination of Foaming Index

Determine the foaming index of the following drugs:

Sapindus trifoliatus (fruit), *Triognella foenum-graecum* (seed), *Ziziphus mauritiana* (fruit), *Medicago sativa* (leaves), *Glycyrrhiza glabra* (root), *Smilax china* (rhizome)

Books Recommended

- Fundamentals of Pharmacognosy and Phytotherapy, (3rd ed.), Michael Heinrich, Elizabeth M. Williamson, Simon Gibbons, Joanne Barnes, Jose Prieto-Garcia, Elsevier Health Sciences, 2018.
- Pharmacognosy: Fundamentals, Applications and Strategies, (1st ed.), Rupika Delgoda (Author), Simone Badal McCreath (Ed.) Academic Press, 2016.
- Practical Pharmacognosy, Rasheeduz Zafar, Neerja Gandhi, CBS Publishers & Distributors (2021).

- Practical Pharmacognosy, S.B Gokhale, Dr. C.K. Kokate, Ali, Nirali Prakashan (2008).
- Powdered Crude Drug Microscopy of Leaves and Barks, Vidhu Aeri, D.B. Anantha Narayana, Dharya Singh, Elsevier Science (2019).
- Encyclopedia of World Medicinal Plants (vol. 5), T. Pullaiah, Illustrated, Regency Publications, New Delhi (2006).
- Drugs of Natural Origin: A Treatise of Pharmacognosy, (7th ed.), *Gunnar Samuelsson, Lars Bohlin*, Swedish Pharmaceutical Press (2015).
- Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals (1st ed.), *Pulok K. Mukherjee*, Publisher Business Horizons, New Delhi (2002).
- Adulteration in Herbal Drugs: A Burning Issue, Shabnum Shaheen, Sehrish Ramzan, Farah Khan, Mushtaq Ahmad, Springer Nature (2019).

SECOND PROFESSIONAL
2nd SEMESTER

PHG-412

Chemical Pharmacognosy-I

Cr. Hrs. 3

1. Carbohydrates and Related Compounds

Introduction and classification of carbohydrates. Uses of carbohydrates as medicinal agent or pharmaceutical aid: source, physical features, chemistry, uses and method of extraction of dextrose, fructose, sorbitol/glucitol, Xylitol, mannose/mannitol, sucrose, maltose, lactose, starch, cellulose, pectin, tragacanth gum, guar gum, agar, alginic acid, carrageenan, laminarin, fucoidan.

2. Fats and Fixed Oils

Introduction, classification; extraction and quality control methods of fixed oils and fats. Sources, physical features, chemical composition, medicinal and pharmaceutical uses of castor oil, cotton seed oil, olive oil, peanut oil, sesame oil, sunflower oil, corn oil, coconut oil, almond oil, flax seed oil, canola oil, soya oil. chaulmoogra oil, mustard oil, palm oil, lanolin, carnaubas wax and bee wax.

3. Volatile Oils

Introduction, classification, biosynthesis and extraction methods of volatile oils. Sources, physical features, chemical composition, medicinal and pharmaceutical uses of clove oil, fennel oil, coriander oil, orange oil, eucalyptus oil, peppermint oil, anise oil, turpentine oil, lemon peel oil, citronella oil, caraway oil and thyme oil.

4. Resins and Oleoresins

Introduction and classification of resins and oleo resins. Sources, physical features, chemical composition, medicinal and pharmaceutical uses of jalap, turpentine, asafoetida, benzoin, rosin, cannabis, podophyllum, ipomea, myrrh and balsam.

5. Tannins

Introduction, classification, extraction and identification of tannins. Source, physical features, chemical composition, medicinal and pharmaceutical uses of tannins found in *Acacia catechu*, *Camellia sinensis*, *Castanea sativa*, *Krameria triandra*, *Pterocarpus marsupium*, *Punica granatum*, *Quercus infectoria* and *Terminalia chebula*.

6. Steroids

Introduction, classification, biosynthesis, extraction and isolation of steroids. Sources, physical features, chemical composition, and medicinal uses of bile acids, plant sterols (*Glycine max*), cardiac glycosides (*Digitalis purpurea*, *Digitalis lanata*, *Convallaria majalis*, *Strophanthus kombe*, *Urginea maritima*, *Nerium oleander*), vitamin D and withanolides.

Books Recommended

- Biosynthesis of Natural Products, Manitto P., John Wiley and Sons, New York (1981).
- Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
- Herbal Drugs and Phytopharmaceuticals, Norman G. Bisset (Ed.), Medpharm Scientific Publishers, Stuttgart (1994).
- Medicinal Natural Products: A Biosynthetic Approach (3rd ed.), Paul M Dewick, John Wiley and Sons, Ltd., Chichester (2009).
- Fundamentals of Pharmacognosy and Phytotherapy, (3rd ed.), Michael Heinrich, Elizabeth M. Williamson, Simon Gibbons, Joanne Barnes, Jose Prieto-Garcia, Elsevier Health Sciences, 2018.
- Textbook of Pharmacognosy and Phytochemistry, (1st ed.), Avinash Seth, Biren Shah, Elsevier India (2010).
- Pharmacognosy: Fundamentals, Applications and Strategies, (1st ed.), Rupika Delgoda (Author), Simone Badal McCreath (Editor) Academic Press (2016).
- Pharmacognosy: Current Herbal Medications and Natural Product Chemistry for a Pharm D Curriculum, Yan Zhang, Cognella Academic Publishing (2020).
- Drugs of Natural Origin, A Treatise of Pharmacognosy, (7th ed.), Gunnar Samuelsson, Lars Bohlin, Swedish Pharmaceutical Press (2015).
- Tannins: Types, Foods Containing, and Nutrition, Georgios K. Petridis, Nova Science Publishers (2011).

Third Professional
1st Semester

PHG-511

Chemical Pharmacognosy-II

Cr. Hrs. 3

1. Alkaloids

Introduction, classification, biosynthesis, extraction and isolation of alkaloids. Sources, physical features, chemical composition, medicinal and pharmaceutical uses of Pyridine (*Nicotiana tabacum*), Piperidine (*Nicotiana tabacum*), Tropane (*Hyocyamus*, *Atropa*, *Datura stramonium*), Imidazole (*Pilocarpus microphyllus*), Isoquinoline (*Cephalis ipecacuanha*, *Chondrodendron tomentosum*, *Papaver somniferum*), Quinoline (*Cinchona succirubra*), Indole (*Claviceps purpurea*, *Rauwolfia serpentina*, *Catharanthus roseus*, *Strychnos nux-vomica*), Purine (*Thea sinensis*), Steroidal (*Veratrum viride*), Diterpene (*Aconitum napellus*), Phenethylamine (*Ephedra sinica*, *Colchicum autumnale*) alkaloids.

2. Glycosides

Introduction, classification, biosynthesis, extraction and isolation of glycosides. Sources, physical features, chemical composition, medicinal and pharmaceutical uses of glycosides from *Cascara sagrada*, *Cassia senna*, *Aloe barbadensis* (anthraquinone glycosides); *Ginkgo biloba* (flavonoid glycosides); *Dioscorea* spp., *Smilax* spp. (steroidal saponin); *Glycyrrhiza glabra* (flavonoid glycosides, triterpenoidal saponins); *Panax ginseng*, (steroid glycosides, triterpenoidal saponins).

3. Methods of Extraction and Isolation of Natural Products

Introduction to extraction, mechanism and factors affecting extraction. Methods of extraction, their advantages and disadvantages. Classic methods: infusion, decoction, percolation, maceration, digestion, distillation; Modern methods: Supercritical fluid extraction method, continuous hot extraction, Soxhlet extraction, counter current extraction, microwave assisted extraction, ultrasonication assisted extraction, enzyme assisted extraction, Pressurized liquid extraction. Methods of Purification: crystallisation, sublimation, distillation, precipitation, chromatography.

4. Chromatography

Introduction and modes of chromatography: adsorption, partition, size exclusion, ion-exchange, affinity. Types of chromatography: column chromatography, thin layer chromatography, paper chromatography, LC-MS, droplet counter current chromatography, HPLC, Gas chromatography, ion-exchange, size exclusion and affinity chromatography, their assembly/Instrumentation, methodology, principle of separation and application. for the separation, isolation, purification and identification of natural products.

5. Characterization of Natural Products

Characterization of natural products by spectroscopic techniques (Atomic absorption, Circular dichroism, FTIR, IR, Mass, NMR, UV, UV/Vis, X-ray spectroscopy and hyphenated techniques.

Books Recommended

- Biosynthesis of Natural Products, Mannito P., John Wiley and Sons, New York (1981).
Herbal Drugs and Phytopharmaceuticals, Norman G. Bisset (Ed.), Medpharm Scientific Publishers, Stuttgart (1994).
- Medicinal Natural Products: A Biosynthetic Approach (3rd ed.), Paul M Dewick, John Wiley and Sons, Ltd., Chichester (2009).
- Medicinal Plants of the World: Chemical Constituents, Traditional and Modern Medicinal Uses (vol. 1-3), Ivan A. Ross, Humana Press, New Jersey (2005).
- Fundamentals of Pharmacognosy and Phytotherapy (3rd ed.), Michael Heinrich, Elizabeth M. Williamson, Simon Gibbons, Joanne Barnes, Jose Prieto-Garcia, Elsevier Health Sciences (2018).
- Understanding Medicinal Plants: Their Chemistry and Therapeutic Action (1st ed.) Bryan Hanson, Routledge (2005).
- Pharmacognosy: Fundamentals, Applications and Strategies (1st ed.), Rupika Delgoda (Author), Simone Badal McCreath (Ed.) Academic Press (2016).
- Green Extraction of Natural Products: Theory and Practice, (1st ed.), Farid Chemat, Jochen Strube (Eds.) Wiley-VCH (2015).
- Natural Products Isolation (Methods in Molecular Biology, 864), (3rd ed.), Satyajit D. Sarker, Lutfun Nahar (Eds.), Springer, 2012.
- Plant-derived Bioactives: Chemistry and Mode of Action (1st ed.), Mallappa Kumara Swamy (Ed.), Springer (2020).
- Chromatography: Concepts and Contrasts (2nd ed.), James M. Miller, Wiley-Interscience (2009).

Third Professional 2nd Semester

PHG-512

Herbal Quality Control Lab-II

Cr. Hrs. 3

1. Extraction, Isolation and identification of Natural Products

- i. Extraction and isolation of starch from the tubers of *Solanum tuberosum*.
- ii. Identification of starch isolated from tubers of *Solanum tuberosum* by chemical methods.

- iii. Extraction and isolation of pectin from the inner pericarp of *Citrus paradisi* fruit.
- iv. Identification of pectin isolated from the inner pericarp of *Citrus paradisi* fruit by chemical method.
- v. Extraction and isolation of caffeine from *Thea sinensis* leaves.
- vi. Extraction and isolation of piperine from *Piper nigrum* fruits.
- vii. Extraction and isolation of myristicin and trimyristicin from *Myristica fragrans* seed.
- viii. Extraction and isolation of Lycopene and β -Carotene from *Solanum lycopersicum* fruits.
- ix. Extraction of volatile oil from plant sources by distillation methods.
Myristica fragrans, *Trachyspermum ammi*, *Eugenia caryophyllus*, *Carum carvi*
- x. Identification of volatile oils by pharmacopeial methods.
- xi. Extraction of fixed oil by solvent extraction method (Soxhlet).
(*Sesamum indicum*, *Arachis hypogea*, *Prunus amygdalus* var. *amara*)
- xii. Analysis of oils adulterated with Sesame seed oil by Baudouin test.
- xiii. Analysis of oils adulterated with Castor seed oil by chemical methods.
- xiv. Determination of saponification value, iodine number, acid number and peroxide value of the fixed oils.
(*Sesamum indicum*, *Arachis hypogea*, *Prunus amygdalus* var. *amara*)

2. Preliminary Screening of Natural Products

- i. Detection of carbohydrates, tannins, alkaloids, glycosides, steroids, saponins, terpenes and flavonoids in the following plant extracts by chemical reagents:
Camellia sinensis, *Cassia senna*, *Cassia fistula*, *Cordia myxa*, *Datura stramonium*, *Glycyrrhiza glabra*, *Strychnos nux-vomica*, *Sapindus trifoliatus*, *Uncaria gambir*.

