CENTRAL UNIVERSITY OF PUNJAB

Master of Pharmacy (Pharmacognosy)

Session - 2024-26

Department of Pharmaceutical Sciences and Natural Products

Course structure for M. Pharm. (Pharmacognosy)

Course code	Name of the course	Credit hours	Credit points	Hrs/wk	Marks
Semester I					
MPG101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPG102T	Advanced Pharmacognosy – I	4	4	4	100
MPG103T	Phytochemistry	4	4	4	100
MPG104T	Industrial Pharmacognostical Technology	4	4	4	100
MPG105P	Pharmacognosy Practical-I	12	6	12	150
MPG106S	Seminar/Assignment	7	4	7	100
	Total	**35**	**26**	**35**	**650**
Semester II					
MPG201T	Medicinal Plant Biotechnology	4	4	4	100
MPG202T	Advanced Pharmacognosy – II	4	4	4	100
MPG203T	Indian Systems of Medicine	4	4	4	100
MPG204T	Herbal Cosmetics	4	4	4	100
MPG205T	Advanced Spectral Analysis	4	4	4	100
MPG205P	Pharmacognosy Practical-II	12	6	12	150
MPG206S	Seminar/Assignment	7	4	7	100
XXX	Inter-Disciplinary Course (or through MOOC)	2	2	2	50
	Total	**41**	**32**	**41**	**800**
Semester III					
MPG301T	Research Methodology & Biostatistics	4	4	4	100
MPG302T	Journal club	1	1	1	25
MPG303T	Discussion/ Presentation (Proposal Presentation)	2	2	-	50
MPG599	Research Work	28	14	-	350
	Total	**35**	**21**	**5**	**525**
Semester IV					
MPG401T	Journal club	1	1	1	25
MPG402T	Discussion / Presentation	3	3	-	75
MPG599	Research Work, thesis and viva-voce[#]	31	16	-	400
	Total	**35**	**20**	**1**	**500**

[#]To be evaluated by external expert

Examination pattern

Core, Discipline Elective, Compulsory Foundation,			**Interdisciplinary Course, Value Added, Entrepreneurship, Innovation and skill development Courses**	
	Marks	Evaluation	Marks	Evaluation
Internal Assessment	25	Various methods	-	-
Mid-semester test (MST)	25	Descriptive	50	Descriptive (70%) Objective (30%)
End-semester test (EST)	50	Descriptive (70%) Objective (30%)	50	Descriptive (70%) Objective (30%)

Objective Questions- one-word/sentence answers, fill-in the blanks, MCQs', and matching

Descriptive Questions- Short answer and essay type questions

Internal assessment- any two or more of the given methods: Surprise Tests, open book examination, assignments, term paper, etc.).

Evaluation criteria for practical:

Item	**Synopsis**	**Performance**	**Practical Note book and continuous evaluation**	**Viva voce**
Marks	20	50	50	30

Thesis/Dissertation Proposal (Third Semester)			**Thesis/Dissertation (Fourth Semester)**		
	Marks	**Evaluation**		**Marks**	**Evaluation**
Supervisor	200	Dissertation proposal and presentation	Supervisor	200	Continuous assessment (regularity in work, mid-term evaluation) dissertation report, presentation, final viva-voce
HoD and senior-most faculty of the department	150	Dissertation proposal and presentation	External expert, HoD and senior-most faculty of the department	200	Dissertation report (100), presentation (50), final viva-voce (50)

Evaluation pattern similar to third and fourth semester dissertation will apply for internship

Graduate attributes for M. Pharm. in Pharmacognosy

After completing a Master of Pharmacy in Pharmacognosy; the graduates will have a quality conscious service providing attitude by adopting the knowledge of spectral analysis and chromatographic techniques in manufacturing and Research & Development of drugs from natural resources. They will have a perspective to develop efficacious, safe, and affordable drugs in a reasonable time using transformative digital technologies along with having an attitude to curb the menace of drug adulteration. Further, the graduates would explore natural resources like marine drugs to decrease the dependence on plants and will appreciate the importance of rich biodiversity of India and applying biotechnological modifications to develop the economically sustainable secondary metabolites. The graduates will have a positive attitude to implement the sustainable development goals to make the planet safe for the next generations by implementing a circular economy and a philosophy to comprehend the socio-economy of medicines and make the world healthy. This program will also help graduates make careers in industry, government organizations or institutions of higher learning.

Semester 1

Course Title: Modern Pharmaceutical Analytical Techniques

L	T	P	Credits
4	0	0	4

Paper Code: MPC101T

Course Hours: 60h

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Conceptualize general principle and theory of UV-Vis, IR and spectroflourimetry

CLO2: Describe the concept and instrumentation of NMR and Mass techniques

CLO3: Separate different constituents of mixture by chromatographic techniques

CLO4: Conceptualize general principle and theory of electrophoresis and X-ray crystallography with handling of instruments.

