

# **SAURASHTRA UNIVERSITY**

## **RAJKOT**

**(ACCREDITED GRADE "A" BY NAAC)**



### **FACULTY OF PHARMACY**

Syllabus for

### **M. Pharm. (PHARMACOGNOSY)**

Choice Based Credit System

**With Effect From: 2017-18**

## **Program Outcomes**

### **POs of M. Pharm (Pharmacognosy)**

Students of all post undergraduate pharmacy degree programs at the time of graduation will be able to learn:

#### **PO1: Research and development**

The students will be able to generate ideas for research, analyse them, execute them and publish the findings.

#### **PO2: Domain knowledge:**

Students will be able to acquire knowledge and comprehension of the core and specialization subjects of the respective pharmacy specialization.

#### **PO3: Communication skills:**

Students will be able to learn communication by giving seminars, journal club and other organizational activities. They will be able to comprehend and write effective reports, make effective presentations and documentation.

#### **PO4: Planning skills:**

Students will be able to demonstrate effective planning abilities including time management, resource management, and organizational skills. They will be able to develop and implement plans and organize work to meet deadlines.

#### **PO5: Problem analysis:**

Students will be able to develop, critical thinking and analytical skills while solving problems and making decisions in dissertation research.

#### **PO6: Usage of contemporary research tools and techniques:**

Students will be able to learn, select, and apply appropriate current methods and procedures in modern pharmaceutical research with an understanding of the limitations.

#### **PO7: Social responsibilities:**

Students will be able to understand, analyze and communicate the value of their professional roles in society (e.g. as health care professionals, promoters of health, educators, managers, employers, employees).

#### **PO 8: Continuous learning:**

They will be able to recognize the need for continuous up gradation of their knowledge and skills

## Program Specific Outcomes PSOs of M. Pharm (Pharmacognosy)

### PSO1.

Understand the basic principles of drug development from natural products and the role of natural products in the development and production of drugs, phytopharmaceuticals and nutraceuticals.

### PSO2.

Understand the regulatory requirement for herbal and natural origin drugs like quality control, GMP, stability testing, patenting, trading etc

### PSO3.

Develop skill in phytochemical analysis, herbal drug standardization and herbal monograph analysis.

### PSO4.

To study and develop skill biotechnological techniques for improving production of secondary metabolites and genetic modification.

### PSO5.

Understand the principles, preparations of medicines of various Indian systems of medicine like Ayurveda, Siddha, Homeopathy and Unani. To study preparation and standardization of herbal drugs, traditional drugs and herbal cosmetics.

### PSO6.

To acquire the knowledge about Ethnopharmacology, reverse pharmacology and Phyto-Pharmacological Screening. Implementation of this knowledge for research.

### PSO7.

Understand the all aspect of research, research design and implementation of statistics in research

**Course Structure and Scheme of Examination**  
**M. Pharm Pharmacognosy (MPG)**  
**M. Pharm Semester-I**

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
MPA 101T	Modern Pharmaceutical Analytical Techniques	4	4	25	75	100	3
MPG 101T	Advanced Pharmacognosy-1	4	4	25	75	100	3
MPG 102T	Phytochemistry	4	4	25	75	100	3
MPG 103T	Industrial Pharmacognostical Technology	4	4	25	75	100	3
MPG 104P	Pharmacognosy Practical I	6	12	50	100	150	6
-	Seminar/Assignment	4	7	-	100	100	-
<b>Total</b>		<b>26</b>				<b>650</b>	



## M. Pharm Semester-2

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester End Examination	Total Marks	Duration of Semester End Examination in Hrs.
MPG201T	Medicinal Plant biotechnology	4	4	25	75	100	3
MPG202T	Advanced Pharmacognosy-II	4	4	25	75	100	3
MPG203T	Indian system of medicine	4	4	25	75	100	3
MPG204T	Herbal cosmetics	4	4	25	75	100	3
MPG205P	Pharmacognosy Practical -II	6	12	50	100	150	6
-	Seminar/Assignment	4	7	-	100	100	-
<b>Total</b>		<b>26</b>				<b>650</b>	

### M. Pharm Semester-3

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester Examination
MRM 301T	Research Methodology and Biostatistics*	4	4	25	75
-	Journal club	1	1	25	-
-	Discussion / Presentation (Proposal Presentation)	2	2	50	-
-	Research Work*	14	28	-	35
<b>Total</b>		<b>21</b>			

\* Non-University Exam

### M. Pharm Semester-4

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage for Internal Examination	Weightage for Semester Examination
-	Journal club	1	1	25	-
-	Discussion/Presentation (Proposal Presentation)	3	3	75	-
-	Research Work and Colloquium	16	31	-	40
<b>Total</b>		<b>20</b>			

# M PHARM SEMESTER 1

## MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPG 101T)

**Theory: 4 Hrs. /Week**

### Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

### Objectives

After completion of course student is able to know,

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

### Course Outcomes

**CO1:** Identification of drug or plant constituents with various analytical techniques

**CO2:** Analysis of drug or plant constituents with various analytical techniques

**CO3:** Student will expose to different analytical data like LC-MS, GC-MS, IR, DSC etc. theoretically and practically.

**CO4:** Fellow student will able to handle different analytical data to predict the unknown structures. The fellow student will gain the interpretation skills

**CO5:** At the end of the course student should know to handle different hyphenated instruments data

### Course content

#### Unit 1

**10 Hrs**

- UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy.
- IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy
- Spectrofluorimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.
- Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

#### Unit 2

**10 Hrs**

NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and <sup>13</sup>C NMR. Applications of NMR spectroscopy.