3. Chromatography

- i. Identification of caffeine isolated from *Thea sinensis* leaves by T.L.C method.
- ii. Identification of piperine from *Piper nigrum* fruits by T.L.C method.
- iii. Identification of myristicin and trimyristicin isolated from *Myristica fragrans* seed by T.L.C method.
- iv. Identification of Lycopene and β -Carotene isolated from *Solanum lycopersicum* fruit by T.L.C method.
- v. Separation of color pigments from ***Bougainvillea glabra* flower petals by column chromatography.**
- vi. **Qualitative and quantitative assessment of glycyrrhizin present in the root extract of *Glycyrrhiza glabra* by HPLC.**
- vii. Characterization of Flavonoids present in medicinal plants by Thin Layer Chromatography (*Ruta graveolens* herb, *Matricaria chamomilla* flowers, *Carum carvi* fruit).
- viii. Analysis of ***Digitalis purpurea*** leaf extract of by paper chromatography.
- ix. Determination of the color pigments present in leaf extract by T.L.C. method.
- x. Analysis of *Strychnos nux-vomica* extract (acid or alkaline) for the presence of strychnine and brucine by thin layer chromatography (TLC).

- xi. Determination of ephedrine in *Ephedra sinica* stem through ion exchange chromatography.
 - xii. Separation of alkaloids from an extract of *Atropa belladonna* through ion exchange chromatography.
 - xiii. Characterization of herbal extracts of the following drugs by TLC /HPTLC Finger Printing.
(*Aegle marmelos*, *Aloe spp.*, *Cassia senna*, *Ocimum tenuiflorum*, *Phyllanthus emblica*, *Withania somnifera*).
- 4. Spectroscopy**
- i. Analysis of Pharmacopeial compounds of natural origin and plant extracts by UV-Vis spectrophotometer.
 - ii. Authentication and identification of crude drugs extract by fluorescence analysis.

Books Recommended

- Chromatography: Concepts and Contrasts (2nd ed.), James M. Miller, Wiley-Interscience (2009).
- Green Extraction of Natural Products: Theory and Practice, (1st ed.), Farid Chemat, Jochen Strube (Eds.) Wiley-VCH (2015).
- Natural Products Isolation: Methods and Protocols, (3rd ed.), Satyajit D. Sarker, Lutfun Nahar (Eds.), Springer (2012).
- Chromatography: Principles and Instrumentation (1st ed.), Mark F. Vitha, John Wiley & Sons, Inc. (2016).
- Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
- Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
- Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.), Hildebert Wagner, Sabine Bladt, Springer-Verlag, New York (1996).
- Principles of Instrumental Analysis (5th ed.), Douglas A. Skoog, F. James Holler, Timothy A. Nieman, Saunders College Publishing, Philadelphia (1998).
- Thin-Layer Chromatography: A Laboratory Handbook, Egon Stahl, Springer-Verlag (1969).
- The Essence of Chromatography, (1st ed.), Colin Poole, Elsevier Science (2002).

Third Professional
2nd Semester

PHG-514

Natural Toxins

Cr. Hrs. 2

1. Introduction to Natural Toxins

Introduction, classification and chemical nature of natural toxins, their toxicities in humans and animals and their applications.

2. Higher Plant Toxins

Essential oils: Terpene (cineol, pine oil), Phenylpropane (apiol, safrole, myristicin), Monoterpene (thujone, menthafuran), Plant acids (oxalic acid, amino acid, resin acid), Glycosides (cardiotonic, cyanogenic), Alkaloids (imidazole, pyrrolizidine, tropane), Lectin (*Abrus precatorius*, *Ricinus communis*), Pyridine/piperidine (*Conium maculatum*, *Lobelia inflata*), Steroidal alkaloids (*Veratrum album*).

3. Lower Plant Toxins

Bacterial toxins (*Staphylococcus aureus*, *Clostridium botulinum*), Algal toxins (*Microcystis aeruginosa*, Cyanobacteria, *Gonyaulax cantenella*).

4. Mycotoxins

Fungal toxins (*Aspergillus spp.*, *Claviceps purpurea*), Mushrooms (*Amanita spp.*).

5. Animal Toxins

Honey bee (*Apis mellifera*), black widow spider (*Latrodectus mactans*), Snake venom (*Bothrops Jararaca*, *Naja nana atra*), Scorpion (*Scorpiones spp.*), Gila monster lizard (*Heloderma suspectum*), Snail (*Conus magus*).

6. Prevention and Control Methods of Toxins

Description, pharmacognostic features, pharmacological actions, chemical constituents, treatment, side-effects, contra-indications, warnings, prevention and control methods of *Abrus precatorius*, *Apis mellifera*, *Bungarus sindanus*, *Datura stramonium*, *Digitalis purpurea*, *Latrodectus mactans*, *Nicotiana tabaccum*, and *Papaver somniferum* poisoning.

Books Recommended

- Dictionary of Plant Toxins, Jeffery B. Harborne, Herbert Baxter, Gerard P. Moss (Eds.), John Wiley, Chichester (1996).
- Herbal Products, Toxicology and Clinical Pharmacology (2nd ed.), Timothy S. Tracy, Richard L. Kingston (Eds.), Humana Press, Totowa (2007).
- Microbial Toxins (1st ed.), P. Gopalakrishnakone, Brad Stiles, Alberto Alape-Girón, J. Daniel Dubreuil, Manas Mandal (Eds.), Springer (2018).

- Poisonous Plants of Pakistan, S. H. Abid Askari, Oxford University Press, (2010).
- Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2005).
- Poisonous Plants and Related Toxins, Thomas Acamovic, Colin S. Stewart, T. W. Pennycott, CABI (2003).
- Poisonous Plants of all Countries (2nd ed.), Arthur-Bernhard Smith, Periodical Expert Book, Delhi (1988).
- Plant Toxins (1st ed.), P. Gopalakrishnakone, Célia Regina Carlini, Rodrigo Ligabue-Braun (Eds.), Springer (2017).
- Poisonous Plants and Phytochemicals in Drug Discovery, Andrew G. Mtewa, Chukwuebuka Egbuna, G.M. Narasimha Rao (Eds.), John Wiley and Sons Ltd. (2020).
- The Toxin Solution: How Hidden Poisons in the Air, Water, Food, and Products We Use are Destroying Our Health-And What We Can Do To Fix It, Joseph Pizzorno, Harper One (2017).

Fourth Professional
1st Semester

PHG-611

Advance Pharmacognosy

Cr. Hrs. 3

1. Allergens and Allergenic Preparations

Introduction, atopy, types of hypersensitivity, classification of allergens, causes, history, Allergy tests (allergy skin testing, blood tests, spirometry, food challenges, drug/medication challenge, aspirin desensitization, patch testing), treatment of allergies (antihistamines, decongestants, nasal steroids, asthma medicines and immunotherapy) and method of preparation of allergy vaccines. Types of allergens on the basis of contact site: inhalant, ingestant, injectant, contactant, infectant and infestant.

2. Enzymes

Introduction, classification, chemistry and functions of plant, animal and microbial enzymes; pharmaceutical, therapeutic and diagnostic importance of enzymes. Study source and uses of L-arginase, asparaginase, bromelains, chymopapain, collagenase, fibrinolysin, glucosidase, hyaluronidase, β -lactamase, papain, pancreatin, pepsin, malt extract, streptokinase, superoxide dismutase, trypsin, urokinase.

3. Anticancer, Anti-AIDS, Immunomodulators

Introduction to anticancer agents of natural origin: *Catharanthus roseus*, *Colchicum autumnale*, *Podophyllum peltatum*, *Taxus brevifolia*, anthracyclines (daunorubicin, doxorubicin), bleomycin, dactinomycin, mitomycin c, macrolide antibiotics (erythromycin, clarithromycin).

Potential anti-AIDS agents: alkaloid (castanospermine), anthraquinone (hypericin), coumarins (calanolides A and B), dimeric sesquiterpene (gossypol), flavonoids (glycyrrhizoflavone, isolicoflavonol, licochalcone), pentacyclic triterpene (glycyrrhizin), tannins (tetragalloylquinic acid).

Potential immunomodulators: capsaicinoid (capsaicin), diarylheptanoid (curcumin), diterpene lactone (andrographolide), flavonols (epigallocatechin-3-gallate, quercetin), isoflavones (genistein), phenethylisoquinoline (colchicine), stilbenes (resveratrol).

4. Hormones

Introduction, chemical classification, commercial production, extraction and isolation of animal hormones. Therapeutic/ medicinal value of Peptide and amino acid derivatives: adrenaline, nor adrenaline (adrenal gland), Thyroxine, Triiodothyronine, Calcitonin (thyroid), vasopressin, oxytocin (pituitary), parathyroid hormone (parathyroid), insulin, glucagon (pancreas); Steroidal hormones: glucocorticoids, mineralocorticoids (adrenal gland), ovaries (progestogens, estrogens), testes (androgens).

Plant hormones: auxins, gibberellin, cytokinins, abscisic acid and their significance in the development of plants and their secondary metabolites.

5. Nutraceuticals

Introduction, classification, regulatory and market aspects of nutraceuticals. Source, chemistry, toxicity, side effects, role in healthcare system of the: cranberry extract, chitosan, chlorella, chondroitin, co-enzyme Q, flavonoids, flax seed oil, fluoride, garlic, isoflavones, kelp, lecithin, lignans, lycopene, pre- and probiotics, phytoestrogens, royal jelly, selenium, spirulina and zinc as nutraceuticals.

6. Cosmeceuticals

Introduction, classification of cosmeceuticals as skin, eye, hair care and others products. Natural source, isolated products, chemistry, uses, toxicity and the use in cosmeceuticals based on aloe, apricot, **argan oil**, arnica, balsam, bromelain, calendula, chamomile, coconut, cucumber, henna, honey, jojoba, lavender, myrrh, oats, pomegranate, propolis, rosemary, tea, turmeric and walnut.

Books Recommended

- Williams Textbook of Endocrinology (11th ed.), Henry Kronenberg, Shlomo Melmed, Keneth Polonsky, Saunders (2008).
- Anticancer Agents from Natural Products, Gordon M. Cragg, David G. I. Kingston, David J. Newman, CRC Press (2005).
- Nutraceuticals: A Guide for Healthcare Professionals (2nd ed.). Brain Lockwood, Pharmaceutical Press, London (2007).

