Scheme and Syllabus

M. Pharmacy
Pharmacognosy

Batch 2017 onwards

PTU

ਆਈ. ਕੇ. ਗੁਜਰਾਲ ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ

By
Board of Studies Pharmacy
Department of Academics

First Semester

Course Code	Course Name	L	P	Marks			Credits
				Internal	External	Total	
MPG101T	Modern Pharmaceutical Analytical Techniques	4	-	25	75	100	4
MPG102T	Advanced Pharmacognosy-I	4	-	25	75	100	4
MPG103T	Phytochemistry	4	-	25	75	100	4
MPG104T	Industrial Pharmacognostical Technology	4		25	75	100	4
MPG105P	Pharmacognosy Practical -I	-	12	50	100	150	6
-	Seminar/Assignment#	-	7	-	-	100	4
	Total	**16**	**19**	**150**	**400**	**650**	**26**

- # Minimum five seminar/assignment each of 20 marks per semester

Second Semester

Course Code	Course Name	L	P	Marks			Credits
				Internal	External	Total	
MPG201T	Medicinal Plant Biotechnology	4	-	25	75	100	4
MPG202T	Advanced Pharmacognosy-II	4	-	25	75	100	4
MPG203T	Indian System of Medicine	4	-	25	75	100	4
MPG204T	Herbal Cosmetics	4		25	75	100	4
MPG205P	Pharmacognosy Practical-II	-	12	50	100	150	6
-	Seminar/Assignment#	-	7	-	-	100	4
	Total	**16**	**19**	**150**	**400**	**650**	**26**

- # Minimum five seminar/assignment each of 20 marks per semester

Third Semester

Course Code	Course Name	L	P	Marks			Credits
				Internal	**External**	**Total**	
MRM301T	Research Methodology & Biostatistics*	4	-	25	75	100	4
-	Journal Club	1	-	25	-	25	1
-	Discussion / Presentation (Proposal Presentation)	2	-	50	-	50	2
-	Research Work*	-	28	-	350	350	14
	Total	**7**	**28**	**100**	**425**	**525**	**21**

- *Non -University Exam

Fourth Semester

Course Code	Course Name	L	P	Marks			Credits
				Internal	External	Total	
-	Journal Club	1	-	25	-	25	1
-	Research Work	-	31	-	400	400	16
-	Discussion/Final Presentation	3	-	75	-	75	3
-	Co-curricular Activities	-	-	Satisfactory/Unsatisfactory			2*
Total		**4**	**31**	**100**	**400**	**500**	**22**

**Note: Required credit points 02 for satisfactory; Less than 02 credit points unsatisfactory*

***Credits not included towards calculation of CGPA**

Semester Wise Credits Distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations & Other Scholarly Activities)	02*
Total Credit Points	**93 + 2* = 95**

- *Credit Points for Co-curricular Activities
- *Credits not included towards calculation of CGPA
- *The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University

Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points
Participation in National Level Seminar/ Conference/ Workshop/ Symposium/ Training Programs (related to the specialization of the student) OR Academic Award/Research Award from State Level/National Agencies	02
Participation in International Level Seminar/ Conference/ Workshop/ Symposium / Training Programs (related to the specialization of the student) #	02
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)*	01
Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)*$	02

- #International Conference held even in India will be considered for award of Credit Points.
- *Only those research / review publications will be considered which have been published during the tenure of M. Pharm. Course.
- $ International Journal: The Editorial Board outside India.

Academic Work

The department / teaching staff of respective courses shall maintain a regular record of attendance in Theory, Practical, Seminar, Assignment, Journal Club, and Discussion with the supervisor, Research work presentation and Dissertation.

Program Committee

1. M. Pharm. Programme shall have a Programme Committee constituted by the Head of the Institution in consultation with all the Heads of the departments.
2. The composition of the Programme Committee shall be as follows:
   a. A teacher at the cadre of Professor shall be the Chairperson
   b. One Teacher from each M. Pharm. Specialization
   c. Four student representatives (two from each academic year), nominated by the Head of the Institution
3. Duties of the Programme Committee:
   a. Periodically review the progress of the classes.
   b. Discuss the problems concerning curriculum, syllabus and the conduct of classes.
   c. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.

Sessional Exams

- Two sessional exams shall be conducted for each theory/practical course
- The average marks of two sessional exams shall be computed for internal assessment
- Sessional exam shall be **conducted for 30 marks** for theory and shall be **computed for 15 marks**.
- Sessional exam for practical shall be **conducted for 40 marks** and shall be **computed for 30 marks**.