### Unit 3

10 Hrs

**Mass Spectroscopy:** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analysers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

### Unit 4

10 Hrs

**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

- a) Thin Layer chromatography
- b) High Performance Thin Layer Chromatography
- c) Ion exchange chromatography
- d) Column chromatography
- e) Gas chromatography
- f) High Performance Liquid chromatography
- g) Ultra High Performance Liquid chromatography
- h) Affinity chromatography
- i) Gel Chromatography

### Unit 5

10 Hrs

**Electrophoresis:** Principle, Instrumentation, working conditions, factors affecting separation and applications of the following:

- a) Paper electrophoresis
- b) Gel electrophoresis
- c) Capillary electrophoresis
- d) Zone electrophoresis
- e) Moving boundary electrophoresis
- f) Iso electric focusing

**X ray Crystallography:** Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

### Unit 6

10 Hrs

**Potentiometry:** Principle, working, Ion selective Electrodes and Application of potentiometry.

**Thermal Techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.

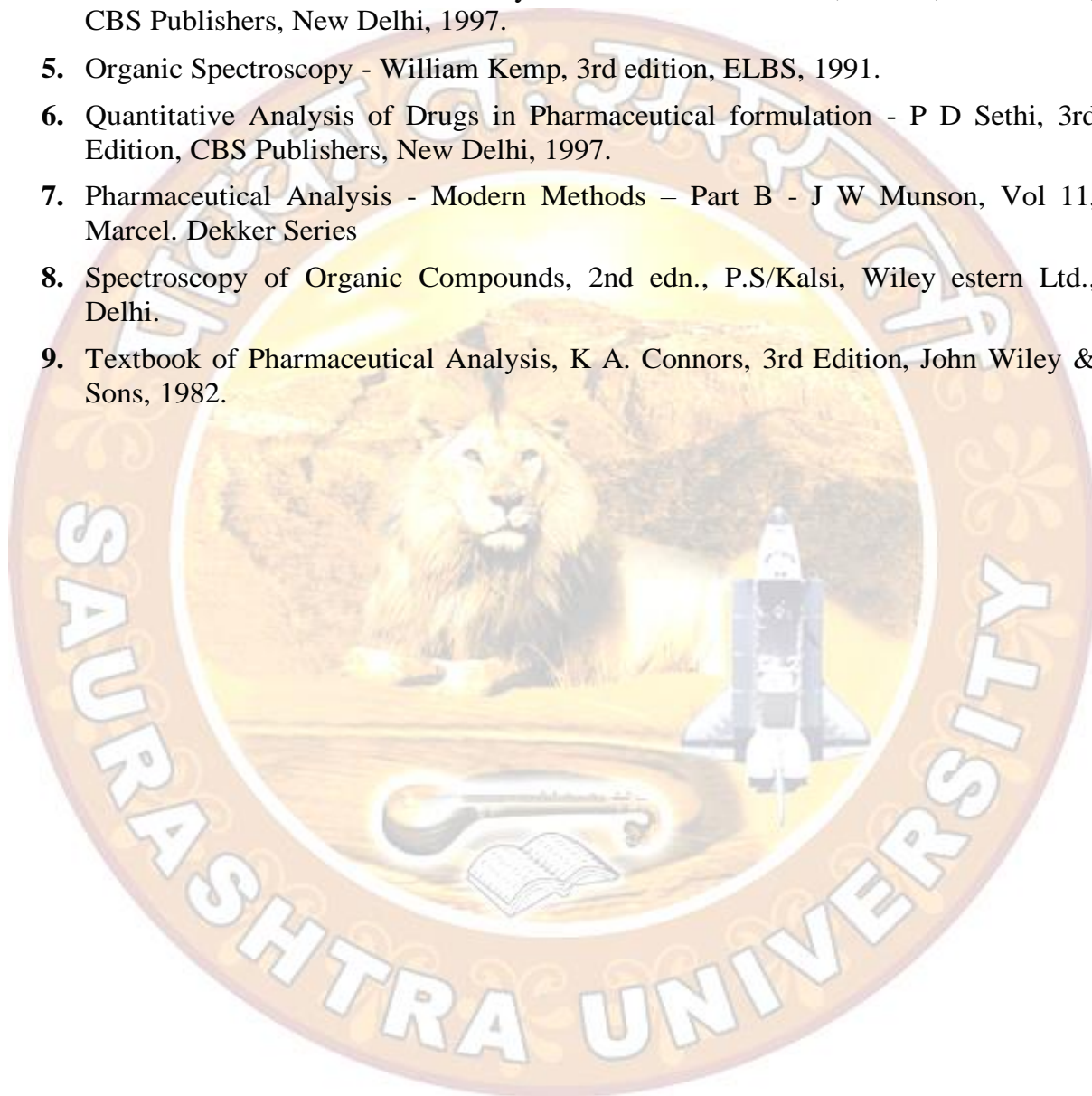
**Differential Thermal Analysis (DTA):** Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA).

**TGA:** Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.



## REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series
8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, K A. Connors, 3rd Edition, John Wiley & Sons, 1982.



# M PHARM SEMESTER 1

## ADVANCED PHARMACOGNOSY – I (MPG 102T)

Theory: 4 Hrs. /Week

### Scope

To learn and understand the advances in the field of cultivation and isolation of drugs of natural origin, various phytopharmaceuticals, nutraceuticals and their medicinal use and health benefits.