- Cosmeceuticals and Active Cosmetics: Drugs versus Cosmetics, Peter Elsner and Howard I. Maibach (Eds.), CRC Press (2005).
- Plants in Cosmetics: Plants and Plant Preparations used as Ingredients for Cosmetic Products, Anton R., Patri F. Silano V., Council of Europe Publishing (2001).
- Research Advancements in Pharmaceutical, Nutritional, and Industrial Enzymology (1st ed.), Shashi Lata Bharati, Pankaj Kumar Chaurasia, IGI Global (2018).
- Directory of Therapeutic Enzymes, (1st ed.), Barry M. McGrath, Gary Walsh, CRC Press, Boca Raton (2005).
- Herbal Biomolecules in Healthcare Applications (1st ed.), Subhash C. Mandal, Amit Kumar Nayak, Amal Kumar Dhara, Academic Press (2021).
- Handbook of Nutraceuticals and Functional Foods (3rd ed.), Robert E.C. Wildman, Richard S. Bruno (Eds.), CRC Press (2019).
- Functional Foods and Nutraceuticals: Bioactive Components, Formulations and Innovations, (1st ed.), Chukwuebuka Egbuna, Genevieve Dable Tupas (Eds.), Springer (2020).
- Cosmeceuticals, Y Madhusudan Rao, Shayeda, BS Publications (2012).

Fifth Professional
1st Semester

PHG-713

Clinical Pharmacognosy

Cr. Hrs. 2

1. Introduction to Clinical Pharmacognosy

Introduction and historical background of Clinical Pharmacognosy. Study of causes, pathogenesis, clinical features (sign and symptoms), diagnosis, prognosis, prevention and epidemiology of chronic diseases; principles of medication; treatment of diseases by herbal medicines.

2. Clinical Use of Herbal Medicine

CNS disorders

Atropa belladonna, Cannabis sativa, Datura stramonium, Hypericum perforatum, Papaver somniferum, Strychnos nux-vomica.

Cardiovascular diseases

Allium sativum, Crataegus monogyna, Convallaria majalis, Digitalis purpurea, D. lanata, Punica granatum, Urgenia indica.

Hepatic disorders

Berberis vulgaris, Chelidonium majus, Lawsonia innermis, Picrorhiza kurroa, Silybum marianum

Renal disorders

Berberis vulgaris, Cucumis melo, Serenoa repens, Tribulus terrestris, Urtica dioica, Zea mays

Pulmonary diseases

Adhatoda vasica, Althaea officinalis, Andrographis paniculate, Eucalyptus globulus, Ficus religiosa.

G.I.T. disorders

Aegle marmelos, Cuminum cyminum, Ferula foetida, Foeniculum vulgare, Mentha piperita, Prunus domestica.

Metabolic disorder: Diabetes

Caesalpinia bonducella, Galega officinalis, Gymnema sylvestre, Melia azadirchta, Momordica charantia, Syzygium jambulana.

Musculo-skeletal disorders

Ananas comosus, Capsicum annum, Curcuma longa, Nigella sativa, Phycotis ajowan, Rosemarinus officinalis, Trigonella foenum-graecum, Zingiber officinale.

Reproductive disorders

Angelica polymorpha Maxim. var. Sinensis, Claviceps purpurea, Glycyrrhiza glabra, Myristica fragrans, Nigella sativa, Ruta graveolens, Saraca indica.

Dermal disorders

Aloe vera, Angelica archangelica, Argania spinosa, Citrus spp., Commiphora mukul, Melaleuca alternifolia, Mentha piperita.

Books Recommended

- Evidence Based Validation of Traditional Medicines- A Comprehensive Approach (1st ed.), Subhash C. Mandal Raja Chakraborty, Saikat Sen, Springer Singapore (2021).
- Herbal Biomolecules in Healthcare Applications, (1st ed.), Subhash C. Mandal, Amit Kumar Nayak, Amal Kumar Dhara, Academic Press (2021).
- Pharmacognosy: Current Herbal Medications and Natural Product Chemistry for a PharmD Curriculum, Yan Zhang, Cognella Academic Publishing (2020).
- Principle and Practice of Phytotherapy: Modern Herbal Medicine, Kerry Bone, Simons Mills, Churchill Livingstone (2013).
- Pharmacological Methods in Phytotherapy Research, Selection, Preparation and Pharmacological Evaluation of Plant Material (vol.1), Elizabeth M. Williamson, David T. Okpako, Fred J. Evans, Wiley Publishers (1996).

- Encyclopedia of World Medicinal Plants (vol. 5), T-Pullaiah., Regency Publication, New Delhi (2006).
- Natural Products: Drug Discovery and Therapeutic Medicine, Lixin Zhang, Arnold L. Demain (Eds.), Humana Press (2005).
- Handbook of Clinical Pharmacy, Dr. A. V. Yadav, B.V. Yadav, T. I. Shaikh, Nirali Parkashan, Pune (2008).
- Drugs of Natural Origin , A Treatise of Pharmacognosy (7th ed.), *Gunnar Samuelsson, Lars Bohlin*, Swedish Pharmaceutical Press (2015).
- Rational Phytotherapy: A Physicians' Guide to Herbal Medicine, (3rd ed.), Schulz V, Hänsel R, Tyler VE, Springer-Verlag (1996).

M. Pharm. Courses
M. Pharm.
FIRST SEMESTER

PHG-801

Analytical Pharmacognosy

Cr. Hrs. 3

Introduction and application of ion exchange chromatography, thin layer chromatography, column chromatography, paper chromatography, droplet counter current chromatography, gas chromatography and high pressure liquid chromatography for the separation of bioactive compounds from natural sources.

Books Recommended

1. Chromatography: Fundamentals and Applications of chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
2. Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
3. Identification of Drugs in Pharmaceutical Formulations by Thin Layer Chromatography (2nd ed.), P.D. Sethi, CBS Publishers (1999).
4. Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.), Hildebert Wagner, Sabine Bladt, Springer-Verlag, New York (1996).
5. Thin-Layer Chromatography: A Laboratory Handbook, Egon Stahl, Springer-Verlag (1969).

PHG-803
Advance Pharmacognosy
Cr. Hrs. 3

Study of select topics about biologically and therapeutically active constituents of natural origin, as:

- Screening and evaluation.
- Cleavage of glycoside linkages.
- Isolation of triterpenoidal saponins.
- Isolation of the biologically active principles.
- Detection and isolation of steroidal saponins.
- Pharmacological approaches to natural product.
- Neolignans with potential biological activity.
- Toxic alkaloids and diterpenes from Euphorbiaceae.
- Saponins with biological and pharmacological activity.
- Dimeric natural compounds with pharmacological activity.
- mono-, di- and sequi-terpenes from plants with pharmacological or therapeutic activities.
- Recent experimental and clinical data for antitumor and cytotoxic agents.
- Problems and prospects of discovering new drugs from higher plants.
- Chinese drug constituents.

Books Recommended

1. Williams Textbook of Endocrinology (11th ed.), Henry Kronenberg, Shlomo Melmed, Kenneth Polonsky, Saunders, (2008).
2. Anticancer Agents from Natural Products, Gordon M. Cragg, David G. I. Kingston, David J. Newman, CRC Press (2005).
3. Nutraceuticals; A Guide for Healthcare Professionals (2nded.). Brain Lockwood, Pharmaceutical Press, London (2007).
4. Cosmeceuticals and Active Cosmetics: Drugs versus Cosmetics, Peter Elsner and Howard I. Maibach (Eds.) CRC Press (2005).
5. Plants in Cosmetics: Plants and Plant Preparations used as Ingredients for Cosmetic Products. Anton R., Patri F. Silano V., Council of Europe Publishing (2001).

PHG-805
Biosynthesis of Natural Products
Cr. Hrs. 3

Introduction, mechanism and biosynthesis of amino acids, vitamins, phenolic compounds, tannins, terpenes, alkaloids and steroids.

Books Recommended

1. Biosynthesis of Natural Products, Manitto P., John Wiley & Sons, New York, (1981).
2. Medicinal Natural Products: A Biosynthetic Approach (1st ed.), Paul M Dewick, John Wiley and Sons, Ltd., Chichester (1997).
3. Trease and Evans' Pharmacognosy (16th ed.), William C. Evans, George E. Trease, Daphne Evans, Elsevier (2009).
4. Pharmacognosy (9th ed.), Tyler V.E., Brady E.R. and Robbers J.E. Lea & Febiger, Philadelphia (1988).
5. Advances in Botanical Research: Biosynthesis of Vitamins in Plants A; Vitamin A, B₁, B₂, B₃, B₅ (Vol. 58), Fabrice Rebeille, Roland Douce (Eds.), Academic Press (2011).

PHG-807

Marine Pharmacognosy

Cr. Hrs. 3

Introduction to marine bioactive substances, chemistry of marine natural products such as, isoprenoids, sterols, benzoids, nitrogenous compounds, non-aromatic compounds with unbranched carbon skeletons. Study of marine algae from Karachi sea coast. Screening of marine natural products as drugs.

Books Recommended

1. Marine Pharmacognosy: Trends and Applications (1st ed.), Se-Kwon Kim (Ed.), CRC Press, (2012).
2. Marine Pharmacognosy: Action of Marine Biotoxins at the Cellular Level, Dean Frederick Martin, Elsevier Science (2012).
3. Drugs from the Sea (1st ed.), Nobuhiro Fusetani (Ed.), S. Karger Pub. (2000).
4. Marine Products for Healthcare: Functional and Bioactive Marine Nutraceuticals Series, Vazhiyil Venugopal, CRC Press (2009).
5. Marine Toxins and other Bioactive Marine Metabolites, Yoshiro Hashimoto, Japan Scientific Societies Press (2009).

PHG-809

Ethnopharmacognosy

Cr. Hrs. 3

Introduction, historical development and evaluation of indigenous drugs with special reference to Egypt, Greece, Rome, India, China and Arabic system of medicines. Study of the medical formularly (*Qarabadin*) of Al-Kindi, modern herbal drugs and herbal pharmacopoeias; recent ethnobotanical and ethnopharmacological studies.

Books Recommended

1. Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices, Deepak Acharya, Anshu Shirivastava, Jai Pur, Aavishkar Publisher (2008).
2. Indusynic Medicine, Khan Usmanghani, Aftab Saeed, Tanweer Alam, Department of Pharmacognosy, University of Karachi (1997).
3. Medicinal Plants of the World: Chemical Constituents, Traditional and Modern Medicinal Uses (vol. 1-3), Ivan A. Ross, Humana Press, New Jersey, (2005).
4. Un-Common Plants of Ayurveda, Gyanendra Pandey, Siri Satguru Publications, Delhi (1994).
5. The Complete Natural Medicine Guide to the 50 Most Common Medicinal Herbs (2nd ed.), Heather Boon, Michael Smith, The Institute of Naturopathic Education and Research (2004).

PHG-811

Advances in Natural Toxicants

Cr. Hrs. 3

Overview of natural toxicants. Study of simple phytotoxins, pyrrolizine and indolizidine alkaloids toxicity, plant teratogens, plant irritant, plant-induced cardiac and pulmonary diseases, treatment and prevention of plant toxicosis.

Books Recommended

1. Herbal Products, Toxicology and Clinical Pharmacology, Timothy S. Tracy, Richard L. Kingston (Eds.), 2nd ed., Humana Press, Totowa (2007).
2. Poisonous Plants of Pakistan, S. H. Abid Askari, Oxford University Press, 2010.
3. Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2004).
4. Poisonous Plants and Related Toxins, Thomas Acamovic, Colin S. Stewart, T. W. Pennycott, CABI (2003).
5. Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2004).

PHG-813

Phytopharmaceutical Analysis

Cr. Hrs. 3

1. Experiments based on Titrimetry, Gravimetry, UV-Vis, FT- IR, HPLC & GC.
2. Interpretation of UV & IR Spectra of some herbal drugs.
3. ELISA Test / LAL Test.
4. Estimation of drugs in biological fluids.
5. Validation of analytical methods.

