

M. PHARM.
PHARMACOGNOSY & PHYTOCHEMISTRY SYLLABUS

Semester – I

Theory Papers:

1. Advanced Pharmacognosy – I	3 Hours
2. Phytochemistry	3 “
*3. Spectroscopic identification of Organic Compounds	3 “
*4. Screening methods in Pharmacology	3 “

Practicals:

1. Advanced Pharmacognosy – I	9 Hours
2. Phytochemistry	9 “

Semester – II

Theory Papers:

1. Advanced Pharmacognosy – II	3 Hours
2. Herbal Drug Technology	3 “
3. Industrial and Research aspects of Pharmacognosy	3 “
*4. Chromatographic Separation Technology	3 “

Practicals:

1. Advanced Pharmacognosy – II	9 Hours
2. Herbal Drug Technology	9 “

*** Common to M. PHARM. - Pharmacognosy & Phytochemistry and Pharmaceutical Chemistry specializations**

Semester – III & IV: Dissertation Work

Semester – III: 1. Dissertation Seminar – I
2. Comprehensive Viva-voce

Semester – IV: 1. Dissertation Seminar – II
2. Thesis Evaluation
3. Dissertation Viva-voce

M. PHARM. (PHARMACOGNOSY & PHYTOCHEMISTRY)

M. PHARM I SEMESTER PAPER-1 ADVANCED PHARMACOGNOSY – I

Unit: I

- a) Good Agricultural and Harvesting Practices
- b) Commercial cultivation, post-harvest care, processing technology and utilization of following medicinal and aromatic plants.
- i) Aswagandha ii) Opium iii) Isapghul iv) Senna v) Lemongrass vi) Patchouli vii) Davana viii) Saffron ix) Turmeric x) Safed musli

Unit: II & III

A brief account on Phytochemical and Pharmacological aspects and uses of following medicinal plants.

Unit: II

- a) i) *Gymnema sylvestre* ii) *Momordica charantia*
- b) i) *Silbum marianum* ii) *Phyllanthus amarus* iii) *Eclipta alba*
- c) i) *Sophora subprostata* ii) *Tribulis terrestris* iii) *Punarnava*

Unit: III

- a) i) *Ocimum sanctum* ii) *Tinospora cordifolia* iii) *Calophyllum langium*
- b) i) *Brahmi* ii) *Hypericum perforatum* iii) *Aesculus hippocastnum*
- c) i) *Coleus forskohlii* ii) *Artemisia annua*

Unit: IV

Biosynthetic studies:

- a) Methods of Biogenetic investigations: Detailed study of Isotopic tracer technique. b) Study of biosynthetic pathway of Atropine, Morphine Cardiac glycosides, Terpenes and Flavonoids.

Unit: V

Plant Tissue culture: Types, techniques, nutritional requirements. Preparation and sterilization of media, preparation of explant, measurement of growth parameters. Organogenesis and Embryo genesis. Micropropagation of medicinal and aromatic plants.

Unit: VI

- a) Secondary metabolism in tissue cultures with emphasis on production of biomedicinals. b) A brief account of immobilization plant cells, techniques and its effect on secondary metabolism. C) A brief account of biotransformation by plant cell culture and secondary metabolites of medicinal importance involved in biotransformation d) A brief account of Hairy root cultures and their applications.

M.PHARM – PHARMACOGNOSY & PHYTOCHEMISTRY

I – SEMESTER PRACTICAL PAPER – 1

ADVANCED PHARMACOGNOSY – I

I: Isolation and Purification of following natural products.