### Objectives

Upon completion of the course, the student shall be able to know the,

- Advances in the cultivation and production of drugs
- Various phyto-pharmaceuticals and their source, its utilization and medicinal value.
- Various nutraceuticals/herbs and their health benefits
- Drugs of marine origin
- Pharmacovigilance of drugs of natural origin

### Course outcomes

**CO1:** Knowledge about cultivation of medicinal plants and different guidelines related to cultivation

**CO2:** Marine drug discovery and study of marine natural products

**CO3:** Scope, medicinal value and standardization of nutraceuticals and regulatory aspect of nutraceuticals

**CO4:** Occurrence, isolation, characterization, identification, biosynthesis and activity profile of biologically active natural products.

**CO5:** WHO guideline study for quality and safety monitoring of herbal drugs and study about herb drug, food drug interaction and adverse effect of herbals.

### Course content

#### Unit 1

12 Hrs

Plant drug cultivation: General introduction to the importance of Pharmacognosy in herbal drug industry, Indian Council of Agricultural Research, Current Good Agricultural Practices, Current Good Cultivation Practices, Current Good Collection Practices, Conservation of medicinal plants- Ex-situ and In-situ conservation of medicinal plants.

#### Unit 2

12 Hrs

Marine natural products: General methods of isolation and purification, Study of Marine toxins, Recent advances in research in marine drugs, Problems faced in research on marine drugs such as taxonomical identification, chemical screening and their solution.

#### Unit 3

12 Hrs

- **Nutraceuticals:** Current trends and future scope, Inorganic mineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibres, Cereals and grains, Health drinks of natural origin, Antioxidants, Polyunsaturated fatty acids, Herbs as functional foods, Formulation and standardization of neutraceuticals,



- **Regulatory aspects**, FSSAI guidelines, Sources, name of marker compounds and their chemical nature, medicinal uses and health benefits of following i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi) Green and Herbal Tea vii) Flax seeds viii) Black cohosh ix) Turmeric.

#### Unit 4

12 Hrs

Phytopharmaceuticals: Occurrence, isolation and characteristic features (Chemical nature, uses in pharmacy, medicinal and health benefits) of following.

- Carotenoids – i)  $\alpha$  and  $\beta$  - Carotene ii) Xanthophyll (Lutein)
- Limonoids – i) d-Limonene ii)  $\alpha$  - Terpineol
- Saponins – i) Shatavarins
- Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin
- Phenolic acids- Ellagic acid
- Vitamins
- Tocotrienols and Tocopherols
- Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol
- Miscellaneous

#### Unit 5

12 Hrs

**Pharmacovigilance of drugs of natural origin:** WHO and AYUSH guidelines for safety monitoring of natural medicine, Spontaneous reporting schemes for biodrug adverse reactions, bio drug-drug and bio drug-food interactions with suitable examples.

#### REFERENCES (Latest Editions of)

1. Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
2. Pharmacognosy-Tyler, Brady,Robbers
3. Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol.I&II
4. Text Book of Pharmacognosy by T.E.Wallis
5. Marine Natural Products-Vol.I toIV.
6. Natural products: A lab guide by Raphael Ikan, Academic Press1991.
7. Glimpses of Indian Ethano Pharmacology, P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute,1995.
8. Medicinal natural products (a biosynthetic approach), Paul M. Dewick, John Wiley & Sons Ltd., England,1998.
9. Chemistry of Marine Natural Products- Paul J. Schewer1973.
10. Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi, 1996.
11. Cultivation of Medicinal Plants by C.K. Atal & B.M.Kapoor.
12. Cultivation and Utilization of Aromatic Plants, C.K. Atal & B. M. Kapoor  
Cultivation of medicinal and aromatic crops, AA Farooqui and B.S. Sreeramu. University Press, 2001
13. Cultivation of medicinal and aromatic crops, AA Farooqui and B.S. Sreeramu. University Press, 2001.
14. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRC Press, New York,1998



15. Recent Advances in Phytochemistry - Vol.1 & 4: Scikel Runeckles - Appleton Century crofts.
16. Text book of Pharmacognosy, C. K. Kokate, Purohit, Ghokhale, Nirali Prakasshan,1996.
17. Pharmacognosy and Pharmaco-biotechnology, Ashutoshkar, New Age Publications, New Delhi.



# M PHARM SEMESTER 1 PHYTOCHEMISTRY (MPG 103T)

Theory: 4 Hrs. /Week

## SCOPE

Students shall be equipped with the knowledge of natural product drug discovery and will be able to isolate, identify and extract and the phyto- constituents

## OBJECTIVES

Upon completion of the course, the student shall be able to know the,

- Different classes of phytoconstituents, their biosynthetic pathways, their properties, extraction and general process of natural product drug discovery
- Phytochemical fingerprinting and structure elucidation of phytoconstituents.

## COURSE OUTCOMES

**CO1:** Biogenesis and biological activity of natural products coming from mevalonate: terpenoids and steroids

**CO2:** Extraction procedures for natural compounds, their differences and their applications the main pathways of aromatic amino acids, alkaloids, phenylpropanoids

**CO3:** Herbal Drug discovery and development. Optimization of Lead compounds.

**CO4:** After finishing the course, the students will get professional, Practical skills & time management skills in extraction, Isolation and Phytochemical analysis of Natural products.

**CO5:** Course provides skill in separation of the active constituents obtained from natural sources, in addition to the different methods of separation (chromatography).

**CO6:** Application of HPTLC and GC technique in fingerprinting, analysis and identification of phytoconstituents. Structure elucidation of unknown molecule

## Course Content

### Unit 1

12 Hrs

Biosynthetic and Radio tracing techniques: Constituents & their Biosynthesis, Isolation, Characterization and purification with a special reference to their importance in herbal industries of following phyto-pharmaceuticals containing drugs:

- a) Alkaloids: Ephedrine, Quinine, Strychnine, Piperine, Berberine, Taxol, Vincaalkaloids.
- b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercetin.
- c) Steroids: Hecogenin, guggulosterone and withanolides
- d) Coumarin: Umbelliferone.
- e) Terpenoids: Cucurbitacins

### Unit 2

12 Hrs

- Drug discovery and development: History of herbs as source of drugs and drug discovery, the lead structure selection process, structure development, product discovery process and drug registration.