Books Recommended

1. HPLC Methods for Recently Approved Pharmaceuticals, George Lunn, Wiley Interscience, New Jersey (2005).
2. Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler, Timothy A. Nieman, 5th ed., Saunders College Publishing, Philadelphia (1998).
3. Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
4. Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
5. Identification of Drugs in Pharmaceutical Formulations by Thin Layer Chromatography (2nd ed.), P.D. Sethi, CBS Publishers (1999).

M. Pharm. SECOND SEMESTER

PHG-802 Spectroscopy of Natural Products Cr. Hrs. 3

Application of modern spectroscopic techniques such as infra-red spectroscopy, ultra-violet spectroscopy, nuclear magnetic resonance spectroscopy and mass spectrometry for the characterization of natural products.

Books Recommended

1. Mass Spectrometry: Instrumentation, Interpretation and Applications, Rolf Ekman, Jerzy Silberring, Ann Westman-Brinkmalam, Agnieszka Kraj (Eds.), Wiley Interscience, New Jersey (2009).
2. Encyclopedia of Spectroscopy & Spectrometry, volume 1. John C. Lindon, Georg E. Tranter, John L. Holmes, John L. Alan, Elsevier Science (2000).
3. Infrared Spectroscopy: Fundamentals and Applications, Barbara H. Stuart, John Wiley & Sons Ltd., (2004).
4. NMR Spectroscopy in Pharmaceutical Analysis, Iwona Wawer, Ulrike Holzgrabe, Bernd Diehl, Elsevier Publisher (2008).
5. Pharmaceutical Analysis, David Lee, Michael Webb, BlackWell Publishing Ltd. (2003).

PHG-804
Seminar in Pharmacognosy
Cr. Hrs. 3

Seminars on topics based on current researches and developments in instrumentation, biosynthesis, structure elucidation and pharmacological activity of natural products followed by discussion from faculty and students.

Books Recommended

1. Presentation Basics, Robert J. Rosania, ASTD (2003).
2. The Presentation Skills Workshop: Helping People Create and Deliver Great Presentations, Sherron Bienvenu, AMACON (2000).
3. How to Run Seminar and Workshops: Presentation Skills for Consultants, Trainers and Teachers, Robert L. Jolles, John Wiley and Sons (2000).
4. Successful Presentation Skills, Andrew Bradbury, Kogan Page (2000).
5. Presentation Skill in 7 Simple Steps, James Schofield, Harper Collins Publishers Ltd. (2014).

PHG-806
Chemotaxonomy
Cr. Hrs. 3

Systematic classification of plants based on the distributional correlations of certain well defined secondary plant metabolites such as flavanoids, terpenes, steroids, glycosides, and alkaloids.

Books Recommended

1. Chemotaxonomy and Serotaxonomy: Proceedings of a Symposium Held at the Botany Department, Birmingham University, 15-16 September, 1967, Volume 1967, John Gregory Hawkes, Academic Press (1968).
2. The Chemotaxonomy of Plants, Philip M. Smith, Edward Arnold (1976).
3. Chemotaxonomy, Terrance James Victorino, Betascript Publishing (2011).
4. Chemotaxonomic Authentication of Problematic Medicinal Plants, Mushtaq Ahmed, Mir Ajab, Muhammad Zafar, LAP Lambert Academy Publications (2010).
5. Chemical Biomarkers in Aquatic Ecosystem, Thomas S. Bianchi, Elizabeth A Canuel, Princeton University Press (2011).

PHG-808
Fungal Metabolites
Cr. Hrs. 3

Introduction to fungi, their cultivation, primary and secondary metabolism. Fungal secondary metabolites derived without the intervention of acetate; from amino acids, fatty acids, polyketides, terpenes and steroids; secondary metabolites derived from tricarboxylic acid intermediates; miscellaneous secondary metabolites.

Books Recommended

1. Handbook of Secondary Fungal Metabolites (Vol.1-3) Richard Cole, Milbra Schweikert, Bruce B Jarvis, Academic Press (2003)
2. Fungal Secondary Metabolism: Methods and Protocols (Methods in Molecular Biology) Nancy P. Keller , Geoffrey Turner (Ed.), Humana Press (2013)
3. The Chemistry of Fungi, James R. Hanson, Cambridge, UK, RSC Publishing (2008).
4. Fungal Bio-Molecules: Sources, Applications and Recent Developmentd, Vijay K. Gupta, S. Sreenivsaprasad, Robert Ludwig Mach, John Wiley and Sons (2015).
5. Chemistry of Fungi, James R. Hanson, Royal Society of Chemistry (2008).

PHG-810

Structure Elucidation of Natural Products

Cr. Hrs. 3

Study methods of isolation, characterization, identification and biosynthesis of biologically active or potentially active natural products from the recent literature. Structure elucidation of natural products by integrating data obtained from spectroscopic and chemical techniques.

Books Recommended

1. Mass Spectrometry: Instrumentation, Interpretation and Applications, Rolf Ekman, Jerzy Silberring, Ann Westman-Brinkmalam, Agnieszka Kra (Eds.), Wiely Interscience, New Jersey (2009).
2. Encyclopedia of Spectroscopy and Spectrometry (vol. 1), John C. Lindon, Georg E. Tranter, John L. Holmes, John L. Aaa, Elsevier Science (2000).
3. Infrared Spectroscopy: Fundamentals and Applications, Barbara H. Stuart, John Wiley and Sons Ltd. (2004).
4. NMR Spectroscopy in Pharmaceutical Analysis, Iwona Wawer, Ulrike Holzgrabe, Bernd Diehl, Elsevier Publisher (2008).
5. Pharmaceutical Analysis, David Lee, Michael Webb, BlackWell Publishing Ltd. (2003).

PHG-812

Cell Biotechnology

Cr. Hrs. 3

Study plant cell culture techniques for higher yield of secondary metabolites that are used as drugs. Elucidation and regulation of biosynthetic pathways in cell cultures of plants having scientific and economic value.

Books Recommended

1. Pharmacognosy and Pharmacobiotechnology,Asutosh Kar,New Age International Publishers (2003).

2. Biotechnology (1st ed.), David P. Clark, Nanette J Pazdernik, Academic Press (2012).
3. Biotechnology: Theory and Techniques (vol.1, 1st ed.), Jack G Chirikjian, http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&field-author=Chirikjian&search-alias=books&sort=relevancerank Jones and Bartlett Publishers (1995).
4. Molecular Biotechnology: Principles and Practices, Channarayappa, Tylor and Francis (2007).
5. Plant Cell and Tissue Culture-A tool in Biotechnology Basics and Application, Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, Springer (2009).

PHG-814

Industrial Pharmacognosy Lab

Cr. Hrs. 3

1. Evaluation and standardization of a given herbal drug by physical, chemical and biological methods.
2. Isolation of total oleo-resin from *Zingiber officinale*.
3. Isolation of pectin from *Citrus paradisi*.
4. Isolation of papain from *Carica papaya*.
5. Isolation of glycyrrhizin from *Glycyrrhiza glabra*.
6. Isolation and estimation of total phenolics.
7. Isolation of Eugenol from *Eugenia caryophyllus*.
8. Isolation of sennosides from *Cassia senna* leaves.
9. Extraction of volatile oil and its formulation into perfume.
10. Isolation of Lycopene from *Solanum lycopersicum*.
11. Isolation of Glucosamine from crab shells.

Books Recommended

1. Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
2. Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
3. Identification of Drugs in Pharmaceutical Formulations by Thin Layer chromatography (2nd ed.), P.D. Sethi, CBS Publishers (1999).
4. Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.), Hildebert Wagner, SabineBladt, Springer-Verlag, New York (1996).
5. Thin-Layer Chromatography: A Laboratory Handbook, Egon Stahl, Springer-Verlag (1969).

PHG-816
Phytomedicine
Cr. Hrs. 3

1. Selection, authentication, herbarium preparation, macroscopy, microscopy and powder drug study of official herbal drugs.
2. Estimation of following phytopharmaceuticals:
 - a. Total triterpene acids in *Boswellia serrata*.
 - b. Total phenolic acids as benzoic acid from Benzoin.
 - c. Total tropane alkaloids from tinctures of *Datura stramonium* and *Hyoscyamus niger*.
 - d. Estimation of andrographolide from *Andrographis paniculata*.
 - e. Column chromatographic isolation of psoralen from *Psolarea corylifolia* seed extracts.
3. Study of UV and visible spectral data of some natural products.
4. Study of IR spectra of some natural products.
5. Preparation of traditional drug formulations mentioned in the Advance Pharmacognosy theory and their standardization.

Books Recommended

1. Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
2. Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
3. Identification of Drugs in Pharmaceutical Formulations by Thin Layer chromatography (2nd ed.), P.D. Sethi, CBS Publishers (1999).
4. Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.), Hildebert Wagner, SabineBladt, Springer-Verlag, New York (1996).
5. Thin-Layer Chromatography: A Laboratory Handbook, Egon Stahl, Springer-Verlag (1969).

ADMISSION REQUIREMENT AND PROCEDURE FOR
M.Phil. / M.S.

Eligibility Criteria

At least sixteen years of studies (Masters degree, M.A., M.Sc., M.B.A., M.P.A., B.B.A.(4 years), M.A.S., M.L.I.S., M. Com., B.S.(4 years), B.E. in Chemical Engineering, B. Pharm., Pharm. D., M.B.B.S., B.D.S., D.V.M.) or equivalent qualification with at least second division in the relevant field from an HEC recognized university/institution. However, candidates with M.B.B.S., B.D.S., D.V.M. or equivalent qualification will be required to undertake 15-credit hour courses (300-600 level), in addition to 24-credit hour courses prescribed for M.Phil. program to be decided by the DRC and 30 credit hour courses for M.S. program. There is no requirement to submit Equivalence certificate for the graduates of Public Sector Universities.

Note: 6 credit hours of research work are mandatory for M.Phil. Those candidates who have done M.S. (with course work) are not eligible for admission in Ph.D.

One M.Phil. seat is especially allocated for the special person from each department/Centre/Institute.

The admission on special persons' reserved seats is granted only after the medical examination and verification from the Social Welfare Department, Government of Sindh and / or civil surgeon.

Admission Procedure

1. All candidates will be required to submit the following documents along with the **ONLINE Entrance Test Application**

Form: <http://eduboard.uok.edu.pk/AdmissionPortal/SignIn>

- i. Consolidated transcript/marks certificate of the last degree examination.
- ii. Matric / O levels Certificate
- iii. Computerized National Identity Card.
- iv. Recent photographs.

2. Appearance in Karachi University Entrance Test 2022 (KUET-2022) is mandatory for all applicants who wish to seek admission in M.Phil./M.S. program to be conducted by relevant departments/centers/institutes of the University of Karachi.

3. a) The test shall comprise of the following sections:

Section-I Subject knowledge	80%
Section-II English and Communication Skills	20%

b) Candidates will be required to score at least 50% marks in each section to be eligible for consideration for the *provisional admission*.

c) If a candidate has already qualified the International (subject) GRE/GAT/NTS, he/she will be exempted from subject test component of KUET 2022. The validity of International (subject) GRE is 5 years and NTS/GAT is for two years. The passing score of GRE minimum is 50% and that of NTS/GAT is 70%. However, the candidate has to appear in Karachi University Entrance Test 2022 (KUET-2022) English test moreover, interview will be mandatory

Note: Qualifying the Karachi University Entrance Test is no guarantee for admission.