- a) Piperine from Black Pepper
- b) Caffeine from Tea Powder
- c) Quinine from Cinchona
- d) Strychnine and Brucine from Nux-vomica
- e) Sennosides from Senna leaves
- f) Eugenol from Clove oil

II. Isolation of natural products by column chromatography

III. Separation and Isolation of natural products by Preparative TLC.

IV. Initiation of Callus Cultures, Suspension cultures and Determination of Growth Index.

V. TLC studies on secondary metabolites of plant tissue culture.

M. PHARM. I - SEMESTER

Paper - 2

Phytochemistry

Unit: I

Preliminary Phytochemical Screening:

- a) Successive solvent extraction.
- b) Qualitative chemical examination-(i) Detection of different classes of phyto constituents by test tube and TLC methods. (ii) Detection of volatile oil by Hydrodistillation Method.

Unit II, III, IV & V: Sources, chemical structures with description of structural features, tests for identification, uses, mechanism of action/SAR of following phytopharmaceuticals.

Unit: II

- a) Morphine and a brief account of its derivatives and analogues
- b) Ergot alkaloids & semisynthetic derivatives c) Caffeine and Theophylline.

Unit: III

- a) Reserpine, b) Quinine and Quinidine, c) Atropine, Hyoscyamine and Scopolamine, Structure and use of Homatropine.

Unit: IV

- a) Vincristine and Vinblastine, b) Taxol, c) Camptothecin, d) Podophyllotoxin and Semisynthetic derivatives of these compounds.

Unit: V

- a) Lanatoside C, Digoxin, Ouabain, Ginsenosides
- b) 8- Methoxypsoralen and other Psoralens
- c) Gaultheria oil, Eucalyptus oil, Menthol and Eugenol.

Unit: VI

Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (^1H , ^{13}C) i) Carvone, Citral, Menthol ii) Luteolin, Kaempferol iii) Luteolin – 7 – O- glucoside iv) Nicotine, Papaverine v) Estrone, Progesterone

Note: In unit VI, the exact shift values need not be given. It is sufficient if the students is taught how many peaks appear for the compound in the NMR and approximately, in which region.

I – SEMESTER
PRACTICAL PAPER – 2
PHYTOCHEMISTRY

I. Preparation of extracts of Organised crude drugs/Herbs by successive solvent extraction method to record the percentage yield and physical status of the respective extracts and for subjecting them to phytochemical screening.

II. Detection of Phytoconstituents such as i) Alkaloids, ii) Steroids, Triterpenoids and their glycosides and Saponins iii) Flavonoids and their glycosides iv) Anthracene Glycosides v) Coumarins vi) Tannins by Test Tube and TLC methods.

III. a) Identification of alkaloids in a mixture by TLC b) Colour reactions of different groups of Alkaloids.

IV) Detection, extraction and estimation of volatile oils by Clevenger's method (Hydrodistillation method) TLC of Volatile oils and their pure constituents.

V) Analysis of recorded spectra of some simple phytochemicals.

Paper 3: Spectroscopic identification of organic compounds

A brief account of the basic principles involved & instrumentation, and a detailed study of applications of the following spectroscopic techniques in the determination of structure of the following classes of compounds with the help of simple examples:

i) Alkanes ii) Cycloalkanes iii) Alkenes iv) Aldehydes and ketones v) Alcohols
vi) Carboxylic acids vii) Phenols viii) Amines ix) Simple Heterocyclic Compounds.

1. UV & IR Spectroscopy
2. ^1H NMR (Proton NMR)
3. ^{13}C NMR
4. Mass spectrometry
5. A brief account of the two dimensional NMR techniques like DEPT, COSY, HMQC/HSQC, HETCOR, HMBC, TOCSY.
6. Problems and their solution – simple problems dealing with structure determination to be worked out.

Note:

1. The aim of this course is to train the student in the spectroscopic identification of organic compounds. Therefore, the emphasis while teaching the subject should be on the applications of the techniques.
2. The Theory behind 2D-NMR techniques shall not be taught.
3. The use of 2D-NMR techniques to confirm the structural features/assignments of the compounds alone will be emphasized, preferably by giving simple examples.
4. Unit-6: problems given in Morrison & Boyd and Silverstein & Basler to be worked out.