- Selection and optimization of lead compounds with suitable examples from the following source: Artemesin, andrographolides.
- Clinical studies emphasising on phases of clinical trials, protocol design for lead molecules.

### Unit 3

12 Hrs

- Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods of extraction commonly used like microwave assisted extraction.
- Methods of fractionation.
- Separation of phytoconstituents by latest CCCET, SCFE techniques including preparative HPLC and Flash column chromatography.

### Unit 4

12 Hrs

Phytochemical finger printing: HPTLC and LCMS/GCMS applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents.

### Unit 5

12 Hrs

Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (<sup>1</sup>H, <sup>13</sup>C)

- Carvone, Citral, Menthol
- Luteolin, Kaempferol
- Nicotine, Caffeine
- Glycyrrhizin

### REFERENCES (Latest Editions of)

1. Organic chemistry by I.L. Finar Vol.II
2. Pharmacognosy by Trease and Evans, ELBS.
3. Pharmacognosy by Tylor and Brady.
4. Text book of Pharmacognosy by Wallis.
5. Clark's isolation and Identification of drugs by A.C.Mottal.
6. Plant Drug Analysis by Wagner & Blatt.
7. Wilson and Gisvolds text book of Organic Medicinal and Pharmaceutical Chemistry by George. R.F.
8. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer International Edn.1994.
9. Natural Products Chemistry Practical Manual by Anees A Siddiqui and Seemi Siddiqui
10. Organic Chemistry of Natural Products, Vol. 1&2. Gurdeep RChatwal.
11. Chemistry of Natural Products- Vol. 1 onwards IWPAC.
12. Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II



13. Medicinal Natural products – a biosynthetic approach, Dewick PM, John Wiley & Sons, Toronto,1998.
14. Chemistry of Natural Products, Bhat SV, Nagasampagi BA, Meenakshi S, Narosa Publishing House, NewDelhi.
15. Pharmacognosy & Phytochemistry of Medicinal Plants, 2<sup>nd</sup> edition, Bruneton J, Interceptt Ltd., New York,1999.



# M PHARM SEMESTER 1

## INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY (MPG 104T)

**Theory: 4 Hrs. /Week**

### SCOPE

To understand the Industrial and commercial potential of drugs of natural origin, integrate traditional Indian systems of medicine with modern medicine and also to know regulatory and quality policy for the trade of herbals and drugs of natural origin.

### OBJECTIVES

By the end of the course the student shall be able to know,

- The requirements for setting up the herbal/natural drug industry.
- The guidelines for quality of herbal/natural medicines and regulatory issues.
- The patenting/IPR of herbals/natural drugs and trade of raw and finished materials.

### COURSE OUTCOMES

**CO1:** Starting up of new herbal drug industry. Regulatory requirements/ documentation for starting a new natural drug industry.

**CO2:** Regulatory requirements/ documentation for starting a new natural drug industry. ISO documentation and Export and import policies in herbal industry sector. GMP / GLP in Herbal drug sector.

**CO3:** Monograph preparation and documentation of herbal drugs and extracts. WHO guidelines in safety assessment of herbal drugs.

**CO4:** Develop skill in testing of herbal drugs and Knowledge about IPR and Patenting.

### Course content

#### Unit 1 12 Hrs

- **Herbal drug industry:** Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Current challenges in upgrading and modernization of herbal formulations.
- Entrepreneurship Development, Project selection, project report, technical knowledge, Capital venture, plant design, layout and construction.
- Pilot plant scale-up techniques, case studies of herbal extracts. Formulation and production management of herbals.

#### Unit 2 12 Hrs

- Regulatory requirements for setting herbal drug industry: Global marketing management. Indian and international patent law as applicable herbal drugs and natural products. Export - Import (EXIM) policy, TRIPS.
- Quality assurance in herbal/natural drug products. Concepts of TQM, GMP, GLP, ISO-9000.

**Unit 3** **12 Hrs**

- Monographs of herbal drugs: General parameters of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, American herbal pharmacopoeia, British herbal pharmacopoeia,
- WHO guidelines in quality assessment of herbal drugs.

**Unit 4** **12 Hrs**

Testing of natural products and drugs: Herbal medicines - clinical laboratory testing. Stability testing of natural products, protocols.

**Unit 5** **12 Hrs**

- Patents: Indian and international patent laws, proposed amendments as applicable to herbal/natural products and process.
- Geographical indication, Copyright, Patentable subject matters, novelty, non-obviousness, utility, enablement and best mode, procedure for Indian patent filing, patent processing, grant of patents, rights of patents, cases of patents, opposition and revocation of patents, patent search and literature, Controllers of patents

