



THE ASSAM
ROYAL GLOBAL UNIVERSITY
— GUWAHATI —

ROYAL SCHOOL OF PHARMACY (RSP)

Master of Pharmacy (M.Pharm)

SYLLABUS

&

COURSE STRUCTURE

M.Pharm. (Pharmacognosy) PCI

Syllabus 2016

M.PHARM (PHARMACOGNOSY)**Programme Structure**

1st Semester							
Sl no	Subject code	Name of the subject	L	T	P	C	TCP
1	MPG 101T	Modern Pharmaceutical Analytical Techniques	3	1	0	4	4
2	MPG 102T	Advanced Pharmacognosy – I	3	1	0	4	4
3	MPG 103T	Phytochemistry	3	1	0	4	4
4	MPG 104T	Industrial Pharmacognostical Technology	3	1	0	4	4
5	MPG 105P	Pharmacognosy Practical – I	0	0	12	6	12
6	MPG 106S	Seminar/Assignment	-	-	7	4	7
TOTAL			12	4	19	26	35

2st Semester							
Sl no	Subject code	Name of the subject	L	T	P	C	TCP
1	MPG 201T	Medicinal Plant Biotechnology	3	1	0	4	4
2	MPG 202T	Advanced Pharmacognosy-II	3	1	0	4	4
3	MPG 203T	Indian System of Medicine	3	1	0	4	4
4	MPG 204T	Herbal Cosmetics	3	1	0	4	4
5	MPG 205P	Pharmacognosy Practical II	0	0	12	6	12
6	MPG 206S	Seminar/Assignment	-	-	7	4	7
TOTAL			12	4	19	26	35

3 rd Semester							
Sl. No.	Subject Code	Names of subjects	L	T	P	C	TCP
1	MRM 301T	Research Methodology and Biostatistics*	3	1	0	4	4
2	MPG 302S	Journal club	0	0	1	1	1
3	MPG 303P	Research/ Presentation (Proposal Presentation)	0	0	2	2	2
4	MPG 304P	Research work	0	0	28	14	28
TOTAL			3	1	31	21	35

4 th Semester							
Sl.No.	Subject Code	Names of subjects	L	T	P	C	TCP
1	MPG 401S	Journal Club	0	0	1	1	1
2	MPG 402P	Research Work/Colloquium	0	0	31	16	31
3	MPG 403P	Discussion/ Final Presentation	0	0	3	3	3
4	MPG 404S	Co-curricular Activities					
TOTAL			0	0	35	20	35

Table-1: Semester wise credits distribution

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (a) Participation in National Level Seminar/Conference/Workshop/Symposium/ Training Programs(related to the specialization of the student-01) (b) Research/Review Publication in National Journals (Indexed in Scopus/Web of Science- 01)	Min-02/Max-07
Total Credit Points	Min-95 & Max. 100

Scheme of Evaluation

<p>Theory Papers (T):</p> <ul style="list-style-type: none"> • Internal assessment: 25% • End Term Examination: 75% 	<p>Practical Papers (P):</p> <ul style="list-style-type: none"> • Internal assessment: 30% • End Term examination: 70%
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Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table-2: Scheme for awarding internal assessment: Continuous mode

Theory	
Criteria	Maximum Marks
Attendance (Refer Table-3)	8
Student-Teacher interaction	2
Total	10
Practical	
Attendance (Refer Table-3)	10
Based on Practical Records, Regular viva-voce, etc.	10
Total	20

Table-3: Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95-100	8	10
90-94	6	7.5
85-89	4	5
80-84	2	2.5
Less than 80	0	0

SEMESTER-I SYLLABUS

Paper I / Subject Name: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPG 101T)

L-T-P-C – 4-0-0-4

Credit Units:4

Scheme of Evaluation:(T)

Objective: 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.

Course Outcome: Upon completion of the course, the student shall be able to

CO1: Understand the operation and applications of modern analytical instruments used in drug analysis, including UV-Visible, IR, Spectrofluorimetry, flame emission, and atomic absorption spectroscopy.

CO2: Understand the principles of NMR and mass spectroscopy and learn to interpret data for identifying organic compounds.

CO3: Understand chromatographic separation processes and apply them to the analysis of pharmaceutical compounds, gaining practical skills in chromatography and electrophoresis techniques.