Books Recommended:

1. Organic chemistry – Morrison & Boyd – 11th edition along with the study guide.
2. Spectroscopic methods of identification of organic compounds – Silverstein and Basler.
3. Organic spectroscopy – William Kemp.
4. Instrumental methods of analysis – John Dyer.
5. Structure elucidation by modern NMR, a workbook – Duddeck, Detrich and Toth.
6. Solving problems with NMR spectroscopy – Atta-Ur- Rahman and Muhammad Iqbal Choudhary.

Paper 4: Screening methods in Pharmacology

Principles and techniques involved in the pharmacological screening of:

1. Analgesic, anti-inflammatory, antipyretic and antiulcer drugs.
2. Antidiabetic, antiulcer and cardiotoxic, antiarrhythmic and antihypertensive drugs.
3. Hepatoprotective and immunomodulatory drugs.
4. a) Screening for free radical scavenging and anti-oxidant activities.
b) Enzyme inhibition studies – Inhibition of COX-1, COX-2 and 5-LOX
5. a) Screening for cytotoxicity
b) Screening of antimicrobial activity
c) Acute toxicity studies
6. Statistical analysis of data, methods of precision, accuracy, fiducial limits, regression analysis, standard error, tests for significance chi-square test, students T test, ANOVA. Importance of tests of significance in pharmaceutical/biological experiments.

Books recommended:

1. Screening methods in pharmacology – Robert A. Turner.
2. Drug Evaluation – Vogel.
3. Evaluation of Drug Activities – Lawrence and Bachrach.
4. Methods in Pharmacology – Swarbrick.
5. Pharmacopoeias.

M.PHARM II – SEMESTER

Paper – 1

ADVANCED PHARMACOGNOSY – II

Unit: I

a) Standardization of Crude Drugs (Raw materials)

b) Study of analytical profiles of following medicinal plants using WHO protocols.

Acorus calamus, Andrographis paniculata, Bacopa monnieri, Boswellia serrata, Centella asiatica, Coleus forshkohilii, Commiphora mukul, Curcuma longa, Glycyrrhiza glabra, Phyllanthus amarus, Psoralea corylifolia, Withania somnifera.

Unit: II

Qualitative and Quantitative analysis of following phytoconstituents by various methods.

a) Sennosides b) Digoxin c) Glycyrrhizin d) Diosgenin e) Guggulsterones f) Withanolides g) Andrographolides h) Hypercin i) Capsaicin J) Ergot alkaloids k) Atropine l) Quinine m) Vasicine n) Phenolic, Aldehyde, Ketonic substances in volatile oils o) Curcuminoids p) Phyllanthin.

Unit: III & IV Neutraceuticals

Unit: III

Definition of Functional foods and Neutraceuticals. Classification of Neutraceuticals. Source, name of marker compounds and their chemical nature, medicinal uses and health benefits of following used as Neutraceuticals/ Functional foods.

i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi) Ginkgo vii) Flax seeds viii) Black cohosh ix) Turmeric x) Tea

Unit: IV

Photochemicals as Neutraceuticals: Occurrence and Characteristic features (Chemical nature, uses in pharmacy, medicinal and health benefits) of following.

- a) Carotenoids – i) α and β - Carotene ii) Lycopene iii) Xanthophyll (Lutein)
- b) Limonoids – i) d-Limonene ii) α - Terpineol
- c) Saponins – i) Glycyrrhizin ii) Shatavarins
- d) Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin
- e) Anthocyanins
- f) Phenolic acids:- Ellagic acid
- g) Tocotrienols and Tocopherols

Unit: V

A) Vegetable Bitters: Definition; Biological source, chemical structural description of the bitter principles, actions and therapeutics of following.

- i) Gentian ii) Chirata iii) Quassia iv) Calumba v) Calamus vi) Cusparia vii) Orange peel viii) Serpentaria

B) Vegetable Laxatives: Purgatives and Bulk Laxatives. Biological source, chemical structural description of active principles, tests for identification/evaluation, action and therapeutics of following.