CLO5: Explain the Principle, thermal transitions and Instrumentation of DSC, DTA and TGA

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **10 Hours**	**UV-Visible Spectroscopy** • Introduction, Theory, Laws, and Instrumentation associated with UV-Visible spectroscopy • Choice of solvents and solvent effect • 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 •Applications of IR spectroscopy, data interpretation **Spectroflourimetry** • Theory of Fluorescence • Factors affecting fluorescence (characteristics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation • Applications of fluorescence spectrophotometer **Flame Emission Spectroscopy and Atomic Absorption Spectroscopy** • Principle, Instrumentation, Interferences and	**CLO1**

	Applications. **Learning activities:** Learner will be provided hands on training to different instruments like UV, IR and spectroflourimetry.	
Unit 2 **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 13C NMR • Applications of NMR spectroscopy **Learning activities:** Learner will be provided NMR for the characterization of compounds.	**CLO2**
Unit 3 **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 **Learning activities:** Learner will be provided mass spectra for the characterization of compounds.	**CLO2**
Unit 4 **10 Hours**	**Chromatography** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: • Thin Layer chromatography • Ion exchange chromatography • Column chromatography • Gas chromatography • High Performance Liquid chromatography •Ultra-High Performance Liquid	**CLO3**

	chromatography • Affinity chromatography • Gel Chromatography **Learning activities:** Learner will be provided experience of chromatography by using different techniques like TLC, Column, HPLC, HPTLC and GC.	
Unit 5 **10 Hours**	**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 **Learning activities:** Learner will be provided conceptual learning based on electrophoresis as well as handling of instruments.	**CLO4**
Unit 6 **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	**CL05**

	• Derivative differential thermal analysis (DDTA) **TGA** • Principle, instrumentation • Factors affecting results • Advantage and disadvantages • Pharmaceutical applications. **Learning activities:** Learner will be provided Web based learning to explain thermal techniques	

Suggested Readings

1. Spectrometric Identification of Organic compounds – Robert M Silverstein, 8th edition, John Wiley & Sons, 2015.
2. Principles of Instrumental Analysis – Doglas A Skoog, F. James Holler, Timothy A. Nieman, 6th edition, Cengage, 2014.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publisher, 2004.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 2007.
5. Organic Spectroscopy – William Kemp, 3rd edition, ELBS, 2008.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – P D Sethi, 3rd edition, CBS Publishers, New Delhi, 2007.
7. Pharmaceutical Analysis – Modern Methods – Part B – J W Munson, Vol 11, Marcel, Dekker Series 1984 (Reprint 2012)
8. Spectroscopy of Organic Compounds, 6th edn., P. S. Kalsi, Wiley Eastern Ltd., Delhi, 2016.
9. Textbook of Pharmaceutical Analysis, KA. Connors, 3rd Edition, John Wiley & Sons, 2007.
10. Introduction to spectroscopy. 4th Edition, Pavia DL, Lampman GM, Kriz GS, Vyvyan JA.; Cengage Learning, 2008
11. Pharmaceutical quality by design: a practical approach. Schlindwein WS, Gibson M, editors. John Wiley & Sons; 2018.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Semester 1

Course Title: Advanced Pharmacognosy-I

L	T	P	Credits
4	0	0	4

Paper Code: MPG.102T

Course Hours: 60h

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

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Knowledge about cultivation of medicinal plants and different guidelines related to cultivation

CLO2: Marine drug discovery and study of marine natural products

CLO3: Scope, medicinal value and standardization of nutraceuticals and regulatory aspect of nutraceuticals

CLO4: Occurrence, isolation, characterization, identification, biosynthesis, and activity profile of biologically active natural products.

CLO5: 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 Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **12 Hours**	**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.	**CLO1**

	Learning activities: Explore Ex-situ and In-situ conservation methods for medicinal plants, emphasizing practical conservation techniques and their importance in maintaining biodiversity.	
Unit 2 **12 Hours**	**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. **Learning activities:** Case studies and discussions focused on taxonomical identification and chemical screening challenges in marine toxin research, fostering critical thinking and problem-solving skills.	**CLO2**
Unit 3 **12 Hours**	**Nutraceuticals:** Current trends and future scope, Inorganic mineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibers, 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. **Learning activities:** Assign students to research and present on emerging nutraceutical trends and technologies, such as personalized nutrition, nutrigenomics, bioactive peptides, and sustainable sourcing practices. Encourage creative thinking and forward-looking perspectives on the future of nutraceuticals.	**CLO3**
Unit 4 **12 Hours**	**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)	**CLO4**

	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 **Learning activities:** Students will conduct literature reviews, and explore potential applications or advancements in the phytopharmaceutical field, fostering independent research skills and scientific inquiry.	
Unit 4 **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. **Learning activities:** Present case studies illustrating scenarios of adverse reactions to bio drugs, as well as instances of bio drug-food interactions. Facilitate group discussions to explore preventive measures and management strategies based on established reporting schemes and guidelines.	**CLO5**

Suggested Readings:

1. Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, NewYork.
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 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

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Transaction Mode

- PPT
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Semester 1

Course Title: Phytochemistry

L	T	P	Credits
4	0	0	4

Paper Code: MPG.103T

Course Hours: 60h

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.