CO4: Explore X-ray crystallography and immunological assays (RIA, ELISA) for characterizing and quantifying biological compounds. Develop skills in drug analysis using advanced techniques, and learn to interpret NMR, Mass, and IR spectra for identifying and characterizing organic compounds.

Detailed Syllabus:

Module	Topics (if applicable)/Course Content	Hours
I.	UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative 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, Data Interpretation. Spectrofluorimetry: Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by fluorimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. Flame emission spectroscopy and atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.	15 hrs
II.	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	15 hrs

	coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and ¹³ C NMR. Applications of NMR spectroscopy. 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 and Applications of Mass spectroscopy.	
III.	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	15 hrs
IV.	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. 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 advantages and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.	15 hrs
TOTAL		60 hrs

Text Books:

1. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
2. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
3. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series.
4. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
5. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons, 1982.

Reference Books:

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: Students will understand and apply principles of UV-Visible, IR, and Spectrofluorimetry, as well as flame emission and atomic absorption spectroscopy in drug analysis.	Traditional teaching, PPT	Class tests, assignments, MCQs
II.	CO2: Students will understand the principles of ionization and mass fragmentation and learn to interpret Mass and NMR spectroscopy data.	Traditional teaching, PPT	Class tests, assignments, MCQs
III.	CO3: Students will gain practical skills in chromatography and electrophoresis techniques for the separation and analysis of compounds.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: Students will explore X-ray crystallography methods and immunological assays (RIA, ELISA) for the characterization and quantification of biological compounds.	Traditional teaching, PPT	Class tests, assignments, MCQs

Subject Name: ADVANCED PHARMACOGNOSY – I (Course Code: MPG 102T)**L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

Objective: The main purpose of subject is 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.

Course Outcome: Upon completion of this course the student should be able to

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

Detailed Syllabus

Modules	Topic (if applicable) & Course Contents	Periods
I	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.	12 Hrs
II	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. 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 nutraceuticals, 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.	24 Hrs
III	Phytopharmaceuticals: Occurrence, isolation and characteristic features (Chemical nature, uses in pharmacy, medicinal and health benefits) of following. a) Carotenoids – i) α and β - Carotene ii) Xanthophyll (Lutein) b) Limonoids – i) d-Limonene ii) α - Terpineol c) Saponins – i) Shatavarins d) Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin e) Phenolic acids- Ellagic acid f) Vitamins g) Tocotrienols and Tocopherols h) Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol i) Miscellaneous	12 Hrs

IV	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.	12 Hrs
	Total	60 Hrs

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 to IV.
6. Natural products: A lab guide by Raphael Ikan , Academic Press 1991.
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. Schewer 1973.
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
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 Prakashan,
17. Pharmacognosy and Pharmacobiotechnology, Ashutoshkar, New Age Publications, New Delhi.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: Students will able to understand the importance of Pharmacognosy and apply Good Agricultural, Cultivation, collection. Practices for medicinal plant conservation.	Traditional teaching, PPT	Class tests, assignments, MCQs
II.	CO2: Able to analysed marine natural products isolation, study marine toxins, and explore nutraceuticals trends, supplements, and regulations	Traditional teaching, PPT	Class tests, assignments, MCQs
III.	CO3: Able to analysed the occurrence, isolation, chemical nature, and medicinal uses of key phytopharmaceutical compounds in pharmacy.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: Understand pharmacovigilance of natural origin drugs, safety monitoring guidelines, adverse reaction reporting, and biodrug interactions.	Traditional teaching, PPT	Class tests, assignments, MCQs

Subject Name: PHYTOCHEMISTRY (Course Code: MPG 103T)**L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

Objective: The main purpose of subject is to learn knowledge of natural product drug discovery and will be able to isolate, identify and extract and the phyto- constituents

Course Outcome: Upon completion of this course the student should be able to

1. Different classes of phytoconstituents, their biosynthetic pathways, their properties, extraction and general process of natural product drug discovery
2. Understand the history of drug discovery from herbs, lead structure selection, optimization, drug registration, and clinical trial phases with examples
3. Gain knowledge of advanced extraction techniques, solvent selection, phytoconstituent separation, and modern chromatographic methods
4. Phytochemical fingerprinting and structure elucidation of phytoconstituents