Question Paper Pattern for Theory Sessional Examinations

Multiple Choice Questions (MCQs) **OR** Objective Type Questions (5 x 2) (Answer all the questions)	10 x 1 = 10 **OR** 05 x 2 = 10
Short Answers (Answer 2 out of 3)	2 x 5 = 10
Long Answers (Answer 1 out of 2)	1 x 10 = 10
Total	**30 Marks**

Question Paper Pattern for Practical Sessional Examinations

Synopsis	10
Experiments	25
Viva voce	05
Total	**40 Marks**

Internal Assessment

- The internal assessment will have two components i.e. **Continuous Mode** and **Sessional Exams**

1. Theory Courses having Internal of 25 Marks the scheme of internal award is:
   - Sessional Exams: 15 Marks
   - Continuous Mode: 10 Marks

Continuous Mode Scheme

Criteria	Maximum Marks
*Attendance (as per table given below)	08
Student – Teacher interaction	02
Total	**10**

2. Practical Courses having Internal of 50 Marks the scheme of internal award is:
   - Sessional Exams: 30 Marks
   - Continuous Mode: 20 Marks

Continuous Mode Scheme

Criteria	Maximum Marks
*Attendance (as per table given below)	10
Based on Practical Records, Regular viva voce, etc.	10
Total	**20**

***Guidelines for the Allotment of Marks for Attendance**

Percentage of Attendance	Theory (Maximum Marks 08)	Practical (Maximum Marks 10)
95 – 100	08	10
90 – 94	06	7.5
85 – 89	04	5
80 – 84	02	2.5
Less than 80	0	0

1st SEMESTER

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG101T	Modern Pharmaceutical Analytical Techniques	4	-	25	75	1	3	4

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

1. Chemicals and Excipients.
2. The analysis of various drugs in single and combination dosage forms.
3. Theoretical and practical skills of the instruments.

Module 01 **10 Hour**

UV-Visible Spectroscopy

- Introduction, Theory, Laws, and Instrumentation associated with UV-Visible spectroscopy
- Choice of solvents and solvent effect
- 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
- Applications of IR spectroscopy, Data Interpretation

Spectroflourimetry

- Theory of Fluorescence
- Factors affecting fluorescence, Quenchers, Instrumentation
- Applications of fluorescence spectrophotometer

Flame Emission Spectroscopy and Atomic Absorption Spectroscopy

- Principle, Instrumentation, Interferences and Applications

Module 02 **10 Hours**

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 ^{13}C NMR
- Applications of NMR spectroscopy

Module 03 **10 Hours**

Mass Spectroscopy

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

Module 04 **10Hours**

Chromatography

Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:

- Thin Layer chromatography
- High Performance Thin Layer Chromatography
- Ion exchange chromatography
- Column chromatography
- Gas chromatography
- High Performance Liquid chromatography
- Ultra High Performance Liquid chromatography
- Affinity chromatography
- Gel Chromatography

Module 05 **10Hours**

Electrophoresis

Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following:

- Paper electrophoresis
- Gel electrophoresis
- Capillary electrophoresis
- Zone electrophoresis
- Moving boundary electrophoresis
- Isoelectric focusing

X ray Crystallography

- Production of X rays
- Different X ray diffraction methods
- Bragg‘s law, Rotating crystal technique, X ray powder technique
- Types of crystals and applications of X-ray diffraction

Module 06 **10 Hours**

Potentiometry

- Principle, working, ion selective electrodes
- 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
- Advantage and disadvantages
- Pharmaceutical applications
- Derivative differential thermal analysis (DDTA)

TGA

- Principle, instrumentation
- Factors affecting results
- Advantage and disadvantages
- Pharmaceutical applications

Recommended Books (Latest editions)

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

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG102T	Advanced Pharmacognosy - I	4	-	25	75	1	3	4

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

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

Module 01 **12Hours**

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

Module 02 **12Hours**

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

Module 03 **12Hours**

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

- Spirulina
- Soya bean
- Ginseng
- Garlic
- Broccoli
- Green and Herbal Tea
- Flax seeds
- Black cohosh
- Turmeric

Module 04 **12 Hours**

Phytopharmaceuticals

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

- Carotenoids – α and β – Carotene, Xanthophyll (Lutein)
- Limonoids – d-Limonene, α – Terpineol
- Saponins – Shatavarins
- Flavonoids – Resveratrol, Rutin, Hesperidin, Naringin, Quercetin
- Phenolic acids- Ellagic acid
- Vitamins
- Tocotrienols and Tocopherols
- Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol
- Miscellaneous

Module 05 **12 Hours**

Pharmacovigilance of Drugs of Natural Origin

- WHO and AYUSH guidelines for safety monitoring of natural medicine
- Spontaneous reporting schemes for bio-drug adverse reactions
- Bio drug-drug and bio drug-food interactions with suitable examples

Recommended Books (Latest editions)

1. Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
2. Pharmacognosy-Tyler, Brady, Robbers.
3. Modem 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 to IV.
6. Natural products: A lab guide by Raphael Ikan, Academic Press.