**REFERENCES (Latest Editions of)**

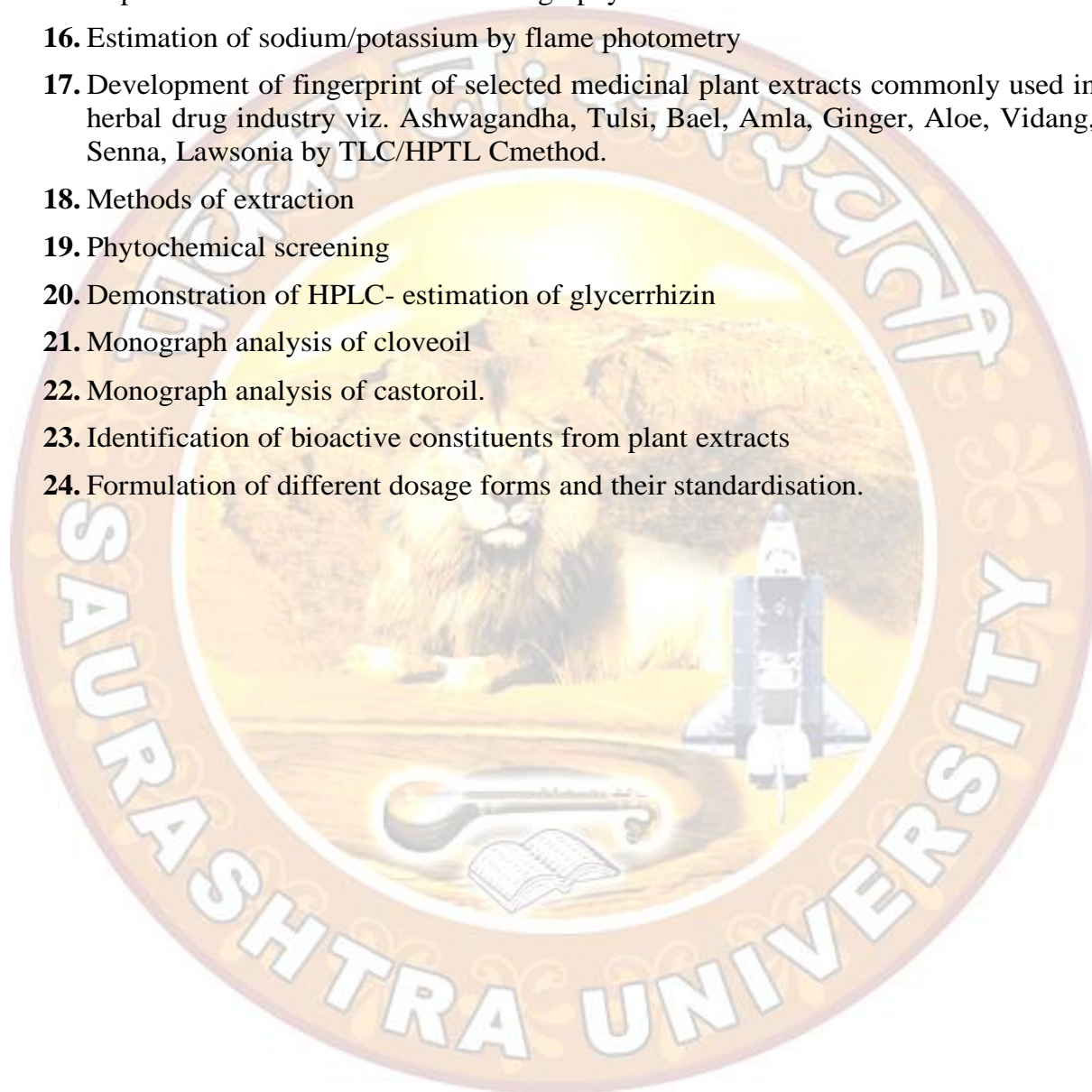
1. Herbal drug industry by R.D. Choudhary (1996), Eastern Publisher, New Delhi.
2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee (2003), Ist Edition, Business horizons Robert Verpoorte, New Delhi.
3. Quality control of herbal drugs by Pulok K Mukarjee (2002), Business Horizons Pharmaceutical Publisher, New Delhi.
4. PDR for Herbal Medicines (2000), Medicinal Economic Company, New Jersey.
5. Indian Herbal Pharmacopoeia (2002), IDMA, Mumbai.
6. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (1996), Nirali Prakashan, New Delhi.
7. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI (2002), Part I & II, Career Publication, Nasik, India.
8. Plant drug analysis by H.Wagner and S.Bladt, Springer, Berlin.
9. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol.I, Eastern Publisher, New Delhi.
10. Phytochemical Dictionary. Handbook of Bioactive Compounds from Plants by J.B.Harborne, (1999), IInd Edition, Taylor and Francis Ltd, UK.
11. Herbal Medicine. Expanded Commission E Monographs by M.Blumenthal, (2004), ISt Edition,
12. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), Eastern Publisher, New Delhi



**M PHARM SEMESTER 1**  
**PHARMACOGNOSY PRACTICAL - I (MPG I05P)**

**Practical: 12 Hrs. /Week**

13. Analysis of Pharmacopoeia compounds of natural origin and their formulations by UV spectrophotometer
14. Analysis of recorded spectra of simple Phyto constituents
15. Experiments based on Gas Chromatography
16. Estimation of sodium/potassium by flame photometry
17. Development of fingerprint of selected medicinal plant extracts commonly used in herbal drug industry viz. Ashwagandha, Tulsi, Bael, Amla, Ginger, Aloe, Vidang, Senna, Lawsonia by TLC/HPTL Cmethod.
18. Methods of extraction
19. Phytochemical screening
20. Demonstration of HPLC- estimation of glycerrhizin
21. Monograph analysis of cloveoil
22. Monograph analysis of castoroil.
23. Identification of bioactive constituents from plant extracts
24. Formulation of different dosage forms and their standardisation.