Learning Outcomes:

After completing this course, the learner will be able to:

- CLO1: Biogenesis and biological activity of natural products coming from mevalonate: terpenoids and steroids.
- CLO2: Extraction procedures for natural compounds, their differences and their applications the main pathways of aromatic amino acids, alkaloids, phenylpropanoids.
- CLO3: Herbal Drug discovery and development. Optimization of Lead compounds.
- CLO4: After finishing the course, the students will get professional, Practical skills & time management skills in extraction, Isolation and Phytochemical analysis of Natural products
- CLO5: Course provides skill in separation of the active constituents obtained from natural sources, in addition to the different methods of separation (chromatography).
- CLO6: Application of HPTLC and GC technique in fingerprinting, analysis, and identification of phytoconstituents. Structure elucidation of unknown molecule.

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **15 Hours**	Biosynthesis, Isolation, Structural Elucidation and purification of following phyto-pharmaceuticals containing drugs: a)	**CLO1**

	Alkaloids: Ephedrine, Quinine, Morphine, Reserpine. b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, c) Steroids: Nomenclature, Stereochemistry of steroids. Hecogenin, guggulosterone and withanolides d) Coumarin: Umbelliferone. e) Terpenoids: Citral, Menthol, β carotene. Flavonoids: Quercetin **Learning activities:** Demonstrate isolation techniques like column chromatography, thin-layer chromatography (TLC), and high-performance liquid chromatography (HPLC) for separating bioactive constituents from plant extracts. Task them with researching the methods used for characterization (e.g., spectroscopic techniques like NMR, MS) and purification (e.g., crystallization, preparative chromatography) of the assigned compound.	
Unit 2 **12 Hours**	**Drug discovery and development:** a) History of herbs as source of drugs and drug discovery, the lead structure selection process, structure development, product discovery process and drug registration. b) Selection and optimization of lead compounds with suitable examples from the following source: Artemisinin, Andrographolides. c) Clinical studies emphasizing on phases of clinical trials, protocol design for lead molecules. **Learning activities:** Provide hands-on experience with software tools commonly used in lead optimization, allowing students to practice virtual screening and molecular docking. Assign literature reviews where students explore clinical trial protocols for lead molecules derived from herbal sources.	**CLO2**
Unit 3 **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.	**CLO3**

	• Separation of phytoconstituents by latest CCCET, SCFE techniques including preparative HPLC and Flash column chromatography. **Learning activities:** Arrange laboratory sessions where students observe and participate in various extraction techniques, including maceration, reflux, and Soxhlet extraction. Demonstrate the effect of different solvents and extraction conditions on the yield and quality of extracted phytochemicals. Facilitate group discussions to identify potential research questions, challenges, and future directions in the field of green extraction.	
Unit 4 **6 Hours**	**Radio tracing techniques:** Utilization of radioactive isotopes in the investigations of Biogenetic studies. Applications of tracer techniques in Synthesis of Secondary Metabolites in Pharmacognosy. **Learning activities:** Interactive seminars and journal club discussions will allow students to critically evaluate current literature and explore innovative applications of tracer techniques in natural product research	**CLO1**
Unit 5 **15 Hours**	**Phytochemical finger printing:** HPTLC and LCMS/GCMS applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents **b. Radio immuno Assay** • ELISA, Radioimmuno assay of digitalis and morphine **Learning activities:** Assign case studies focusing on real-world applications of HPTLC and LC-MS/GC-MS in the characterization of herbal extracts. Provide students with chromatographic data and mass spectra to interpret and identify phytoconstituents present in the samples. Facilitate a discussion where students interpret the	**CLO5,** **CLO6**

	spectral data obtained for the given herbal compounds.	

Suggested Readings:

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 edition.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. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I & II Page 14 of 28
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, Interceptt Ltd., New York,1999.

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Transaction Mode

- PPT
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Semester 1

Course Title: Industrial Pharmacognostical Technology

L	T	P	Credits
4	0	0	4

Paper Code: MPG.104T

Course Hours: 60h

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

- The requirements for setting up the herbal/natural drug.
- 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
- **Learning Outcomes:**

  After completing this course, the learner will be able to:

- CLO1: Starting up of new herbal drug industry. Regulatory requirements/ documentation for starting a new natural drug industry.
- CLO2: 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.
- CLO3: Monograph preparation and documentation of herbal drugs and extracts. WHO guidelines in safety assessment of herbal drugs.
- CLO4: Develop skill in testing of herbal drugs and Knowledge about IPR and Patenting.

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **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–	**CLO1**

	up techniques, case studies of herbal extracts. Formulation and production management of herbals. **Learning activities:** Assign students a literature review task to explore herbal drug production, formulation, and management, aiding in their understanding of theoretical concepts and current research. Additionally, organize debates on contentious topics within the herbal drug industry, such as efficacy, regulatory challenges, and ethical considerations, promoting critical thinking and communication skills development.	
Unit 2 **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. **Learning activities:** Facilitate debates and discussions on the impact of patent laws, TRIPS agreement, and EXIM policies on the global marketing of herbal/natural drug products. Encourage students to explore different perspectives and propose strategies for navigating legal and regulatory challenges.	**CLO2**
Unit 3 **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. **Learning activities:** Assign students to analyze monographs of herbal drugs from different pharmacopoeias, including IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, American Herbal Pharmacopoeia, and British Herbal Pharmacopoeia. Students can compare and contrast the specifications, quality standards, and testing methods	**CLO3**