- i) Senna ii) Cascara iii) Rhubarb iv) Aloes v) Isapgol vi) Agar vii) Castor oil.

Unit: VI

A brief account of natural products derived from Marine source with special reference to Cardiovascular, anti-cancer, anti-viral, anti-microbial anti-parasitic, anticoagulant and anti-inflammatory agents.

M. PHARM. II – SEMESTER

Paper – 2

HERBAL DRUG TECHNOLOGY

Unit: I - HERBAL EXTRACTS: Types of extracts; Extraction methods such as Maceration, Percolation, Super critical fluid extraction, Distillation Methods; Methods for drying of extracts. Selection and purification of solvents for extraction. Equipment for preparing herbal extracts:

- a) Introduction – Constraints on the manufacturing equipments.
- b) Process and equipments – Name of the equipment and its uses with merits and demerits in each of the following unit operations in the extraction process.
 - i) Size reduction ii) Extraction iii) Filtration iv) Evaporation /Distillation v) Solvent recovery vi) Drying of extracts.
- c) Utilities equipments – Name of the equipment with its merits and demerits required for following utilities.
 - i) Demineraliser water ii) Steam iii) Cool water iv) Refrigeration v) Compressed air.

Unit: II, III & IV

Natural Excipients:

- a) Definition and Classification of natural excipients based on source/origin, chemical nature and function they perform.
- b) Source, description, parameters for standards, chemistry, incompatibilities, methods of sterilization, uses and storage condition for the following.

Unit: II

As Binding agents, Granulating agents, Disintegrating agents, Diluents, Glidants, Emulsifying, Suspending and Thickening agents in various dosage forms.

- i) Acaica ii) Tragacanth iii) Starch v) Guargum vi) CMC vii) Lactose viii) Mannitol ix) Sucrose x) Talc xi) Chitin xii) Gelatin xiii) Agar xiv) Methyl cellulose xv) Pectin xvi) Alginic acid

Unit: III

a) As Ointment bases, Suppository bases and Hardening agents:

- i) Lanolin ii) Beeswax iii) Cocoa Butter iv) Hard paraffin v) Petroleum jelly.
- b) As Flavours and Perfumers: i) Cardamom oil ii) Vanilla iii) Lemon oil iv) Orange oil v) Sandal wood oil vi) Palmrosa oil vii) Geranium oil viii) Rose oil ix) Patouli oil.

Unit: IV

Natural sweeteners: a) Definition of Nutritive and Non nutritive sweeteners with examples. Sweetness potency. Qualities of an ideal sweetner.

b) Biological source, chemical structure with description of structural features, sweetness potency, extraction details and usage of following i) Stevioside ii) Rebaudioside iii) Glycyrrhizin. c) A brief account of Neohesperidin dihydrochalcone, Thaumatin, Agave syrup and sugar alcohols.

Natural Colourants: a) General Introduction.

b) Biological source, colouring principle(s) chemical nature with its structure and usage of following.

i) Saffron ii) Annatto iii) Cochineal iv) Beet juice v) Paprika vi) Turmeric vii) Caramel viii) Henna

Unit: V

Herbal Cosmetics: General method of preparation and evaluation of Herbal Cosmetics such as a) Skin care products and b) Hair care preparations with examples and the claims for the various herbal materials used in them. A brief account of following Herbals or Herb extracts or Herbal products of cosmetic importance such as Aloe vera, Neem, Henna, *Acacia concinna* pods, *Citrus aurantium* peel, Liquorice, Sandal wood, Olive oil, Wheat germ oil, Almond oil and Tea – tree oil with special emphasis on their source, active principles and cosmetic properties.

Unit: VI

Herbal Drug Formulations: Study of different dosage forms such as solid, semi-solid, liquid and gaseous containing herbs/herbal extracts/herbal products intended for treatment of GIT, CVS, Respiratory systems, CNS, Musculo-skeletal, Skin, Genito – urinary system (GUS) disorders etc. with regard to their composition and the claims for the various herbal materials used in them.