4. All the students who qualify the Karachi University Entrance Test will be required to appear in person for an interview to be conducted by the respective Departmental Research Committee (DRC) to finalize the admission procedure. Distribution of interview marks are given in **Annexure-II**.

M.Phil Courses
M. Phil. / MS.
FIRST SEMESTER

PHG-821
Biostatistics
Cr. Hrs. 3

1. Introduction

Biostatistics, application of statistics in biological and pharmaceutical sciences. Types of biological data.

2. Samples and population

Simple random sampling, sample distribution and standard error, stratified random sampling, systematic and cluster sampling.

3. Test of hypothesis and significance

Statistical hypothesis, level of significance, test of significance, confidence interval, test involving binomial and normal distribution.

4. Goodness-of-fit test

Chi-square distribution, its properties and application, contingency tables. Yate's correction for continuity, Test of homogeneity.

5. "Student" t- and F-distribution

Properties of t-distribution and F-distribution; test of significance based on t-distribution and F-distribution.

6. Analysis of variance

One-way classification; partitioning of sum of squares and degree of freedom; two-way classification, multiple comparison test; the analysis of variance models.

7. Experimental designs

Basic principle of experimental designs, completely randomized design; randomized complete block design and Latin-square design.

Books Recommended

1. Bio-Statistic: A Foundation for Analysis in the Health Sciences (4th ed.), Wayne. W. Daniel, Wiley Global Education (2012).
2. Introduction to Statistics (3rd ed.), Ronald E. Walpole, Prentice Hall International (1997).
3. Biostatistics: A Methodology for Health Sciences, Gerald van Belle, Lloyd D. Fischer, Patrick J. Heagerty, Thomas Lumely, John Wiley and Sons (2004).
4. Basic Biostatistics: Statistics for Public Health Practice (2nd ed.), B. Burt Gerstman, Jones and Bartlett Learning (2015).

5. Introduction to Biostatistics and Research Methods, P.S.S. Sunder Rao, J. Richard, PHI Learning Pvt. Ltd. (2012).

PHG-823

Advances in Spectroscopic Techniques

Cr. Hrs. 3

Application of major spectroscopic techniques such as infra-red spectroscopy, ultra-violet spectroscopy, optical rotatory dispersion, circular dichroism, nuclear magnetic resonance spectroscopy (DEPT, COSY-45, J-Resolve, NOESY, Hetero-COSY, NOE), and mass spectrometry (EI, CI, FD, FAB and GC-MS) for the characterization of natural products.

Books Recommended

1. Mass Spectrometry: Instrumentation, Interpretation and Applications, Rolf Ekman, Jerzy Silberring, Ann Westman-Brinkmalm, Agnieszka Kra (Eds.), Wiley Interscience, New Jersey (2009).
2. Encyclopedia of Spectroscopy and Spectrometry (vol. 1), John C. Lindon, Georg E. Tranter, John L. Holmes, John L. Aaa, Elsevier Science (2000).
3. Infrared Spectroscopy: Fundamentals and Applications, Barbara H. Stuart, John Wiley and Sons Ltd. (2004).
4. NMR Spectroscopy in Pharmaceutical Analysis, Iwona Wawer, Ulrike Holzgrabe, Bernd Diehl, Elsevier Publisher (2008).
5. Pharmaceutical Analysis, David Lee, Michael Webb, BlackWell Publishing Ltd. (2003).

PHG-825

Analytical Pharmacognosy

Cr. Hrs. 3

Introduction and application of ion exchange chromatography, thin layer chromatography, column chromatography, droplet counter current chromatography, gas chromatography, high pressure liquid chromatography, gel chromatography and gel electrophoresis for the separation of bioactive compounds from natural sources. Quantitative determination of active compounds in plant extracts.

Books Recommended

1. Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
2. Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
3. Identification of Drugs in Pharmaceutical Formulations by Thin Layer chromatography (2nd ed.), P.D. Sethi, CBS Publishers (1999).

4. Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.), Hildebert Wagner, Sabine Bladt, Springer-Verlag, New York (1996).
5. Thin-Layer Chromatography: A Laboratory Handbook, Egon Stahl, Springer-Verlag (1969).

PHG-827

Advances in Pharmacognosy

Cr. Hrs. 3

Study of selected topics about biologically and therapeutically active constituents of natural origin as:

1. Screening and evaluation.
2. Cleavage of glycoside linkages.
3. Isolation of triterpenoidal saponins.
4. Isolation of the biologically active principles.
5. Detection and isolation of steroidal saponins.
6. Pharmacological approaches to natural product.
7. Neolignans with potential biological activity.
8. Triterpenoidal saponins, steroidal saponins, alkaloids and diterpenes from Euphorbiaceae.
9. Saponins with biological and pharmacological activity.
10. Dimeric natural compounds with pharmacological activity.
11. mono-, di- and sesqui-terpenes from plants with pharmacological or therapeutical activity.
12. Recent experimental and clinical data for antitumor and cytotoxic agents.
13. Problems and prospects of discovering new drugs from higher plants.

Books Recommended

1. Williams Textbook of Endocrinology (11th ed.), Henry Kronenberg, Robert Hardin Williams, Saunder/Elsevier (2008).
2. Anticancer Agents from Natural Products, Gordon M. Cragg, David G. I. Kingston, David J. Newman, CRC Press (2005).
3. Nutraceuticals; A Guide for Healthcare Professionals (2nd ed.), Brian Lockwood, Pharmaceutical Press London (2007).
4. Cosmeceuticals and Active Cosmetics: Drugs versus Cosmetics Peter Elsner, Howard I. Maibach (Eds.), CRC Press (2005).
5. Plants in Cosmetics: Plants and Plant Preparations used as Ingredients for Cosmetic Products. Anton R., Patri F., Silan V., Council of Europe Publishing (2001).

PHG-829
Cell Biotechnology
Cr. Hrs. 3

Study plant cell culture techniques for higher yield of secondary metabolites that are used as drugs. Elucidation and regulation of biosynthetic pathways in cell cultures of plants having scientific as well as economic value.

Books Recommended

1. Pharmacognosy and Pharmacobiotechnology, Asutosh Kar, New Age International Publishers (2003).
2. Biotechnology (1st ed.), David P. Clark, Nanette J Pazdernik, Academic Press (2012).
3. Biotechnology: Theory and Techniques (vol.1, 1st ed.), Jack G Chirikjian, Jones and Bartlett Publishers (1995).
4. Molecular Biotechnology: Principles and Practices, Channarayappa, Tylor and Francis (2007).
5. Plant Cell and Tissue Culture-A tool in Biotechnology Basics and Application, Karl-Hermann Neumann, Ashwani Kumar, Jafargholi Imani, Springer (2009).

PHG-831
Biosynthesis of Natural Products
Cr. Hrs. 3

Introduction, mechanism and biosynthetic pathway of amino acids, vitamins, phenolic compounds, terpenes, steroids, alkaloids and glycosides.

Books Recommended

1. Biosynthesis of Natural Products, Manitto P., John Wiley & Sons, New York, (1981).
2. Medicinal Natural Products: A Biosynthetic Approach (1st ed.), Paul M Dewick, John Wiley and Sons, Ltd., Chichester (1997).
3. Trease and Evans' Pharmacognosy (16th ed.), William C. Evans, George E. Trease, Daphne Evans, Elsevier (2009).
4. Pharmacognosy (9th ed.), Tyler V.E., Brady E.R. and Robbers J.E. Lea & Febiger, Philadelphia (1988).
5. Advances in Botanical Research: Biosynthesis of Vitamins in Plants A; Vitamin A, B₁, B₂, B₃, B₅ (Vol. 58), Fabrice Rebeille, Roland Douce (Eds.), Academic Press (2011).

PHG-833
Basics of Research Methodology
Cr. Hrs. 3

1. **Foundation:** Introduction to Research and the Research Process, Research Ethics and Integrity, Critical appraisal.

2. **Quantitative Research:** Introduction to Quantitative Research, Study Designs and Methods, Analysis and Interpretation of Quantitative Data, data analysis and presentation, Critical Appraisal of Quantitative Research
3. **Qualitative Research:** Introduction to Qualitative Research, Study Designs and Methods, data analysis and presentation, Analysis and Interpretation of Qualitative Data, Critical Appraisal of Qualitative Research
4. **Mixed Methods Research:** Introduction to Mixed Methods Research, Study Designs and Methods, Analysis and Interpretation of Mixed Methods Data, Critical Appraisal of Mixed Methods Research
5. **Conceptualising and conducting a research proposal:** scope of the research process, beginning with literature review, postulating novel and important research questions and preparing a research proposal.

Books Recommended

- Conducting Research Literature Reviews: From the Internet to Paper (3rd ed.) Arlene Fink., Sage Publications (2010).
- Engaging Inquiry: Research and Writing in the Disciplines, Judy Kirscht, Mark Schlenz, Prentice Hall (2001).
- Practical Research Methods: A Process of Inquiry (6th ed.), Anthony M. Graziano, Michael L. Raulin, Allyn and Bacon (2006).
- Practical Research: Pearson New International Edition: Planning and Design, Paul D. Leedy, Jeanne E. Ormrod, Pearson Education Ltd. (2013).
- Mixed Methods in Health Sciences Research: A Practical Primer (vol. 1), Leslie Curry, Marcella Nunez-Smith, SAGE Publications (2014).
- Creswell, J. W. *Research design: Qualitative, quantitative and mixed methods approaches*. 5th Ed. Thousand Oaks, CA: Sage (2018).

PHG-835

Pharmacoeconomics

Cr. Hr. 03

1. Introduction to Pharmacoeconomics

- Introduction and overview
- Type of Pharmacoeconomics studies
- Scope of Pharmacoeconomics
- Importance of perspective in Pharmacoeconomics
- Relationship of Pharmacoeconomics to other research disciplines

2. Differences between Pharmacoeconomics and Health Economics

- Pharmacoeconomics and health economics

- Introduction and scope of health economics
- Pharmacoeconomics as a subdivision of health economics

3. Perspectives in Pharmacoeconomics

4. Pharmacoeconomic Analysis

- Cost of illness
- Cost-minimization analysis
- Cost-effectiveness analysis
- Cost-utility analysis
- Budget-impact analysis
- Decision-analysis
- Retrospective database and sensitivity analyses

5. Introduction to Pharmacoeconomics

- Introduction and overview
- Type of Pharmacoeconomics studies
- Scope of Pharmacoeconomics
- Importance of perspective in Pharmacoeconomics
- Relationship of Pharmacoeconomics to other research disciplines

6. Differences between Pharmacoeconomics and Health Economics

- Pharmacoeconomics and health economics
- Introduction and scope of health economics
- Pharmacoeconomics as a subdivision of health economics

7. Perspectives in Pharmacoeconomics

8. Pharmacoeconomic Analysis

- Cost of illness
- Cost-minimization analysis
- Cost-effectiveness analysis
- Cost-utility analysis
- Budget-impact analysis
- Decision-analysis
- Retrospective database and sensitivity analyses

Books Recommended

1. Pharmacoeconomic from Theory to Practice, Renee J. G. Arnold, CRC Press, 2021, ISBN: 9780367521363.
2. The Art of Pharmacoeconomics, A Guide to Getting Started, Rola KaaKeh, Salus Vitae Group LLC, 2021, ISBN: 978-1736838600.
3. Pharmacoeconomics Principles and Best Practices: A Practical Guide, Francisco Nuno Rocha Goncalves, Laszlo Gulacsi, Nada Abu-Shraie, Innovative Healthcare Institute, 2020, ISBN: 0578793962.