	outlined in these monographs.	
Unit 4 **12 Hours**	**Testing of natural products and drugs:** Herbal medicines - clinical laboratory testing. Stability testing of natural products, protocols. **Learning activities:** Assign students to conduct a literature review on recent advancements in herbal medicine testing and stability assessment. They can critically evaluate research papers, identify gaps in knowledge, and propose areas for further study.	**CLO4**
Unit 5 **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, nonobviousness, 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 **Learning activities:** Organizing guest lectures by patent attorneys or IP experts focusing on patentable subject matter, filing procedures, and patent holders' rights, offering practical insights for students. Additionally, assign students to research recent developments in Indian and international patent laws regarding herbal/natural products and processes, including proposed amendments, court cases, and regulatory changes, to assess their implications on the industry.	**CLO4**

Suggested Readings:

1. Herbal drug industry by R.D. Choudhary (1996), Eastern Publisher, New Delhi.

2. 2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee (2003), 1 st edition, Business horizons Robert Verpoorte, NewDelhi.
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, NewDelhi.
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. StandardizationofBotanicals.Testingandextractionmethodsofmedicinal herbs by V. Rajpal (2004), Vol. I, Eastern Publisher, NewDelhi.
10. Phytochemical Dictionary. Handbook of Bioactive Compounds from Plants by J.B.Harborne, (1999), 2nd edition, Taylor and Francis Ltd, UK.
11. Herbal Medicine. Expanded Commission E Monographs by M. Blumenthal, (2004), 1 st edition,
12. Drug Formulation Manual by D.P.S. Kohli and D.H. Shah (1998), Eastern Publisher, New Delhi.

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Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Pharmacognosy–I (Practical)

L	T	P	Credits
0	0	12	6

Paper Code: MPG 105P
Course Hours: 60h

Learning Outcomes:
After completing this course, the learner will be able to:

CLO1: Apply concepts of spectroscopic analysis for the identification and characterization of natural products.
CLO2: Perform TLC and HPTLC studies of Phytoconstituents
CLO3: Perform various extraction techniques and estimate phytoconstituents in herbal extracts and drugs
CLO4: Develop skills for the quality control of herbal drugs and formulation
CLO5: Formulate and evaluate different types of herbal dosage forms

Course Content

Practical	Content/Title	Mapping with course learning outcome
1.	Analysis of Pharmacopoeia compounds of natural origin and their formulations by UV spectrophotometer **Learning Activity:** Students calibrate UV spectrophotometers, prepare sample solutions, and measure absorbance to quantify compound concentrations, interpreting spectra for purity assessment.	**CLO1, CLO2**
2.	Analysis of recorded spectra of simple Phytoconstituents **Learning Activities:** Students review recorded spectra, identify peaks, and correlate spectral features with molecular structures, comparing with reference standards to determine compound identity and purity.	**CLO1, CLO2**
3.	Experiments based on Gas Chromatography **Learning Activities:** Students prepare samples, and interpret chromatograms to identify compounds, quantifying concentrations using calibration curves.	**CLO3**
4.	Estimation of sodium/potassium by flame photometry **Learning Activities:** Students prepare standard solutions, perform flame photometry analysis, measure emission intensities, and calculate concentrations using calibration curves for sodium/potassium estimation.	**CLO3**

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 **Learning Activities:** Students prepare samples, spot TLC/HPTLC plates, develop chromatograms, and compare fingerprints with standard compounds for identification of plant extracts.	**CLO2, CLO3**
6.	Methods of extraction **Learning Activities:** Students perform Soxhlet and maceration extractions, optimize conditions, and isolate target compounds, characterizing them using spectroscopic techniques.	**CLO3**
7.	Phytochemical screening **Learning Activities:** Students perform tests for secondary metabolites, observing reactions to infer the presence of phytochemicals in plant extracts.	**CLO3**
8.	Demonstration of HPLC- estimation of glycyrrhizin **Learning Activities:** Students prepare samples, quantify glycyrrhizin using peak area, and compare with standard calibration curves for estimation.	**CLO4**
9	Monograph analysis of clove oil **Learning Activities:** Students review monograph specifications, analyze physical and chemical properties, and perform tests to meet pharmacopeial standards.	**CLO4**
10	Monograph analysis of castor oil. **Learning Activities:** Students review monograph specifications, analyze physical and chemical properties, and perform tests to meet pharmacopeial standards	**CLO4**
11	Identification of bioactive constituents from plant extracts **Learning Activities:**	**CLO4**
12	Formulation of different dosage forms and their standardization. **Learning Activities:** Students develop different dosage forms, standardizing formulations through quality control tests and documentation.	**CLO5**

Course Title: Seminar/Assignment

L	T	P	Credits	Marks
0	0	0	4	100

Paper Code: MPG106S

Learning outcome: Students who successfully complete this course will be able to

- Perform literature review on a given topic
- Prepare a report on a given topic
- Prepare a power point presentation on a given topic