7. Glimpses of Indian Ethano Pharmacology, P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute.
8. Medicinal natural products (a biosynthetic approach), Paul M. Dewick, John Wiley & Sons Ltd., England.
9. Chemistry of Marine Natural Products- Paul J. Schewer.
10. Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi.
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.
13. Cultivation of medicinal and aromatic crops, AA Farooqui and B.S. Sreeramu. University Press.
14. Natural Products from Plants, by Peter B. Kaufman, CRC Press, New York.
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.
17. Pharmacognosy and Pharmacobiotechnology, Ashutoshkar, New Age Publications, New Delhi.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG103T	Phytochemistry	4	-	25	75	1	3	4

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

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

Module 01 **12 Hours**

Biosynthetic Pathways 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

- Alkaloids: Ephedrine, Quinine, Strychynine, Piperine, Berberine, Taxol, Vinca alkoloids
- Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercitin
- Steroids: Hecogenin, guggulosterone and withanolides
- Coumarin: Umbelliferone
- Terpenoids: Cucurbitacins

Module 02 **12 Hours**

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

Module 03 **12 Hours**

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

Module 04 **12 Hours**

Phytochemical Finger Printing

- HPTLC and LCMS/GCMS applications in the characterization of herbal extracts
- Structure elucidation of phytoconstituents

Module 05 **12 Hours**

Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (^{1}H, ^{13}C)

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

Recommended Books (Latest editions)

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 & Bladt.
7. Wilson and Gisvolds Text book of Organic Medicinnal and Pharmaceutical Chemistry by Deorge. R. F.
8. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer International Edn.
9. Natural Products Chemistry Practical Manual by Anees A Siddiqui and Seemi Siddiqui.
10. Organic Chemistry of Natural Products, Vol. 1& 2. Gurdeep R Chatwal.
11. Chemistry of Natural Products- Vol. 1 onwards IWPAC.
12. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I &II.
13. Medicinal Natural products – a biosynthetic approach, Dewick PM, John Wiley & Sons, Toronto.
14. Chemistry of Natural Products, Bhat SV, Nagasampagi BA, Meenakshi S, Narosa Publishing House, New Delhi.
15. Pharmacognosy & Phytochemistry of Medicinal Plants, Bruneton J, Interceptt Ltd., New York.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG104T	Industrial Pharmacognostical Technology	4	-	25	75	1	3	4

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

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

Module 01 **12 Hours**

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

Module 02 **12 Hours**

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

Module 03 **12 Hours**

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

Module 04 **12 Hours**

Testing of Natural Products and Drugs

- Herbal medicines - clinical laboratory testing
- Stability testing of natural products, protocols

Module 05 **12 Hours**

Patents

- Indian and international patent laws, proposed amendments as applicable to herbal/natural products and process
- Geographical indication, Copyright, Patentable subject maters, 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

Recommended Books (Latest editions)

1. Herbal Drug Industry by R.D. Choudhary, Eastern Publisher, New Delhi.
2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee, Business horizons Robert Verpoorte, New Delhi.
3. Quality control of herbal drugs by Pulok K Mukarjee, Business Horizons Pharmaceutical Publisher, New Delhi.
4. PDR for Herbal Medicines, Medicinal Economic Company, New Jersey.
5. Indian Herbal Pharmacopoeia (2002), IDMA, Mumbai.
6. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae, Nirali Prakashan, New Delhi.
7. Text book of Pharmacognosy and Phytochemistry by Vinod D. Rangari, 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, Vol.I, Eastern Publisher, New Delhi.
10. Phytochemical Dictionary. Handbook of Bioactive Compounds from Plants by J.B.Harborne, Taylor and Francis Ltd, UK.
11. Herbal Medicine. Expanded Commission E Monographs by M. Blumenthal.
12. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah, Eastern Publisher, New Delhi.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG105P	Pharmacognosy Practical - I	-	12	50	100	6	6	6