Examples of Disorders of a) GIT – Diabetes, Liver, Constipation, Diarrhoea, Dysentery. B) CVS – Hypertension, Angina c) RS – Bronchitis, Asthama, Tussive d) CNS – Pain, Fever, Anxiety Convulsions e) Musculo – Skeltal – Rhuematisim, Cramps, f) Skin – Leucoderma g) GUS-Oedema, Uninary calculus, Leucorrhoea Dysmenorrhoea.

II – SEMESTER PRACTICAL - PAPER – 1
ADVANCED PHARMACOGNOSY – II

- I. Experiments based on any six phytoconstituents mentioned in theory under Unit II.
- II. Microscopical Evaluation of Powdered Organised Crude Drugs.
- III. Screening of Herbal Extracts/Products for a) Anti-diabetic b) Analgesic c) Anti-inflammatory d) Hepatoprotective e) antimicrobial activities f) Anti-oxidant properties.

II – SEMESTER PRACTICAL - PAPER - 2
HERBAL DRUG TECHNOLOGY

- I. Isolation/preparation of following Natural Excipients. a) Strach b) Pectin c) Glycyrrhizin d) Bixin e) Curcuminoids f) Lawsone
- II. Determination of Extractive values of some Crude Drugs.
- III. Preparation and evaluation of any Four Herbal Cosmetics.
- IV) Study of analytical profiles of following medicinal plants with special emphasis on their marker compounds.

a) *Withania somnifera* b) *Bacopa monnieri* c) *Phyllanthus amarus* d) *Psoralea corylifolia* e) *Curcuma longa* f) *Glycyrrhiza glabra*

M. PHARM. II SEMESTER

Paper – 3

Industrial and Research aspects of Pharmacognosy

Unit : I

Sources of Natural Drugs with examples. Alternative systems of medicine such as Ayurveda, Unani, Siddha, Homeopathy as a source of information regarding natural drugs. Various forms of drugs their uses in these systems of medicine.

Folklore as a source of information about drugs: Examples of various plants/plant parts/plant products and their form for treatment of different ailments.

Unit : II

Organizations involved in research and development of natural products and key components of their programme. A brief account of some of the technologies developed for herbal products [standardized extracts, increase in yield of phytochemicals etc.] by different research institutes and companies of both national and international status like CIMAP, RRL, CDRI, NBRI, CSIR. National centre for development of natural products (NCDNP), NCI, Natural Product Research Institute (NPRI – Seoul), Arizona, Bristol – Mayer's Squibb, CIPLA, NCL (Pune) Chemiloids, Mehta Pharmaceuticals, Amsar etc.

A brief account of NAPRALERT

Unit: III

Natural Products as drug leads: A brief account of exploration of biologically active/inactive proto types towards newer and better semi-synthetic or synthetic drugs. Following natural products shall be taught as examples, giving the structural relationship, uses, merits and demerits (if any). i) Quinine (Ex. Aminoquinolines) ii) Morphine iii) Salicin and Salicylic acid iv) Ephedrine v) Atropine vi) Cocaine vii) Podophyllotoxin viii) Vinca alkaloids ix) Ergot alkaloids x) Carotene xi) Diosgenin xiii) 10-Deacetylbaocatin

Unit: IV

Herbal drugs industry: International Scenario.

a) Cultivation of medicinal and aromatic plantats in an organized way: Names of the plants, purpose, production/annum, area under cultivation, region and country names, commerce in the past decade.

b) Names of different companies manufacturing different herbal extracts, standardized extracts with the concentration of marker compounds, active principles and claims regarding their uses.

c) A brief account of companies making herbal drug formulations: List of formulations containing single herbal powder/extract, poly herbal powder/extracts, standardized extracts/single/multi phytopharmaceutical and their composition and uses.

Unit: V

Herbal Drugs Industry – National Scenario.

A,B and C: Same contents as in Unit IV A, B, C.