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Report evaluation

Semester 2

Course Title: Medicinal Plant Biotechnology

L	T	P	Credits
			4

Paper Code: MPG.201T

Course Hours: 60h

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,

- Know the process like genetic engineering in medicinal plants for higher yield of Phytopharmaceuticals. The guidelines for quality of herbal/natural medicines and regulatory issues.
- Use the biotechnological techniques for obtaining and improving the quality of natural products/medicinal plants.
- **Learning Outcomes:**

  After completing this course, the learner will be able to:

  CLO1: Explain significance of plant biotechnology in improving quality of medicinal plants
  CLO2: Develop skill in Plant tissue culture techniques for production of genetically modified plants.
  CLO3: Describe methods of production of secondary plant metabolites.
  CLO4: Different methods of cloning and its applications.
  CLO5: Knowledge about Application of PCR in plant genome analysis.
  CLO6: Plant fermentation technology in production of secondary metabolites.

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **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 signaling, DNA recombinant technology **Learning activities:** Task students with	**CLO1**

	conducting literature reviews on recent publications in plant biotechnology and pharmacognosy. They can critically analyze research articles, patents, and review papers to identify emerging trends, challenges, and opportunities in the field.	
Unit 2 **12 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. **Learning activities:** Organize hands-on laboratory demonstrations for students to learn tissue culture techniques including organogenesis, embryogenesis, synthetic seed production, protoplast fusion, and hairy root culture, with guidance on sterilization methods and aseptic techniques. Additionally, task students with conducting literature reviews on recent advancements in plant tissue culture and gene transfer technologies, presenting their findings to the class to highlight key research findings, technological innovations, and potential applications in agriculture and medicine.	**CLO2**
Unit 3 **12 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. **Learning activities:** Provide case studies highlighting the applications of immobilized plant cells in secondary metabolite production. Assign students to analyze how immobilization techniques	**CLO3**

	enhance productivity, stability, and scalability of biotechnological processes for producing medicinal agents.	
Unit 4 **12 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. **Learning activities:** Assign students literature reviews on PCR in plant genome analysis, exploring recent articles, reviews, and protocols to understand PCR-based techniques like gene amplification, expression analysis, and marker-assisted breeding in plants.	**CLO4,** **CLO5**
Unit 5 **12 Hours**	**Fermentation technology:** Application of Fermentation technology, Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest. **Learning activities:** Facilitate a literature review activity where students explore recent research articles on enzymes with pharmaceutical applications, such as proteases, lipases, or kinases. Each student will select a specific enzyme and present its structure, function, and current industrial or medical uses to the class.	**CLO6**

Suggested Readings:

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, CBSPublishers.
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, Shargoal, CKCPress.
13. Pharmacognosy by Varo E. Tyler, Lynn R. Brady and James E. Robberrt, That Tjen, NGO.
14. Plant Biotechnology, CiddiVeerasham

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Semester 2

Course Title: Advanced Pharmacognosy II

L	T	P	Credits
			4

Paper Code: MPG.202T

Course Hours: 60h

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

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Interpret the stereochemistry of natural products. Explain the efficacy, validation, Pharmacodynamic & Pharmacokinetic aspects of Herbal medicine products/therapies.
CLO2: Develop skills for the detection of adulteration and evaluation techniques
CLO3: Discuss the therapeutic actions of main classes of phytochemical and their interactions with other herbs or drugs and become familiar with DNA fingerprinting techniques.
CLO4: Describe the role of ethnobotany and ethnopharmacology in drug discovery and evaluation
CLO5: Develop analytical profile of different classes of phytochemicals.
CLO6: Students will study the biological screening of herbal drugs and related guidelines

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **20 Hours**	**a. Stereochemistry:** Basic Concepts including stereoisomerism, optical activity, absolute and relative configurations' notations. Racemic resolution and method of asymmetric synthesis with examples.	**CLO1**

	b. Herbal remedies: Toxicity and Regulations: Herbals vs Conventional drugs, Efficacy of Herbal medicine products, Validation of herbal therapies, Pharmacodynamic and Pharmacokinetic issues. **Learning activities:** Students will engage in a series of interactive lectures, supplemented with visual aids and molecular models, to grasp fundamental concepts of stereochemistry such as chirality, stereoisomerism, optical activity, and configurations. Organizing discussions where students present case studies or research articles highlighting pharmacodynamic and pharmacokinetic considerations associated with herbal therapies.	
Unit 2 **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. **Learning activities:** Introduce students to the concept of adulteration and substitution in herbal drugs through case studies, highlighting the impact on therapeutic efficacy and safety. Organize discussions on DNA fingerprinting methods for authentication and identification of herbal drugs, featuring guest speakers or experts in molecular biology to introduce techniques like PCR, DNA sequencing, and DNA barcoding, demonstrating their applications in herbal drug authentication.	**CLO2,** **CLO3**
Unit 3 **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. **Learning activities:** Encourage students	**CLO4**

	to critically evaluate the societal and environmental implications of integrating traditional knowledge into modern healthcare systems.	
Unit 4 **12 Hours**	Analytical Profiles of herbal drugs: *Andrographis paniculata, Boswellia serata, Coleus forskholii, Curcuma longa, Embelica officinalis, Psoralea corylifolia.* **Learning activities:** Organize a class presentation or poster session where students present their analytical profiles for the assigned herbal drugs.	**CLO5**
Unit 5 **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. **Learning activities:** Students research and present in vivo evaluation techniques relevant to their assigned pharmacological activity, such as animal models, biochemical markers, and histopathological analysis.	**CLO6**