# **M.PHARM SEMESTER-II**

## **MEDICINAL PLANT BIOTECHNOLOGY (MPG 201T)**

**Theory: 4 Hrs. /Week**

### **SCOPE**

To explore the knowledge of Biotechnology and its application in the improvement of quality of medicinal plants

### **OBJECTIVES:**

Upon completion of the course, the student shall be able to,

- Know the process like genetic engineering in medicinal plants for higher yield of Phytopharmaceuticals.
- Use the biotechnological techniques for obtaining and improving the quality of natural products/medicinal plants

### **COURSE OUTCOME:**

- CO1:** Describe mechanisms of plant pollination and differentiate between haploid and diploid cells and their role in sexual reproduction
- CO2:** Develop skill in Plant tissue culture techniques for production of genetically modified plants.
- CO3:** Develop skill in Hairy root culture for production of different primary and secondary metabolites.
- CO4:** Different methods of cloning and its applications.
- CO5:** Knowledge about Application of PCR in plant genome analysis.
- CO6:** Plant fermentation technology in production of secondary metabolites.

### **Course content**

#### **Unit 1** **12 Hrs**

- Introduction to Plant biotechnology: Historical perspectives, prospects for development of plant biotechnology as a source of medicinal agents.
- Applications in pharmacy and allied fields.
- Genetic and molecular biology as applied to pharmacognosy, study of DNA, RNA and protein replication, genetic code, regulation of gene expression, structure and complicity of genome, cell signalling, DNA recombinant technology

#### **Unit 2** **15 Hrs**

- Different tissue culture techniques: Organogenesis and embryogenesis, synthetic seed and monoclonal variation, Protoplast fusion, Hairy root multiple shoot cultures and their applications.
- Micro propagation of medicinal and aromatic plants. Sterilization methods involved in tissue culture, gene transfer in plants and their applications.

**Unit 3****15 Hrs**

- Immobilisation techniques & Secondary Metabolite Production: Immobilization techniques of plant cell and its application on secondary metabolite Production.
- Cloning of plant cell: Different methods of cloning and its applications.
- Advantages and disadvantages of plant cell cloning.
- Secondary metabolism in tissue cultures with emphasis on production of medicinal agents. Precursors and elicitors on production of secondary metabolites.

**Unit 4****13 Hrs**

- Biotransformation and Transgenesis: Biotransformation, bioreactors for pilot and large-scale cultures of plant cells and retention of biosynthetic potential in cell culture.
- Transgenic plants, methods used in gene identification, localization and sequencing of genes. Application of PCR in plant genome analysis.

**Unit 5****05 Hrs**

Fermentation technology: Application of Fermentation technology, Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest.

**REFERENCES (Latest Editions of)**

1. Plant tissue culture, Bhagwani, vol 5, Elsevier Publishers.
2. Plant cell and Tissue Culture (Lab. Manual), JRMM. Yeoman.
3. Elements in biotechnology by PK. Gupta, Rastogi Publications, New Delhi.
4. An introduction to plant tissue culture by MK. Razdan, Science Publishers.
5. Experiments in plant tissue culture by John HD and Lorin WR., Cambridge University Press.
6. Pharmaceutical biotechnology by SP. Vyas and VK. Dixit, CBS Publishers.
7. Plant cell and tissue culture by Jeffrey W. Pollard and John M Walker, Humana press.
8. Plant tissue culture by Dixon, Oxford Press, Washington DC, 1985
9. Plant tissue culture by Street.
10. Pharmacognosy by G. E. Trease and WC. Evans, Elsevier.
11. Biotechnology by Purohit and Mathur, Agro-Bio, 3 rd revised edition.
12. Biotechnological applications to tissue culture by Shargool, Peter D, Shargool, CKC Press.
13. Pharmacognosy by Varo E. Tyler, Lynn R. Brady and James E. Robberrt, That Tjen, NGO.
14. Plant Biotechnology, Ciddi Veerasham



## **M.PHARM SEMESTER-II**

### **ADVANCED PHARMACOGNOSY – II (MPG 202T)**

**Theory: 4 Hrs. /Week**

#### **SCOPE:**

To know and understand the Adulteration and Deterioration that occurs in herbal/natural drugs and methods of detection of the same. Study of herbal remedies and their validations, including methods of screening

#### **OBJECTIVES:**

Upon completion of the course, the student shall be able to know the,

- validation of herbal remedies
- methods of detection of adulteration and evaluation techniques for the herbal drugs
- methods of screening of herbals for various biological properties

#### **COURSE OUTCOME:**

**CO1:** Students will study the role of ethno botany and ethnopharmacology in drug development

**CO2:** Critically evaluate the use of plant and plant products as medicinal agents

**CO3:** Develop analytical profile of different classes of phytochemicals

**CO4:** Discuss the therapeutic actions of main classes of phytochemical and their interactions with other herbs or drugs and become familiar with DNA fingerprinting techniques.

**CO 5:** To study the toxicity and regulations of herbal vs conventional drugs

**CO6:** Students will study the biological screening of herbal drugs and related guidelines.

### **Course content**

#### **Unit 1 12 Hrs**

Herbal remedies – Toxicity and Regulations: Herbals vs Conventional drugs, Efficacy of Herbal medicine products, Validation of herbal therapies, Pharmacodynamic and Pharmacokinetic issues.

#### **Unit 2 12 Hrs**

Adulteration and Deterioration: Introduction, Types of Adulteration/ Substitution of Herbal drugs, Causes and Measures of Adulteration, Sampling Procedures, Determination of Foreign Matter, DNA Finger printing techniques in identification of drugs of natural origin, detection of heavy metals, pesticide residues, phytotoxin, microbial contamination in herbs and their formulations.

#### **Unit 3 12 Hrs**

Ethnobotany and Ethnopharmacology: Ethnobotany in herbal drug evaluation, Impact of Ethnobotany in traditional medicine, New development in herbals, Bio-prospecting tools for drug discovery, Role of Ethnopharmacology in drug evaluation, Reverse Pharmacology.