4. Pharmacoeconomics: Principle and Practice, Lorenzo Pradelli, Albert Wertheimer, Seed Medical Publisher, 2013, ISBN-10: 8897419372.
5. Pharmacoepidemiology and Pharmacoeconomics: Concepts and Practice, K.G. Revikumar, Pharma Med Press, 2016. ISBN-10: 9352301323.

**M. Phil. / MS.
SECOND SEMESTER**

PHG-822

Computer Application in Pharmacy

Cr. Hrs. 3

1. Fundamentals

Basic concepts of computer, disk, disk operating systems and programming.

2. Use of computer in research

Literature survey and use of information services via computer. Preliminary introduction to some packages: PC tools, Norton Utilities, any one of the popular word processor, data base, and spread sheet packages, Energraphics and SPSS Statistical package. Research paper and dissertation composing by computer.

3. Use of computer in hospital pharmacy

Computerization of different hospital systems as, management, finance, patient history and profiles, drug utilization reports. Drug information systems of diagnostics, interactions and poison control. Computerization of drug distribution system in central Pharmacy and satellite pharmacies, drug inventory control, inpatient registration and management of nursing floors and surgical rooms. Patient information distribution among medical professionals. Prescription evaluation, costing, transmission of necessary information for patient and record keeping. Drug/plasma level monitoring, dose calculations.

4. Use of computer in pharmaceutical industry

Use of computers in production planning, budgeting, scheduling, accounts, batch-wise cost accounting; managing production and packaging; raw material and packing material stores via computer. Quality assurance assessments, quality control charts, computation of shelf life and bioequivalence studies. Personnel management, sales and distribution control and evaluation.

Books Recommended

1. Peter Norton's New Inside the PC, Peter Norton, Scott H. Clark, Sams Publishing (2002).
2. System Analysis and Design, Alan Dennis, Barbara Haley Wixom, Roberta M Roth, John Wiley and Sons (2008).
3. Understanding and using MS-DOS/PC-DOS (2nd ed.), Cody T. Copeland, Jonathan Bacon, West Publisher Co. (1990).

4. Doing Data Analysis With SPSS version 18.0, Robert H Carver, Jane Gradwohl Nash, Brooks/Cole Cengage Learning (2012).
5. Information Technology in Pharmacy: An Integrated Approach (vol.2), Stephen Goundrey-Smith, Springer Science and Buiseness Media (2012).

PGH-824

Structure Elucidation of Natural Products

Cr. Hrs. 3

Application of spectroscopic and chemical techniques to elucidate the structure of natural products with particular reference to alkaloids, steroids, saponins, flavonoids and terpenes.

Books Recommended

1. Mass Spectrometry: Instrumentation, Interpretation and Applications, Rolf Ekman, Jerzy Silberring, Ann Westman-Brinkmalam, Agnieszka Kra (Eds.), Wiely Interscience, New Jersey (2009).
2. Encyclopedia of Spectroscopy and Spectrometry (vol. 1), John C. Lindon, Georg E. Tranter, John L. Holmes, John L. Aaa,Elsevier Science (2000).
3. Infrared Spectroscopy: Fundamentals and Applications, Barbara H. Stuart, John Wiley and Sons Ltd. (2004).
4. NMR Spectroscopy in Pharmaceutical Analysis, Iwona Wawer, Ulrike Holzgrabe, Bernd Diehl, Elsevier Publisher (2008).
5. Pharmaceutical Analysis, David Lee, Michael Webb, BlackWell Publishing Ltd. (2003).

PHG-826

Natural Toxicants

Cr. Hrs. 3

Overview of natural toxicants. Study of simple phytotoxins, pyrrolizine and indolizidine alkaloids toxicity, plant teratogens, plant irritant, plant-induced cardiac and pulmonary diseases, treatment and prevention of plant toxicosis.

Books Recommended

1. Herbal Products, Toxicology and Clinical Pharmacology, Timothy S. Tracy, Richard L. Kingston (Eds.), 2nd ed., Humana Press, Totowa (2007).
2. Poisonous Plants of Pakistan, S. H. Abid Askari, Oxford University Press, 2010.
3. Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2004).
4. Poisonous Plants and Related Toxins, Thomas Acamovic, Colin S. Stewart, T. W. Pennycott, CABI (2003).
5. Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2004).

PHG-828

Advance Phytopharmaceutical Analysis

Cr. Hrs. 3

1. Separation Techniques

Theory, instrumentation, applications of GLC, HPLC, HPTLC, Chiral chromatography, Ion Pair chromatography and Capillary electrophoresis.

2. Spectroscopic Methods

Introduction, application and structure elucidation using UV, IR, NMR and Mass Spectroscopy with examples.

3. Thermal Analysis

Theory, instrumentation and applications of thermo-gravimetric analysis, differential thermal analysis, differential scanning, colorimetry.

4. Immunochemical Techniques

Immuno-electrophoresis, immuno-precipitation, ELISA, Radio- Immunoassays.

5. Quality Assurance Techniques

Introduction, validation of equipments and processes of herbal product manufacturing etc.

Books Recommended

1. Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
2. Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
3. Identification of Drugs in Pharmaceutical Formulations by Thin Layer chromatography (2nd ed.), P.D. Sethi, CBS Publishers (1999).
4. Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.), Hildebert Wagner, SabineBladt, Springer-Verlag, New York (1996).
5. Thin-Layer Chromatography: A Laboratory Handbook, Egon Stahl, Springer-Verlag (1969).

PHG-830

Industrial Pharmacognosy

Cr. Hrs. 3

Herbal drug industry

1. Herbal drug regulatory affairs.
2. Information retrieval systems of herbal drugs.
3. Literature survey, dosage form and drug design of the following:

- a. Immunomodulators: *Withania somnifera*, *Centella asiatica*, *Embelica officinalis*, *Ocimum sanctum*.
 - b. Antipeptic ulcer: *Glycyrrhiza glabra*, *Zingiber officinale*, *Solanum tuberosum*, *Atropa belladonna*.
 - c. Hepatoprotectives: *Silybum marianum*, *Phyllanthus indica*, *Picrorrhiza kurroa*, *Andrographis paniculata*.
 - d. Anticancer: *Taxus* species, *Camptotheca acuminata*, *Catharanthus roseus*.
 - e. Antifertility: *Embelica ribes*, *Azadirachta indica*, *Gossypium* species.
 - f. Nervine Tonic: *Centella asiatica*, *Acorus calamus*, *Valeriana wallichii*, *Valeriana jatamensis*
 - g. Anti-AIDS: *Areca catechu*, *Thea sinensis*, *Ricinu communis*.
4. Volatile oils and their commercial significance.
 5. Review of natural sweeteners, dyes, pigments and preservatives.

Books Recommended

1. Textbook of Industrial Pharmacognosy, A. N. Kalia, CBS Publishers, (2009).
2. Herbal Drugs Industry: A Practical Approach to Industrial Pharmacognosy, Ram Dev Chaudry, Eastern Publishers, (1996)
3. History of Pharmacy and Pharmaceutical Industry, Patrice Bousset, Henri Bonnemaine, Frank James Bové, Asklepios Press (1983).

PHG-832

Phytomedicine

Cr. Hrs. 3

1. Cultivation and post harvest technology

Cultivation and post harvest technology of *Papaver somniferum*, *Solanum nigrum*, *Withania somniferum*, *Cassia angustifolia*.

1. Isolation and estimation

Isolation and estimation of clove oil, atropine, curcumin, vinca alkaloids, quinidine, taxol, emetine, sennoside, glycyrrhizin, starch, microcrystalline cellulose.

2. Structural elucidation

Structural elucidation of citral, nicotine, atropine, amygdaline, caffeine, morphine.

3. Chemotaxonomy

Flavonoids and terpenoids.

4. Marine natural products

6. Effects of pests on phytomedicine

Books Recommended

1. Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).

- Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
- The Chemotaxonomy of Plants, Philip M. Smith, Edward Arnold, (1976).
- Marine Pharmacognosy: Trends and Applications (1st ed.), Se-Kwon Kim (Ed.) CRC Press; (2012).
- Spectroscopy of Organic Compounds (6th ed.), P.S. Kalsi, New Age Publisers (2004).

PHG-834

Standardization of Phytomedicine

Cr. Hrs. 3

1. Plant Extracts

Preparation and standardization of the extracts of *Tinospora cordifolia*, *Curcuma longa*, *Solanum xanthocarpum*, *Ocimum sanctum*, *Adhatoda vasica*, *Embllica officinalis*, *Centella asiatica*, *Melia azadirachta*, *Withania somnifera*.

2. Traditional drug formulations

Ayurveda, Homoeopathy, Unani and Aromatherapy.

3. Herbal drug formulations

Cosmeceuticals: skin and hair care products.

4. Agroproducts of economic importance

Corn oil, soybean, spirulina, pectin, papain.

5. Standardization of Phytopharmaceuticals by HPTLC technique

Bacoside, andrographolide, solasodine, glycyrrhetic acid, vasicine, sennosides.

6. Standardization of Phytopharmaceutical by HPLC technique

Amarogentin, asiaticoside, cordifolioside, lupeol, solasodine, vasicine.

Books Recommended

- Chromatography: Fundamentals and Applications of Chromatographic and Electrophoretic Methods. Part A, Fundamentals and Techniques, E. Heftmann, Elsevier Scientific Publishing Company, Amsterdam (1983).
- Clarke's Isolation and Identification of Drugs, Moffat A. C., Pharmaceutical Press, London (1975).
- Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Pulok K. Mukherjee Business Horizons (2002).
- Herbal Drugs and Phytopharmaceuticals, Norman G. Bisset (Ed.) Medphram Scientific Publishers, Stuttgart (1994).
- Herbal Drugs and Finger Prints: Evidence Based herbal Drugs, Devi Datt Joshi, Springer (2012).

**Ph. D.
FIRST SEMESTER**

**PHG – 901
Research Methodology
Cr. Hrs. 3**

1. **Research objective**
2. **Selection of the area of research**
Medical, pharmaceutical sciences, basic health sciences, applied sciences, social sciences, literature.
3. **Selection of research guide/supervisor**
4. **Selection of topic / problem**
Construction of a strong statement that summarizes the selected topic.
Summarize key points on which research would be carried out and make it a part of work plan.
5. **Sources of information**
Books, journals/periodicals, old testimonials, newspapers, internet, proceedings of conferences, seminars, workshops, training programs and conversations.
6. **Detail of equipment / fields / area**
Type of Instruments: Their models, make and country of origin; Validation: reliability and accuracy; Service centers: availability of supplies and engineers; Environment: laboratory conditions.
7. **Plan of work**
 - a. Collection of material/authentication
 - b. Preliminary screening/pilot plan
 - c. Experimental: detailed procedure, recording of observations, calculations, results, conclusion.
8. **Places for practical work and resources**
Identifying a place where research work would be conducted, sources of information and experimental work.
9. **Result compilation**
Selection of results: What kind of results can be submitted? Where to submit? How to submit?
How non-significant results can be submitted? Who will benefit from this research? Prospects of implementing research work.

Books Recommended

1. Conducting Research Literature Reviews: From the Internet to Paper (3rd ed.) Arlene Fink., Sage Publications (2010).
2. Engaging Inquiry: Research and Writing in the Disciplines, Judy Kirscht, Mark Schlenz, Prentice Hall (2001).
3. Practical Research Methods: A Process of Inquiry (6th ed.), Anthony M. Graziano, Michael L. Raulin, Allyn & Bacon (2006).
4. Practical Research: Pearson New International Edition: Planning and Design, Paul D. Leedy, Jeanne E. Ormrod, Pearson Education Ltd., (2013).
5. Mixed Methods in Health Sciences Research: A Practical Primer (Vol. 1), Leslie Curry, Marcella Nunez-Smith, SAGE Publications (2014).