Modules	Topic (if applicable) & Course Contents	Periods
I	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: a) Alkaloids: Ephedrine, Quinine, Strychnine, Piperine, Berberine, Taxol, Vinca alkaloids. b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercetin. c) Steroids: Hecogenin, guggulosterone and withanolides d) Coumarin: Umbelliferone. e) Terpenoids: Cucurbitacins	12 Hrs
II	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.	12 Hrs
III	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.	12 Hrs
IV	Phytochemical finger printing: HPTLC and LCMS/GCMS applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents. Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (¹ H, ¹³ C) a. Carvone, Citral, Menthol b. Luteolin, Kaempferol	24 Hrs

	c. Nicotine, Caffeine d) Glycyrrhizin.	
	Total	60 Hrs

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 & Bladt.
7. Wilson and Gisvolds text book of Organic Medicinal and Pharmaceutical Chemistry by Deorge. 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 R Chatwal.
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, New Delhi.
15. Pharmacognosy & Phytochemistry of Medicinal Plants, 2nd edition, Bruneton J, Intercept Ltd., New York, 1999

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: students will learn about biosynthetic pathways, radio tracing techniques, and their application in isolating and characterizing phyto-pharmaceuticals.	Traditional teaching, PPT	Class tests, assignments, MCQs
II.	CO2: Understand the drug discovery process, lead compound optimization, and clinical trial phases using herbal-based examples.	Traditional teaching, PPT	Class tests, assignments, MCQs
III.	CO3: Knowledge of advanced extraction methods, solvent selection, and phytoconstituent separation using modern techniques.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: Understand phytochemical fingerprinting using HPTLC, LCMS/GCMS, and elucidate structures of phytoconstituents through spectroscopic techniques.	Traditional teaching, PPT	Class tests, assignments, MCQs

Subject Name: INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY**(Course Code: MPG 104T)****L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

Objective: The main purpose of subject is to learn 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.

Course Outcome: Upon completion of this course the student should be able to

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

Modules	Topic (if applicable) & Course Contents	Periods
I	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. 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.	24 Hrs
II	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.	12 Hrs
III	Testing of natural products and drugs: Herbal medicines - clinical laboratory testing. Stability testing of natural products, protocols.	12 Hrs
IV	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.	12 Hrs
	Total	60 Hrs

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), 1st Edition,
12. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), Eastern Publisher, New Delhi.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: Student will get knowledge of herbal drug industry infrastructure, production, modernization, entrepreneurship, and regulatory requirements for quality assurance.	Traditional teaching, PPT	Class tests, assignments, MCQs
II.	CO2: Upon completion, students can analysed and compare herbal drug monographs across various pharmacopoeias and guidelines.	Traditional teaching, PPT	Class tests, assignments, MCQs
III.	CO3: Able to evaluate clinical laboratory testing and stability protocols for herbal medicines.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: Understand patent laws for herbal products, including filing processes, rights, and international regulations.	Traditional teaching, PPT	Class tests, assignments, MCQs

Subject Name: PHARMACOGNOSY PRACTICAL – I (Course Code: MPG 105P)

L-T-P-C/0-0-0-6

Credit unit: 6

Scheme of Evaluation: P

OBJECTIVES:

Practical complementary to the theoretical discussions. Practical allows the verification of different processes/methods discussed in theory classes through experiments This is helpful for developing an insight on the subject.

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.

SEMESTER II

Subject Name: MEDICINAL PLANT BIOTECHNOLOGY**(Course Code: MPG 201T)****L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

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

Course Outcome: Upon completion of this course the student should 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

Modules	Topic (if applicable) & Course Contents	Periods
I	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 signaling, DNA recombinant technology.	24 Hrs
II	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.	15 Hrs
III	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.	15 Hrs
IV	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. Fermentation technology: Application of Fermentation technology, Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest.	18 Hrs
	Total	60 Hrs

REFERENCE:

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, 3rd 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.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: To understand plant biotechnology's historical development, genetic applications, and pharmaceutical uses, including DNA technology.	Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,
II.	CO2: To understand tissue culture techniques, micropropagation, protoplast fusion, and gene transfer applications in plant biotechnology.	Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,

<p>III.</p>	<p>CO3: Know immobilization techniques and cloning methods for enhanced secondary metabolite production in plant cells.</p>	<p>Traditional teaching, PPT</p>	<p>Class tests, assignments, MCQs</p>
<p>IV.</p>	<p>CO4: To understand biotransformation, transgenesis, fermentation technology, and their applications in plant and pharmaceutical biotechnology."</p>	<p>Traditional teaching, PPT</p>	<p>Class tests, assignments, MCQs</p>

Subject Name: ADVANCED PHARMACOGNOSY II**(Course Code: MPG 202T)****L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

Objective: 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.