**Unit 4****12 Hrs**

Analytical Profiles of herbal drugs: *Andrographis paniculata*, *Boswellia serata*, *Coleus forskholii*, *Curcuma longa*, *Embelica officinalis*, *Psoralea corylifolia*.

**Unit 5****12 Hrs**

Biological screening of herbal drugs: Introduction and Need for Phyto-Pharmacological Screening, New Strategies for evaluating Natural Products, In vitro evaluation techniques for Antioxidants, Antimicrobial and Anticancer drugs. In vivo evaluation techniques for Anti-inflammatory, Antiulcer, Anticancer, Wound healing, Antidiabetic, Hepatoprotective, Cardio protective, Diuretics and Antifertility, Toxicity studies as per OECD guidelines.

**REFERENCES (Latest Editions of)**

1. Glimpses of Indian Ethano Pharmacology by P. Pushpangadam. Ulf Nyman V. George Tropical Botanic Garden & Research Institute.
2. Natural products: A lab guide by Raphael Ikan, Academic Press.
3. Pharmacognosy - G. E. Trease and W.C. Evans. WB. Saunders Edinburgh, New York.
4. Pharmacognosy-Tyler, Brady, Robbers, Lee & Fetiger.
5. Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I & II, Springer Publishers.
6. Herbal Drug Industry by RD. Choudhary, Eastern Publishers, New Delhi.
7. Text book of Pharmacognosy by C.K.Kokate, Purohit, Ghokhale, NiraliPrakashan.
8. Text Book of Pharmacognosy by T.E. Wallis, J & A Churchill Ltd., London.
9. Quality control of herbal drugs by Pulok K Mukherjee, Business Horizons Pharmaceutical Publishers, New Delhi.
10. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
11. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI, Part I & II, Career Publication, Nasik, India.
12. Plant drug analysis by H.Wagner and S.Bladt, 2nd edition, Springer, Berlin.
13. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol.I, Eastern PublisherS, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M.Blumenthal.



# **M.PHARM SEMESTER-II**

## **INDIAN SYSTEMS OF MEDICINE (MPG 203T)**

**Theory: 4 Hrs. /Week**

### **SCOPE**

To make the students understand thoroughly the principles, preparations of medicines of various Indian systems of medicine like Ayurveda, Siddha, Homeopathy and Unani. Also focusing on clinical research of traditional medicines, quality assurance and challenges in monitoring the safety of herbal medicines.

### **OBJECTIVES:**

After completion of the course, student is able to

- To understand the basic principles of various Indian systems of medicine
- To know the clinical research of traditional medicines, Current Good Manufacturing Practice of Indian systems of medicine and their formulations.

### **COURSE OUTCOME:**

**CO1:** Students will get knowledge of fundamental concepts of Ayurveda, siddha, unani and homeopathic system of medicine. Basic principles and healing potentials of Yoga, Naturopathy and Aromatherapy.

**CO2:** Students will get knowledge of formulation development and standardisation of various traditional formulations. Various purification process (Shodana and Marana concepts)

**CO3:** Quality control and quality assurance concepts involved in traditional system of medicine.

**CO4:** Study the concepts of AYUSH, AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU.

### **Course content**

#### **Unit 1**

**12 Hrs**

Fundamental concepts of Ayurveda, Siddha, Unani and Homoeopathy systems of medicine Different dosage forms of the ISM. Ayurveda: Ayurvedic Pharmacopoeia, Analysis of formulations and bio crude drugs with references to: Identity, purity and quality. Siddha: Gunapadam (Siddha Pharmacology), raw drugs/Dhatu/Jeevam in Siddha system of medicine, Purification process (Suddhi).

#### **Unit 2**

**12 Hrs**

Naturopathy, Yoga and Aromatherapy practices

- a) Naturopathy - Introduction, basic principles and treatment modalities.
- b) Yoga - Introduction and Streams of Yoga. Asanas, Pranayama, Meditations and Relaxation techniques.
- c) Aromatherapy – Introduction, aroma oils for common problems, carrier oils.



**Unit 3****12 Hrs**

Formulation development of various systems of medicine Salient features of the techniques of preparation of some of the important class of Formulations as per Ayurveda, Siddha, Homeopathy and Unani Pharmacopoeia and texts. Standardization, Shelf life and Stability studies of ISM formulations.

**Unit 4****12 Hrs**

Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives, Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records. Quality assurance in ISM formulation industry - GAP, GMP and GLP. Preparation of documents for new drug application and export registration. Challenges in monitoring the safety of herbal medicines: Regulation, quality assurance and control, National/Regional Pharmacopoeias.

**Unit 5****12 Hrs**

TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU

**REFERENCES (Latest Editions of)**

1. Ayurvedic Pharmacopoeia, The Controller of Publications, Civil Lines, Govt. of India, New Delhi.
2. Hand Book on Ayurvedic Medicines, H. Panda, National Institute of Industrial Research, New Delhi.
3. Ayurvedic System of Medicine, KavirajNagendranathSengupata, Sri Satguru Publications, New Delhi.
4. Ayurvedic Pharmacopoeia. Formulary of Ayurvedic Medicines, IMCOPS, Chennai.
5. Homeopathic Pharmacopoeia. Formulary of Homeopathic Medicines, IMCOPS, Chennai.
6. Homeopathic Pharmacy: An introduction & Hand book, Steven B. Kayne, Churchill Livingstone, New York.
7. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
8. British Herbal Pharmacopoeia, British Herbal Medicine Association, UK.
9. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Pulok K Mukharjee, Business Horizons, New Delhi.
10. Indian System of Medicine and Homeopathy in India, Planning and Evaluation Cell, Govt. of India, New Delhi.
11. Essential of Food and Nutrition, Swaminathan, Bappco, Bangalore.
12. Clinical Dietitics and Nutrition, F.P. Antia, Oxford University Press, Delhi.
13. Yoga - The Science of Holistic Living by V.K.Yoga, Vivekananda Yoga Prakashna Publishing, Bangalore.