Unit: VI

a) WHO guidelines for quality control of herbal drugs (Format for a monograph shall be taught)

b) Ayurvedic Pharmacopoeia of India – Format of API monograph for Ayurvedic formulations.

c) Patent laws, proposed amendments as applicable to herbal/natural products and processes; Important points to be kept in mind while drafting and filing a patent.

Paper 4: Chromatographic separation technology

Theory and instrumentation of the following techniques for the separation of organic compounds.

1. TLC and HPTLC
2. Column chromatography (open) and its modifications like flash, vacuum liquid and medium pressure chromatographies, Gel Permeation technique.
3. HPLC
4. GLC
5. Electrophoresis (Gel and Paper)
6. A brief account of:
 - a) Paper Chromatography
 - b) Super Critical Chromatography
 - c) Chiral Separations
 - d) Circular Counter Current Chromatography (CCCC)
 - e) Ion Exchange Methods

Note: Emphasis should be on

- A) The various column materials used in these techniques.
- B) The detectors in the case of techniques like HPLC, HPTLC and GLC.
- C) The relative advantages and limitations of the techniques.

Books recommended:

1. Instrumental methods of analysis – Willard, Merritt, Dean and Settle.
2. Instrumental methods of chemical analysis – Gurudeep R. Chatwal and Sham K. Anand.
3. TLC – Egon Stahl.
4. TLC – Kirchner.

Recommended references:

1. Herbal Drugs Industry by R.D. Chowdary
2. Quality control of Herbal Drugs by Pulok. K. Mukarjee
3. Pharmacognosy, Phytochemistry, Medicinal Plants by Jean Bruneton
4. Natural Products a laboratory guide by Raphael Ikan.
5. Foye's Principles of Medicinal Chemistry by Thomas L.Lemke David A. Williams et.al.
6. Pharmacognosy by C.K. Kokate
7. Pharmacognosy by Trease & Evans
8. Pharmacognosy & Phytochemistry by Vinod Rangari
9. Pharmacognosy by Brady Taylor et. al.
10. Natual Excipients by R.S. Guad, Surana et. al.
11. Spectrometric identification of Organic compounds by Silverstein
12. Organic chemistry by Morrison & Boyd
13. Cultivation of Medicinal and aromatic crops by A..A.Farooqui and B.S. Sreeramu.
14. Pharmacognosy & Pharmacobiotechnology by Ashutosh kar
15. Advances in Haticulture Volume.II Medicinal and Aromatic Plants by K.L. Chada & Rajendra Gupta.
16. Herbal Medicine expanded commission E Monographs. Blumenthal/ Goldberg/Brinckmam.
17. A handbook of Cosmetics by B.M. Mithal & RN Saha
18. The Complete Technology Book on Herbal Perfumes&Cosmetics by Panda
19. Plant Drug Analysis by Wagner H. and Bladt S.
20. "The Wealth of India" Raw materials, (I-XI) and Industrial Products – Volumes (I-VIII) (A to Z) by CSIR, New Delhi.
21. "Indian Medicinal Plants" Volumes by Kirtikar K.R. and Basu B.D.
22. The Merck Index.
23. Medicinal Plant Biotechnology by Ciddi Veeresham
24. Plant Tissue Culture by Bhojwani
25. Plant Tissue culture by M.K. Razdan.
26. Wilson and Gisvold's Text Book of Organic medicinal and Pharmaceutical Chemistry.
27. Burger's Medicinal Chemistry and Drug Discovery.
28. PHARMACOLOGY by H.P. Rang, M.M. Dale et. al.
29. Goodman and Gilman's Pharmacological Basis of Therapeutics.
30. PHARMACOPOEIA'S – IP, BP, USP, EP, API, IHP.
31. Journals Publishing Phytochemical and Pharmacological investigations on plants.
32. Websites on Herbal Medicines/Products.
33. Pharmacognosy and Pharmacobiotechnology by Robert Siperio et. al.
34. Medicinal Natural Products by Paul M. Deweek.