Course Outcome: 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

Modules	Topic (if applicable) & Course Contents	Periods
I	Herbal remedies – Toxicity and Regulations: Herbals vs Conventional drugs, Efficacy of Herbal medicine products, Validation of herbal therapies, Pharmacodynamic and Pharmacokinetic issues.	12 Hrs
II	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.	12 Hrs
III	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.	12 Hrs
IV	Analytical Profiles of herbal drugs: Andrographis paniculata, Boswellia serata, Coleus forskholii, Curcuma longa, Embelica officinalis, Psoralea corylifolia. 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.	24 Hrs
	Total	60 Hrs

REFERENCES:

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, 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. 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.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	<p>CO1: To understand herbal remedies' toxicity, regulations, efficacy, and pharmacological differences from conventional drugs.</p>	<p>Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)</p>	<p>Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,</p>
II.	<p>CO2: To understand herbal drug adulteration types, causes, detection methods, and DNA fingerprinting for drug identification.</p>	<p>Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)</p>	<p>Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,</p>
III.	<p>CO3: Evaluation of role of ethnobotany and ethnopharmacology in herbal drug discovery and traditional medicine.</p>	<p>Traditional teaching, PPT</p>	<p>Class tests, assignments, MCQs</p>
IV.	<p>CO4: To analysed herbal drug profiles and apply in vitro/in vivo techniques for biological screening and toxicity evaluation.</p>	<p>Traditional teaching, PPT</p>	<p>Class tests, assignments, MCQs</p>

Subject Name: INDIAN SYSTEMS OF MEDICINE**(Course Code: MPG 203T)****L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

Objective: 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.

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

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.

Modules	Topic (if applicable) & Course Contents	Periods
I	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). 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.	24 Hrs
II	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.	12 Hrs
III	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.	12 Hrs
IV	TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU	24 Hrs
	Total	60 Hrs

REFERENCES:

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 & 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.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: To understand fundamental principles, practices, and dosage forms of Ayurveda, Siddha, Unani, and holistic therapies.	Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,
II.	CO2: To know formulation techniques, standardization, and stability studies in Ayurveda, Siddha, Homeopathy, and Unani systems.	Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,
III.	CO3: To understand GMP (Schedule-T) components, infrastructure, quality assurance, and regulatory challenges in herbal medicine production.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: To understand TKDL, Geographical Indication Bill, and key AYUSH government bodies including CCRAS, CCRS, CCRH, CCRU.	Traditional teaching, PPT	Class tests, assignments, MCQs

Subject Name: HERBAL COSMETICS**(Course Code: MPG 204T)****L-T-P-C/4-0-0-4****Credit unit: 4****Scheme of Evaluation: T**

Objective: 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.

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

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

Modules	Topic (if applicable) & Course Contents	Periods
I	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.	12 Hrs
II	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	12 Hrs
III	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.	12 Hrs
IV	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. Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act.	24 Hrs
	Total	60 Hrs

REFERENCES:

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.

Teaching Learning Process and Assessment Methods:

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I.	CO1: To understand herbal/natural cosmetics, classification, economic aspects, regulatory provisions, and industry involvement in production.	Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,
II.	CO2: To understand herbal cosmetic formulation, ingredients, interactions, and perform preformulation and compatibility studies effectively.	Class room lectures though online resources, Educational Softwares, digital simulations, concept videos, practical demonstrations, case based presentations, scientific report discussions (Research articles, research reports etc.)	Seminar, quiz, assignments, journal club, problem based assignments, report writing, Internal assessments (Sessional exams), continuous evaluation) and End Sem Examinations,

III.	CO3: To understand the physiology, chemistry, preparation, and standardization of herbal cosmetics for skin, hair, and nails.	Traditional teaching, PPT	Class tests, assignments, MCQs
IV.	CO4: To analysed and formulate herbal-based cosmeceuticals while ensuring safety and regulatory compliance.	Traditional teaching, PPT	Class tests, assignments, MCQs

Subject Name: PHARMACOGNOSY PRACTICAL – II (Course Code: MPG 205P)

L-T-P-C/0-0-0-6

Credit unit: 6

Scheme of Evaluation: P

OBJECTIVES:

Practical complementary to the theoretical discussions. Practical allows the verification of different processes/methods discussed in theory classes through experiments This is helpful for developing an insight on the subject.

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.