## **M.PHARM SEMESTER-II HERBAL COSMETICS (MPG 204T)**

**Theory: 4 Hrs. /Week**

### **SCOPE:**

This subject deal with the study of preparation and standardization of herbal/natural cosmetics. This subject gives emphasis to various national and international standards prescribed regarding herbal cosmeceuticals.

### **OBJECTIVES:**

After completion of the course, student shall be able to,

- Understand the basic principles of various herbal/natural cosmetic preparations
- Current Good Manufacturing Practices of herbal/natural cosmetics as per the regulatory authorities

### **COURSE OUTCOME:**

**CO1:** Study of herbal formulations, cosmeceutical and regulatory requirements of herbal drugs along with biological screening for their therapeutic efficacy will help the student to understand the overall process of formulation and development of herbal drugs.

**CO2:** Develop skill in Herbal cosmeceutical development and standardization Raw product analysis

**CO3:** Students will study import and export of herbal cosmetics.

**CO4:** Students will also become familiar with possible interactions between chemicals and herbs

**CO5:** Develop skill in Quality control and quality assurance of herbal cosmetics. To learn toxicological and allergen screening techniques

### **Course content**

#### **Unit 1**

**12 Hrs**

Introduction: Herbal/natural cosmetics, Classification & Economic aspects. Regulatory Provisions relation to manufacture of cosmetics: - License, GMP, offences & Penalties, Import & Export of Herbal/natural cosmetics, Industries involved in the production of Herbal/natural cosmetics.

#### **Unit 2**

**12 Hrs**

Commonly used herbal cosmetics, raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation.

#### **Unit 3**

**12 Hrs**

Herbal Cosmetics: Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail, Cleansing cream, Lotions, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Preparation and standardisation of the following: Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails.



**Unit 4****12 Hrs**

Cosmeceuticals of herbal and natural origin: Hair growth formulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sun burn preparations, moisturizing creams, deodorants.

**Unit 5****12 Hrs**

Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act.

**REFERENCES (Latest Editions of)**

1. Panda H. Herbal Cosmetics (Hand book), Asia Pacific Business Press Inc, New Delhi.
2. Thomson EG. Modern Cosmetics, Universal Publishing Corporation, Mumbai.
3. P.P.Sharma. Cosmetics - Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi.
4. Supriya K B. Handbook of Aromatic Plants, Pointer Publishers, Jaipur.
5. Skaria P. Aromatic Plants (Horticulture Science Series), New India Publishing Agency, New Delhi.
6. Kathi Keville and Mindy Green. Aromatherapy (A Complete Guide to the Healing Art), Sri Satguru Publications, New Delhi.
7. Chattopadhyay PK. Herbal Cosmetics & Ayurvedic Medicines (EOU), National Institute of Industrial Research, Delhi.
8. Balsam MS & Edward Sagarin. Cosmetics Science and Technology, Wiley Interscience, New York.



**M. PHARM SEMESTER III**  
**HERBAL COSMETICS PRACTICALS (MPG 205P)**  
**Practical: 12 Hrs. /Week**

**List of practical**

1. Isolation of nucleic acid from cauliflower heads
2. Isolation of RNA from yeast
3. Quantitative estimation of DNA
4. Immobilization technique
5. Establishment of callus culture
6. Establishment of suspension culture
7. Estimation of aldehyde contents of volatile oils
8. Estimation of total phenolic content in herbal raw materials
9. Estimation of total alkaloid content in herbal raw materials
10. Estimation of total flavonoid content in herbal raw materials
11. Preparation and standardization of various simple dosage forms from Ayurvedic, Siddha, Homoeopathy and Unani formulary
12. Preparation of certain Aromatherapy formulations
13. Preparation of herbal cosmetic formulation such as lip balm, lipstick, facial cream, herbal hair and nail care products
14. Evaluation of herbal tablets and capsules
15. Preparation of sunscreen, UV protection cream, skin care formulations.
16. Formulation & standardization of herbal cough syrup.

**M. PHARM SEMESTER III**  
**RESEARCH METHODOLOGY & BIostatISTICS**  
**(MRM 301T)**

**Theory: 4 Hrs. /Week**

**Scope**

This subject deals with various established methods used in pharmaceutical research.

**Objectives**

Upon completion of the course student shall be able to understand

Learn general research methodology and the basic concepts of biostatistics.

Understand the functions of ethics committees in medical research.

**Course Outcomes**

**CO1** Able to carry out different parametric and non-parametric tests

**CO2** Learn about the ethics committee and its function in medical research

**CO3** Learn the guidelines for the experimentation on animals

**CO4** prepare protocol for Animal study

**Course content**

**Unit 1**

**12 Hrs**

**General Research Methodology:**

Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

**Unit 2**

**12 Hrs**

**Biostatistics:**

Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxon rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

**Unit 3**

**12 Hrs**

**Medical Research:**

History, values in medical ethics, autonomy, beneficence, non- maleficence, double effect, conflicts between autonomy and beneficence/non- maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

**Unit 4****12 Hrs****CPCSEA guidelines for laboratory animal facility:**

Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anaesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

**Unit 5****12 Hrs****Declaration of Helsinki:**

History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