PHG – 903

Attending Seminars / Conferences/ Workshops / Research Publications / Project Proposal for Funding
Cr. Hrs. 6

This course is based on academic activities of the Ph.D. scholar, including participation or presenting papers in any three seminars / conferences/ symposiums/ workshops (national or international)/ publishing articles in BASR/HEC/ISI Index journals or writing a project proposal for funding to national or international sponsoring agencies. (The concerned research supervisor shall award the grades to the scholar).

PHG-905

Marine Resources and Their Applications
Cr. Hrs. 3

1. Introduction to marine resources
2. Marine habitat as source for pharmaceuticals
3. Marine derived nutraceuticals
4. Marine cosmeceuticals
5. Marine toxins
6. Marine biotechnology

Recommended Books

1. Marine Pharmacognosy: Trends and Applications (1st ed.), Se-Kwon Kim (Ed.), CRC Press, (2012).
2. Marine Pharmacognosy: Action of Marine Biotoxins at the Cellular Level, Dean Frederick Martin, Elsevier Science (2012).
3. Drugs from the Sea (1st ed.), Nobuhiro Fusetani (Ed.), S. Karger Pub. (2000).
4. Marine Products for Healthcare: Functional and Bioactive Marine Nutraceuticals Series, Vazhiyil Venugopal, CRC Press (2009).
5. Marine Toxins and other Bioactive Marine Metabolites, Yoshiro Hashimoto, Japan Scientific Societies Press (2009).

PHG-907

Ethnopharmacognosy and Drug Discovery

Cr. Hrs. 3

1. Introduction to ethnopharmacognosy, scope of the subject area covered under ethnopharmacognosy, principles and practices utilized in ethnopharmacognosy research.
2. Ethnopharmacognosy: A base for new drug development.
3. Contemporary issues, diverse perspectives, ethical, commercial, and legal issues related to the ownership of indigenous knowledge, intellectual property, regulation of organisms, biopiracy, and genetic resources. Intellectual property rights regarding traditional use of medicinal plants.
4. Importance of botanical medicines in the public health programs and medical practices of developing countries and indigenous cultures.
5. Literature, databases, and other informational resources related to the study and practice of ethnopharmacognosy.
6. Bioactive molecules in medicinal plants: A perspective on their therapeutic action.
7. Evolutionary relationship among plants and humans.
8. Biological and chemical assays available during drug discovery and development ability assessment.

Books Recommended

1. Innovative Approaches in drug Discovery, 1st Edition, Ethnopharmacology, system Biology and Holistic Targeting, Authors; Bushan Patwardhan, Rathnam Chaguturu, ISBN: 9780128018149, Academic Press 2017
2. Textbook of Drug Design and Discovery, Kristian Stromgaard, Povl Krogsgaard- Larsen, Ulf Madsen (Eds.), CRC Press, 5th ed., 2016
3. Ethnopharmacology, Michael Heinrich, Anna K. Jäger (Eds.) John Wiley & Sons, 2015.
4. Therapeutic Medicinal Plants From Lab to the Market, Edited by; Marta C.T. Duarte Mahendra Rai, CRC press –2015
5. Drugs of Natural Origin a Treatise of Pharmacognosy, Seventh Edition, Gunnar Samuelsson Lars Bohlin Swedish Pharmaceutical Press - 2015
6. Plant Bioactives and Drugs Discovery: Principles, Practice, and Perspective, John Wiley & Sons, Inc Editor(s) Valdir

- Cechinel- Filho, 2012, ISBN: 9780470582268
7. Ethnomedicinal Plants: Revitalizing of traditional Knowledge of Herbs, Mahendra Rai, Deepak Acharya, Jose Luis Rios 2011 by CRC Press ISBN: 9781578086962
 8. Herbal Medicines: Development and validation of Plants – derived Medicines for Human Health, Giacinto Begtta, Marco Cosentino, Marie tiziana Corasaniti, Shinobu Sakurada 2011 by CRC Press ISBN: 9781439837689
 9. Ethnobotany and the Search for New Drugs, Derek J. Chadwick, Joan Marsh (Editor) ISBN: 978-0-4770-51464-1, 2008.
 10. Ethnopharmacology of Medicinal Plants Asia and the Pacific, Christophe Wiart, Humana Press Inc. Totowa, New Jersey, 2006.
 11. Drug Discovery and Development , Mukund S. Chorghade (Ed.), John Wiley and Sons Ltd., 1st ed., 2006.
 12. Modern Phytomedicine: Turning Medicinal Plants into Drugs, Wiley – VCH Verlag GmbH & Co.KGaA Editor(s) Iqbal Ahmed, Farrukh Aqil, Mohammad Owais, 2006, ISBN: 978352731507
 13. Drug Discovery Handbook, Shayne Cox Gad (Ed), John Wiley and Sons Ltd., 1st ed.,2005.
 14. Textbook of Drug Design and Discovery, Third Edition, Tommy Liljefors, Povl Krogsgaard-Larsen, Ulf Madsen 2002 by CRC Press, ISSBN: 9780415282888
 15. Ethnomedicine and Drug Discovery, 1st edition, Editor: M. M. Iwu, J. wootton, Elsevier Science, 2002.
 16. Advances in drug Discovery Techniques, Alan L. Harvey, 1998 by CRC Press, ISBN 9780471975090
 17. The Process of New Drug Discovery and Development. Charles G. Smith , James T. O'Donnell (Eds.),Taylor & Francis Inc, 2nd ed.,1992.
 18. Flora of Pakistan, Monographs, Department of Botany, University of Karachi.

PHG – 909
Research Seminars
Cr. Hrs. 3

This course is based on three seminars given by the Ph.D. students in three phases before the submission of thesis. Each seminar will be of 1 credit hour.

“Good caring and weak medicine can give a better outcome than poor caring and a strong medicine” (Unknown)

PHG-911
Integrative Medicine
Cr. Hrs. 3

1. Introduction

Introduction to integrative medicine (IM), rationale, core values, management of disease through physical, emotional, mental, social, spiritual, and environmental influences, challenges in the implementation of integrative medicine practice.

2. Evidence Based Integrative Medicine

Insight on evidence based IM, rationales and strategies for integrative care, ethical and regulatory issues, evidence based medicine interventions in healthcare, collaboration and understanding among conventional and non-conventional practitioners and its impact on health outcomes of patients.

3. Integrative Healthcare Practices

Traditional Chinese medicine, Ayurvedic medicine, Unani medicine, homeopathy, herbal medicine, osteopathy medicine, dietary supplements, aromatherapy, music therapy, naturopathy, meditation, acupuncture and chiropractic means.

4. Stakeholders' Perspective and Approaches

Perspective and approaches regarding healthcare professionals, patients, regulators, academia, industrialist and philanthropists.

5. Application of Integrative Medicine in Healthcare

Oncology, cardiology, neurology, ophthalmology, gastroenterology, rheumatology, psychiatry, pediatrics, geriatrics, gerontology, female disorders, immune disorders and palliative care.

Books Recommended

1. The Scientific Basis of Interactive Medicine, 2009, Leonard A. Wisneski, Lucy Anderson, 2nd ed. CRC Press, Boca Raton.
2. The Practice of Integrative Medicine: A Legal and Operational Guide, 2006, Michael Cohen, Mary Ruggie, Marc S. Micozzi, 1st ed., Springer.
3. Traditional Complementary and Integrative Medicine: An International Reader, 2012, Jon Adams, Gavin J. Andrews, Joanne Barnes, Alex Broom and Parker Magin, Palgrave Macmillan, New York.
4. Immune System: General Practice: The Integrative Approach, 2012, Kerryn Phelps, Craig Hassed, Elsevier Health Sciences.
5. https://www.who.int/health-topics/traditional-complementary-and-integrative-medicine#tab=tab_1
6. WHO Global Report on Traditional and Complementary Medicine 2019 World Health Organization ISBN: 978-92-4-151543-6
7. Integrative Medicine: General Practice: The Integrative Approach Series, 2012 Kerryn Phelps, Craig Hassed, 1st ed. Elsevier Health Sciences ISBN: 97080729581868.
8. Complementary Medicine in Clinical Practice: Integrative Practice in American Healthcare, 2006, David Rakel, Nancy Faass, Jones and Bartlett Publishing, Massachusetts.
9. Integrative Medicine: Achieving Wellness through the Best of Eastern and Western Medical Practices, 2012, Kathleen Phalen, 1st ed., Tuttle Publishing 2010.
10. A Guide to Evidence-Based Integrative and Complementary Medicine, 2011, Vicki Kotsirilos, Luis Vitetta and Avni Sali, 1st ed., Churchill Livingstone, Sydney.
11. Integrative Pathway: Navigating Chronic Illness with a Mind-Body-Spirit Approach, 2018, Angele McGrady, Donald Moss, Springer International Publishing.

12. Primary Health Care and Complementary and Integrative Medicine Practice and Research, 2013, Jon Adams, Parker Magin, Alex Broom, Imperial College Press, New Jersey.
13. Complementary and Alternative Medicine for Health Professionals: A Holistic Approach to Consumer Health, 2013, Linda Baily Synovitz, Karl L. Larson, Jones and Bartlett Publishers.
14. The ACP Evidence-Based Guide to Complementary and Alternative Medicine, 2009, Bradly P. Jacobs and Katherine Gundling, 1st ed., American Collage of Physician.
15. Complementary and Integrative Therapies for Cardiovascular Disease, 2005, William Frishman, Michael Weintraub, Marc Micozzi, Elsevier/Mosby.
16. Complementary and Integrative Therapies for Mental Health and Aging, 2015, Helen Lavretsky, Martha Sajatovic, Charles Reynolds III, 1st ed., Oxford University Press.
17. Integrative Geriatric Medicine, Mikhail Kogan, 2018, Oxford University Press, New York.
18. The Gerontological Imagination an Integrative Paradigm of Aging, 2018, Kenneth F. Ferraro, Oxford University Press, New York.
19. Women's Health in Complementary and Integrative Medicine: A Clinical Guide, 2004, Tieraona Low Dog, Marc S. Micozzi, 1st ed., Churchill Living Stone.
20. A Clinical Guide to Integrative Oncology, 2017, Kylie O'Brien, SaliAvni, Springer International Publishing.

**Ph. D.
Second Semester**

PHG -902

Seminars on Current Advances in the Discipline

Cr. Hrs. 3

This course is based on a seminar to be given by the Ph.D. scholar on the recent development/ research done in the discipline.

PHG-904

Herbal Bioequivalence

Cr. Hrs. 3

1. **Herbal pharmacokinetics**

Definition, importance and ethical standards of bioequivalence. Assay methods of drugs in biological fluids, validation of assay methods, clinical statistical evaluation (AUC, AUMC, C_{max}), biological half life, distribution volume.

2. **Herbal pharmacodynamics**

Clinical responses to a drug on different physiological systems (ENT, CVS, CNS, UGS, RS and RTS).