Suggested Readings:

1. Glimpses of Indian Ethno Pharmacology by P. Pushpangadam. Ulf NymanV.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. 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 herbsby V. Rajpal (2004), Vol. I, Eastern Publisher, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M. Blumenthal.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Indian Systems of Medicine

L	T	P	Credits
			4

Paper Code: MPG.203T

Course Hours: 60h

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

- 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.
- **Learning Outcomes:**

  After completing this course, the learner will be able to:

  CLO1: 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.
  CLO2: Students will get knowledge of formulation development and standardization of various traditional formulations. Various purification process (Shodana and Marana concepts).
  CLO3: Quality control and quality assurance concepts involved in traditional system of medicine.
  CLO4: Study the concepts of AYUSH, AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU.

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **12 Hours**	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).	**CLO1**

	Learning activities: Demonstrating preparation techniques and administration methods for various dosage forms in Ayurveda, Siddha, and Unani medicine, emphasizing their advantages, limitations, and therapeutic applications. Encourage students to critically assess analytical techniques used for evaluating parameters like morphological features, physicochemical properties, and chemical composition, with reference to scientific literature and regulatory standards.	
Unit 2 **12 Hours**	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. Learning activities: Organize case studies or role-playing activities where students apply naturopathic principles to develop personalized treatment plans for hypothetical patients, integrating multiple modalities for optimal health outcomes.	**CLO1**
Unit 3 **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. Learning activities: Encourage students to analyze case studies or research articles showcasing innovative approaches and best practices in formulation development across different systems of medicine.	**CLO2**
Unit 4 **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 equipment's,	**CLO3**

	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. **Learning activities:** Facilitate cross-group discussions to compare and contrast GAP, GMP, and GLP requirements, and their roles in ensuring product quality, safety, and efficacy in the ISM formulation industry.	
Unit 5 **12 Hours**	TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU **Learning activities:** Facilitate group presentations where students share their findings and discuss the contributions of their assigned research council to the advancement of ISM research, healthcare practice, and public health initiatives.	**CLO4**

Suggested Readings:

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 KMukharjee, 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.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Course Title: Herbal Cosmetics

L	T	P	Credits
4	0	0	4

Paper Code: MPG.204T

Course Hours: 60h

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

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

Learning Outcomes:

After completing this course, the learner will be able to:

CLO1: Explain the economic aspects of various herbal/natural cosmetic preparations.
CLO2: Describe the regulatory provisions and the principles of various herbal/natural cosmetic preparations
CLO3: Analyze commonly used raw materials and design of herbal cosmetic formulations.
CLO4: Develop the skill to formulate and evaluate herbal cosmetics
CLO5: Apply the test methods in the analysis of cosmetics, as per Drug and Cosmetics Act and also toxicity screening methods.
CLO6: Discuss the market potential of herbal cosmetics and various aspects including its raw materials, preparations and analysis.

Course Contents

Units/Hours	Content	Mapping with course learning outcomes
Unit 1 **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. **Learning activities:** Divide students into groups and assign each group a regulatory	**CLO1, CLO2**

	provision related to cosmetics manufacturing (e.g., licensing requirements, GMP, offences and penalties, import/export regulations). Students research and present the legal framework governing their assigned provision, including relevant laws, rules, guidelines, and responsible regulatory agencies.	
Unit 2 **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. **Learning activities:** Encourage students to research the properties, benefits, and applications of various raw materials commonly used in herbal cosmetics, including preservatives, surfactants, humectants, oils, colors, and functional herbs.	**CLO3**
Unit 3 **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. **Learning activities:** Present students with case studies on cosmetic formulation challenges, regulatory compliance, or consumer preferences. Encourage group collaboration for brainstorming, research, and presentations to foster critical thinking, problem-solving, and teamwork skills.	**CLO4**
Unit 4 **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.	**CLO4**

	Learning activities: Facilitate sensory evaluation sessions for students to assess appearance, fragrance, texture, and skin feel of their formulated products. Provide standardized evaluation forms and guidelines for conducting tests on themselves or volunteers. Encourage feedback collection to refine formulations for optimal sensory appeal and consumer acceptance. Additionally, encourage students in creating commercial advertisements for their formulated products, emphasizing marketing strategies, branding, and consumer engagement.	
Unit 5 **12 Hours**	Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act. **Learning activities:** Present students with case studies related to quality control and toxicity issues in cosmetics, derived from real-world scenarios	**CLO5,** **CLO6**

Suggested Readings:

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. Aromatheraphy (A Complete Guide to the HealingArt), Sri Satguru Publications, New Delhi.
7. Chattopadhyay P K. Herbal Cosmetics & Ayurvedic Medicines (EOU), National Institute of Industrial Research, Delhi.
8. 8. Balsam M S & Edward Sagarin. Cosmetics Science and Technology, Wiley Interscience, New York.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Tutorial
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google drive
- Google meet