1. Analysis of Pharmacopoeial compounds of natural origin and their formulations by UV Vis spectrophotometer
2. Analysis of recorded spectra of simple phytoconstituents
3. Experiments based on Gas Chromatography
4. Estimation of sodium/potassium by flame photometry
5. 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/HPTLC method
6. Methods of extraction
7. Phytochemical screening
8. Demonstration of HPLC- estimation of glycerrhizin
9. Monograph analysis of clove oil
10. Monograph analysis of castor oil
11. Identification of bioactive constituents from plant extracts
12. Formulation of different dosage forms and their standardisation

2nd SEMESTER

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG201T	Medicinal Plant Biotechnology	4	-	25	75	1	3	4

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

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

Module 01 **12 Hours**

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

Module 02 **15 Hours**

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

Module 03 **15 Hours**

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

Module 04 **13 Hours**

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

Module 05 **05 Hours**

Fermentation Technology

- Application of Fermentation technology
- Production of ergot alkaloids
- Single cell proteins
- Enzymes of pharmaceutical interest

Recommended Books (Latest editions)

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.
9. Plant tissue culture by Street.
10. Pharmacognosy by G. E. Trease and WC. Evans, Elsevier.
11. Biotechnology by Purohit and Mathur, Agro-Bio.
12. Biotechnological applications to tissue culture by Shargool, Peter D, Shargoal, CKC Press.
13. Pharmacognosy by Varo E. Tyler, Lynn R. Brady and James E. Robberrt, That Tjen, NGO.
14. Plant Biotechnology, Ciddi Veerasham.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG202T	Advanced Pharmacognosy -II	4	-	25	75	1	3	4

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

1. Validation of herbal remedies.
2. Methods of detection of adulteration and evaluation techniques for the herbal drugs.
3. Methods of screening of herbals for various biological properties.

Module 01 **12 Hours**

Herbal Remedies

- Toxicity and Regulations: Herbals vs Conventional drugs
- Efficacy of Herbal medicine products
- Validation of herbal therapies
- Pharmacodynamic and Pharmacokinetic issues

Module 02 **12 Hours**

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

Module 03 **12 Hours**

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

Module 04 **12 Hours**

Analytical Profiles of Herbal Drugs

- *Andrographis paniculata, Boswellia serata, Coleus forskholii, Curcuma longa, Embelica officinalis, Psoralea corylifolia*

Module 05 **12 Hours**

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

Recommended Books (Latest editions)

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. Modem 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, Nirali Prakashan.
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. Textbook 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 ,Vol.I, Eastern PublisherS, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M.Blumenthal.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG203T	Indian Systems of Medicine	4	-	25	75	1	3	4

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 medicine.

Objectives: After completion of the course, student is able to

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

Module 01 **12 Hours**

Introduction

- 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)

Module 02 **12 Hours**

Naturopathy, Yoga and Aromatherapy Practices

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

Module 03 **12 Hours**

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

Module 04 **12 Hours**

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

Module 05 **12 Hours**

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

Recommended Books (Latest editions)

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, Kaviraj Nagendranath Sengupata, 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 & Handbook, 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.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG204T	Herbal Cosmetics	4	-	25	75	1	3	4

Scope: This subject deals 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

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

Module 01 **12 Hours**

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

Module 02 **12 Hours**

- 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

Module 03 **12 Hours**

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

Module 04 **12 Hours**

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

Module 05 **12 Hours**

Analysis of Cosmetics, Toxicity Screening and Test Methods

- Quality control and toxicity studies as per Drug and Cosmetics Act

Recommended Books (Latest editions)

1. Panda H. Herbal Cosmetics (Handbook), 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. Aromatheraphy (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.

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MPG205P	Pharmacognosy Practical - II	-	12	50	100	6	6	6

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

3rd SEMESTER

Course Code	Course Title	Teaching Load		Marks		Exam (hrs)		Credits
		L	P	Int.	Ext.	Int.	Ext.	
MRM301T	Research Methodology & Biostatistics	4	-	25	75	1	3	4

Module 01 **12 Hours**

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

Module 02 **12 Hours**

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 (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values

Module 03 **12 Hours**

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

Module 04 **12 Hours**

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, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals

Module 05 **12 Hours**

Declaration of Helsinki

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

Recommended Books (Latest editions)

1. Basic & Clinical Biostatistics, Beth Dawson and Robert G. Trapp. Lange Medical Books/McGraw-Hill Medical Publishing Division.
2. Research Methdology, R. Panneerselvam, PHI Learning Pvt. Limited, Delhi.
3. Methods in Biostatistics, B.K. Mahajan. JAYPEE Brothers Medical Publishers (P) Ltd.
4. CPCSEA Guidelines.
   A Handbook of Applied Statistics in Pharmacology, Katsumi Kobayashi and K. Sadasivan Pillai. CRC Press, Taylor & Francis Group.