3. **Guide lines for bioequivalence**
 - a. WHO guide lines for Bioequivalence.
 - b. FDA guide lines for Bioequivalence.
4. **Patents for herbal formulations/products**
Procedure for patenting natural products.
5. **Techniques used in new product development**
 - a. New product data, therapeutic window, minimum effective concentration, minimum toxic concentration, dosage time.
 - b. Waiver or bioequivalence
6. **Bioequivalence studies on natural sources**
Literature survey and clinical data on: *Silybum marianum*, *Glycyrrhiza glabra*, *Centella asiatica*, *Hypericum perforatum*, *Allium sativum*, *Zingiber officinale*, *Allium cepa*, *Trigonella foenum-graecum*, *Digitalis purpurea*, *Gingko biloba*, *Cinnamomum zeylanicum*, *Ginseng cinerariifolium*, *Ginseng quinquefolium*.

Books Recommended

1. BioPharmaceutics and Clinical Pharmacokinetics (4th ed.), Milo Gibaldi, Lea and Febiger (1991).
2. Applied Biopharmaceutics and Pharmacokinetics (6th ed.), Leon Shargel, Andrew Yu, Susanna Wu-Pong, McGraw Hill Professional (2012).
3. Essentials of Biopharmaceutics and Pharmacokinetics, Ashutosh Kar, Elsevier (2011).
4. Biopharmaceutics and Pharmacokinetics, Jayant S Kulkarni, CBS Publishers (2008).
5. Basic Pharmacokinetics and Pharmacodynamics: An Integrated Text Book and Computer Simulations, Sara E. Rosenbaum, John Wiley and Sons (2012).

PHG-906

Agriculture Pharmacognosy

Cr. Hrs. 3

1. **Introduction**

Definition of agriculture/farming and procedures. Techniques used in growth, cultivation, collection and harvest. Role in production/supply of food and medicinal material for commercial market. Classification of plant drugs.

2. **Procedure**

Biological and chemical processes by which crops and livestock grow; factors affecting the growth and quality of food, medicinal and ornamental plants.

3. **Planting, Farming and Harvesting of Herbal Medicine**

Plant evolution, taxonomy, morphology, distribution, species, mode of propagation; Cultivation: Land preparation for small scale/ large scale cultivation. Soil and climatic factors, Planting, fertilizers, irrigation, Intercultures, transplantation, pests and diseases. Harvesting, yield, chemical and pharmacological status, drying, storage, processing, economics and utilization.

4. **Plant Pathology**

Study of plant diseases origination and environmental conditions that cause infectious diseases, the mechanisms and the process by which it occurs. The effect of diseases on plant growth, yield, quality. The methods of preventing diseases in plants.

5. **Adulteration and Evaluation**

Agriculture material i.e food/drugs on different bases in botanical. Chemical and biological types of adulterants and their detection methods.

6. **Agronomy**

Study of the technology for successful growth and management of crop/plants and their usage as food, fuel, feed and fiber e.g Sun flower, *Zea mays*. Grains, sugar-cane, peanuts, cotton, potato. Integrated study and application of biology, chemistry, ecology, earth science and genetics.

7. **Sustainable Development**

Plant drugs/food for commercial market. *Ephedra spp.*, *Allium spp.*, *Glycyrrhiza glabra*, *Curcuma longa*, *Cinnamomum zeylanicum*, *Piper nigrum*, *Nigella sativa*, *Zingiber officinale*.

Recommended Books

1. Pharmacognosy (Pharmacognosy and plant cultivation) (Vol. 2), Mohammad Ali, CBS Publishers and Distributors Pvt. Ltd., New Delhi (2008).
2. Pharmacognosy (9th ed.), Tyler VE, Brady LR, Robbers JE, Lea and Febiger (2009).
3. Trease and Evans Pharmacognosy (16th ed.), William C Evans, George E Trease, daphne Evans, Elsevier (2009).
4. Textbook of Pharmacognosy and Phytochemistry (1st ed.), Biren Shah, Avinash Seth, Elsevier Health Sciences (2012).
5. Herbs Cultivation and Medicinal Uses, H. Panda, National Institute of Industrial Research, 2005.

PHG-908**Advances in Clinical Pharmacognosy****Cr. Hrs. 3**

1. Clinical uses and evaluation of herbal medicines.
2. Role and utilization of minerals, animals and marine resources in the management and cure of diseases.
3. Clinical application of plant extractives and natural compounds with special reference to Pharmacopoeia.
4. Ethical issues concerning the use of crude natural products, extractives, natural and semisynthetic compounds.
5. Molecular modes of action of drugs used in phytomedicine.
6. Herb-drug/ herb-food interactions of commonly used medicinal plants.

Recommended Books

1. Herbal Medicine: Biomolecular and Clinical Aspects (2nd ed.) Iris F. F. Benzie and Sissi Wachtel-Galor. CRC Press (2011).
2. Botanical Medicine in Clinical Practice, Ronald Ross Watson, Victoria R. Preedy, CABI (2008).
3. Herbal Medicines: Development and Validation of Plant-derived Medicines for Human Health, Giacinto Bagetta, Marco Cosentino, Marie Tiziana Corasaniti, Shinobu Sakurada, CRC Press (2012).
4. Recent Advances in Plant-based, Traditional and Natural Medicine. Subramayam Vemulpad, Joanne Jamie, CRC Press (2014).
5. Textbook of Natural Medicine (4th ed.), Joseph E. Pizzorno, Michael T. Murray, Elsevier (2013).

PHG -910**Research Publication / Project proposal for Funding****Cr. Hrs. 6**

This course is based on publishing articles in BASR/HEC/ISI Index journals or writing a project proposal for funding to national or international sponsoring agencies. (The concerned research supervisor shall award the grades to the scholar).

PHG- 912
Advance Pharmacoeconomics
Cr. Hrs. 03

1. Good Practices in Pharmacoeconomics

- Clinical outcomes assessment
- Epidemiology and public health
- Health policy and regulatory affairs
- Health technology assessment
- Medical technologies
- Methodological and statistical research
- Patient centered research
- Real world data and information systems
- Specialized treatment areas
- Specific diseases and conditions
- Study approaches

2. Impact of Pharmacoeconomics in formulary development

3. Implementation of Pharmacoeconomics in real world

4. Pharmacoeconomics in developing countries

5. Herbal Pharmacoeconomics and possibilities

6.

Books Recommended

1. Pharmacoeconomic from Theory to Practice, Renee J. G. Arnold, CRC Press, 2021, ISBN: 9780367521363.
2. The Art of Pharmacoeconomics, A Guide to Getting Started, Rola KaaKeh, Salus Vitae Group LLC, 2021, ISBN: 978-1736838600.
3. Pharmacoeconomics Principles and Best Practices: A Practical Guide, Francisco Nuno Rocha Goncalves, Laszlo Gulacsi, Nada Abu-Shraie, Innovative Healthcare Institute, 2020, ISBN: 0578793962.
4. Pharmacoeconomics: Principle and Practice, Lorenzo Pradelli, Albert Wertheimer, Seed Medical Publisher, 2013, ISBN-10: 8897419372.
5. Pharmacoepidemiology and Pharmacoeconomics: Concepts and Practice, K.G. Revikumar, Pharma Med Press, 2016. ISBN-10: 9352301323.

Pharm.D. (Deficiency) Courses
FIRST SEMESTER

PHG-713(D)

Clinical Pharmacognosy

Cr. Hrs. 2

1. Introduction to clinical Pharmacognosy

General introduction and historical background of clinical Pharmacognosy. Study of causes, pathogenesis, clinical features (sign and symptoms), diagnosis, prognosis, prevention and epidemiology of chronic diseases; principles of medication, treatment by herbal medicines.

2. Clinical Use of herbal medicine

Diabetes: *Gymnema sylvestre*, *Melia azadirchta*, *Momordica charantia*, *Syzygium jambulana*.
Cardiac diseases: *Digitalis spp.*, *Convallaria majalis*, *Urgenia indica*, *Allium sativum*, *Punica granatum*.

Hepatitis: *Berberis vulgaris*, *Picrorhiza kurroa*, *Lawsonia innermis*.

Respiratory diseases: *Ficus religiosa*, *Adhatoda vasica*.

Skin diseases: *Aloe vera*, *Angelica archangelica*, *Mentha piperita*, *Citrus spp.*, *Commiphora mukul*.

CNS disorders: *Strychnos nux-vomica*, *Datura stramonium*, *Cannabis sativa*, *Papaver somniferum*, *Atropa belladonna*.

Musculo-skeletal disorders: *Nigella sativa*, *Phycotis ajowan*, *Trigonella foenum-graecum*, *Zingiber officinale*.

Renal disorders: *Cucumis melo*, *Berberis vulgaris*, *Zea mays*, *Tribulus terrestris*.

Reproductive disorders: *Saraca indica*, *Ruta graveolens*, *Nigella sativa*, *Glycyrrhiza glabra*, *Claviceps purpurea*, *Myristica fragrance*.

G.I.T. disorders: *Foeniculum vulgare*, *Ferula foetida*, *Cuminum cyminum*, *Aegle marmelos*, *Prunus domestica*.

Books Recommended

1. Principle and Practice of Phytotherapy: Modern Herbal Medicine, Kerry Bone, Simons Mills, Churchill Livingstone (2013).
2. Pharmacological Methods in Phytotherapy Research, Selection, Preparation and Pharmacological Evaluation of Plant Material (vol.1), Elizabeth M. Williamson, David T. Okpako, Fred J. Evans, Wiley Publishers, (1996)
3. Encyclopedia of World Medicinal Plants (vol. 5), T-Pullaiah., Regency Publication, New Delhi (2006).
4. Natural Products: Drug Discovery and Therapeutic Medicine, Lixin Zhang, Arnold L. Demain (Eds.), Humana Press (2005).
5. Hand Book of Clinical Pharmacy, Dr. A. V. Yadav, B.V. Yadav, t.I. Shaikh, Nirali Parkashan, Pune (2008).

SECOND SEMESTER

PHG-514(D)

Natural Toxicants

Cr. Hrs. 2

5. General introduction to plant toxicology

Classification and chemical nature of natural toxins and toxicities in humans and animals.

2. Higher plant toxins

Essential oils: Terpene(cineol, pine oil), Phenyl propane(apiol, safrole, myristicin), Monoterpene(thujone, menthafuran) Plant acids (oxalic acid, amino acid, resin acid), Glycosides (cardiotonic, cyanogenic glycosides), Alkaloids (imidazole, pyrrolizidine, tropane).

3. Lower plant toxins

Bacterial toxins (*Staphylococcus aureus*, *Clostridium botulinum*), Algal toxins (*Microcystis aeruginosa*, Cyanobacteria, *Gonyaulax cantenella*).

4. Mycotoxins

Fungal toxins (*Aspergillus spp.*, *Claviceps purpurea*), Mushrooms (*Amanita spp.*).

5. Study of toxins, their prevention and control methods

Description, pharmacognostic features, pharmacological actions, chemical constituents, treatment, side-effects, contra-indications, warnings, prevention and control methods of *Abrus precatorius*, *Papaver somniferum*, *Eucalyptus spp.*, *Nicotiana tabaccum*, *Cannabis sativa*, *Digitalis purpurea*, *Datura stramonium* poisoning.

Books Recommended

1. Herbal Products, Toxicology and Clinical Pharmacology, Timothy S. Tracy, Richard L. Kingston (Eds.), 2nd ed., Humana Press, Totowa (2007).
2. Poisonous Plants of Pakistan, S. H. Abid Askari, Oxford University Press, 2010.
3. Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2004).
4. Poisonous Plants and Related Toxins, Thomas Acamovic, Colin S. Stewart, T. W. Pennycott, CABI (2003).
5. Poisonous Plants: A Hand Book for Doctors, Pharmacists, Toxicologists, Biologists and Veterinarians (2nd ed.), Dietrich Forhne, Hans J Pfander, Manson Publishing, London (2004).