Semester –II

Course Title: Advanced Spectral Analysis
Paper Code: MPG205T
Course Hours: 60hr

L	T	P	Credits
4	0	0	4

Learning Outcomes
After completion of the course, student shall be able to understand:

CLO1: Conceptualize general principle and theory of UV-Vis, IR and spectroflourimetry
CLO2: Describe the concept and instrumentation of NMR and Mass techniques
CLO3: Separate different constituents of mixture by chromatographic techniques
CLO4: Explain the Principle, thermal transitions and Instrumentation of DSC, DTA and TGA with application of Raman spectroscopy and radio immunoassay

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **12 Hours**	**UV and IR spectroscopy:** Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α, β-carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds **Learning activities:** Learner will be provided hands on training to different instruments like UV, IR and spectroflourimetry.	**CLO1**
Unit 2 **11 Hours**	**NMR Spectroscopy:** 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds **Learning activities:** Learner will be provided NMR for the characterization of compounds.	**CLO2**
Unit 3 **10 Hours**	**Mass Spectroscopy:** Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.	**CLO2**

	Learning activities: Learner will be provided Mass spectra for the characterization of compounds.	
Unit 4 **12 Hours**	**Chromatography:** Principle, Instrumentation and Applications of the following : • GC-MS • GC-AAS • LC-MS • LC-FTIR • LC-NMR • CE-MS • High Performance Thin Layer chromatography • Super critical fluid chromatography • Ion Chromatography • I-EC (Ion- Exclusion Chromatography) • Flash chromatography **Learning activities:** Learner will be provided experience of chromatography by using different techniques like TLC, Column, HPLC, HPTLC and GC.	**CLO3**
Unit 5 **12 ours**	**a. Spectral Characterization of the following compounds by spectroscopic techniques**: UV, IR, MS, NMR (1H, 13C) a) Carvone, Citral, Menthol b) Luteolin, Kaempferol c) Nicotine, Caffeine d) Glycyrrhizin **Learning activities:** Students will develop advanced skills in data interpretation and problem-solving through the rigorous analysis of spectral data acquired from UV, IR, MS, and NMR experiments conducted on natural products.	**CLO4**

REFERENCES:

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. Organic Spectroscopy - William Kemp, ELBS.
5. Quantitative analysis of Pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.
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

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration
- Team teaching
- Self-learning

Transaction Mode

- PPT
- YouTube
- Google meet

Course Title: Dissertation Part-I
Paper Code: CMC. 600

L	T	P	Credits
0	0		4

Learning outcome:
After completing this course, the learner will be able to:

CLO1: Designing of research problem and prepare synopsis
CLO2: Preparation of synopsis for Project
CLO3: Planning of experiments

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Report evaluation

Mapping with course learning outcome: CLO1, CLO2, CLO3

The following are some of the **modes of classroom transaction**

- Lecture cum demonstration
- Project Method
- Seminar
- Group discussion

The following **tools** can be used in **different transactional modes**:

PPT
Video
Multimedia packages

TED Talks
google drive

Software tools

- Tracker
- ChemBioDraw
- Schrodingermaestro/AutoDck

- ppt
- BLAST
- Endnote

M PHARM SEMESTER 1 PHARMACOGNOSY PRACTICAL – II
(MPG 205P)

Course Title: Pharmacognosy–I (Practical)

L	T	P	Credits
0	0	12	6

Paper Code: MPG 105P
Course Hours: 60h

Learning Outcomes:
After completing this course, the learner will be able to:

CLO1: Prepare different dosage forms of ISM drugs
CLO2: Perform the isolation and identification of genetic materials from natural sources
CLO3: Use sterilization techniques to sterilize explants for the initiation of callus and suspension culture
CLO3: Compare quality of medicinal plants and formulations with the reference substances using standardization parameters
CLO4: Apply different analytical methods for the identification and characterization of phytochemicals in herbal raw materials
CLO5: Explain the preparation and analysis of herbal cosmetics and aromatherapy formulations

Course Content

Practical	Content/Title	Mapping with course learning outcome
1.	Isolation of nucleic acid from cauliflower heads **Learning Activities:** Students extract nucleic acids from cauliflower heads using extraction kits or traditional methods, followed by purification and quantification using spectrophotometry	**CLO2**
2.	Isolation of RNA from yeast **Learning Activities:** Students lyse yeast cells, extract RNA using phenol-chloroform and assess RNA quality and quantity using spectrophotometry.	**CLO2**
3.	Quantitative estimation of DNA **Learning Activities:** Students perform DNA quantification using UV absorbance methods.	**CLO2**
4.	Immobilization technique **Learning Activities:** Students immobilize enzymes or biomolecules onto solid supports using techniques like adsorption, covalent bonding, or entrapment,	**CLO2**

	optimizing conditions for maximum activity and stability.	
5.	Establishment of callus culture **Learning Activities:** Students culture plant tissue explants on nutrient media supplemented with plant growth regulators, observing and maintaining callus growth, and subculturing for propagation.	**CLO2, CLO3**
6.	Establishment of suspension culture **Learning Activities:** Students initiate suspension cultures from plant callus or cell cultures, optimizing growth conditions, and monitoring cell viability and biomass accumulation.	**CLO3**
7.	Estimation of aldehyde contents of volatile oils **Learning Activities:** Students use chemical assays like Schiff's reagent or spectrophotometric methods to quantify aldehyde levels in volatile oils, validating results through standard curves.	**CLO3**
8.	Estimation of total phenolic content in herbal raw materials **Learning Activities:** Students employ colorimetric assays such as Folin-Ciocalteu to quantify total phenolic content in herbal raw materials, correlating absorbance with phenolic concentration.	**CLO4**
9	Estimation of total alkaloid content in herbal raw materials **Learning Activities:** Students perform alkaloid extraction using appropriate solvents, followed by quantification using UV spectrophotometry with standard alkaloids.	**CLO4**
10	Estimation of total flavonoid content in herbal raw materials **Learning Activities:** Students use colorimetric assays like aluminum chloride method or UV spectrophotometry to determine total flavonoid content in herbal raw materials, interpreting results based on standard curves.	**CLO4**
11	Preparation and standardization of various simple dosage forms from Ayurvedic, Siddha, Homoeopathy and Unani formulary **Learning Activities:** Students prepare various dosage forms following Ayurvedic formulations, standardizing them for quality, efficacy, and safety.	**CLO4**
12	Preparation of certain Aromatherapy formulations **Learning Activities:** Students formulate aromatherapy products like essential oil blends,	**CLO5**

	massage oils, or inhalation blends, ensuring proper blending and standardization for therapeutic effects.	
13	Preparation of herbal cosmetic formulation such as lip balm, lipstick, facial cream, herbal hair and nail care products **Learning Activities:** Students develop herbal cosmetics such as lip balm, lipstick, facial cream, and hair care products, considering natural ingredients and standardizing formulations for efficacy and safety.	**CLO5**
14	Evaluation of herbal tablets and capsules **Learning Activities:** Students assess the quality by phytometabolite profiling of herbal tablets by HPLC techniques	**CLO5**
15	Preparation of sunscreen, UV protection cream, skin care formulations **Learning Activities:** Students formulate sunscreen, UV protection cream, and skin care products using herbal ingredients.	**CLO5**
16	Formulation & standardization of herbal cough syrup **Learning Activities:** Students develop herbal cough syrup formulations, optimizing ingredients and concentrations for efficacy.	**CLO5**

Course Title: Seminar/Assignment

Paper Code: MPG206S

L	T	P	Credits	Marks
0	0	0	4	100

Learning outcome: Students who successfully complete this course will be able to

- Perform literature review on a given topic
- Prepare a report on a given topic
- Prepare a power point presentation on a given topic

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Report evaluation

Semester III

Course Title: Research Methodology & Biostatistics

L	T	P	Credits
4	0	0	4

Paper Code: MRM301T
Course Hours: 60h

Learning Outcomes:
After completing this course, the learner will be able to:

CLO1: Define an appropriate research problem
CLO2: Understand and interpret commonly reported statistical measures and analysis of different types of data using statistical software's
CLO3: Develop skills for scholarly investigations, pursuit of discovery including principles in research in clinical practice
CLO4: To understand and promote the care of animals in biomedical/behavioral and breeding of animals for this purpose
CLO5: To understand principles and history of human care in medical research

Course Content

Units/Hours	Content	Mapping with course learning outcome
Unit 1 **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. **Learning activities:** Learner will be engaged in literature search and study design	**CLO1, CLO2**
Unit 2 **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. **Learning activities:** Learner will be engaged in Web based learning to explain concepts of biostatics in research problem and analysis of different type of	**CLO2**

	statistical data	
Unit 3 **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 **Learning activities:** Learner will be engaged to get familiarize with terms related to medical research and ethics in medical research	**CLO3**
Unit 4 **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 **Learning activities:** Learner will be engaged to develop a comprehensive understanding of ethical and practical consideration in care and use of animal in research settings.	**CLO4**
Unit 5 **12 Hours**	**Declaration of Helsinki** • History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care **Learning activities:** Learner will be engaged in understanding profound history and principles applicable to medical research	**CLO5**

Suggested Readings:

1. Gupta, S. (2005). *Research methodology and statistical techniques*, Deep & Deep Publications (p) Ltd. New Delhi.
2. Kothari, C. R. (2008.) *Research Methodology(s)*, New Age International (p) Limited.New Delhi

3. Best J. W., Khan J. V. (Latest Edition) *Research in Education*, Prentice Hall of India Pvt. Ltd.
4. *Safe Science: Promoting a Culture of Safety in Academic Chemical Research*; National Academic Press, www.nap.edu.
5. Creswell, D., & Creswell, J. W. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*.

The following are some of the modes of classroom transaction

- Lecture
- Group discussion
- Demonstration

Transaction Mode

- PPT
- YouTube
- Google drive

Course Title: Journal Club

Paper Code: MPG302T

L	T	P	Credits	Marks
0	**0**		**1**	**25**

Course Title: Discussion/ Presentation (Proposal Presentation)

Paper Code: MPG303T

L	T	P	Credits	Marks
0	0	0	2	50

Course Title: Research Work Paper

Code: MPG599

L	T	P	Credits	Marks
0	**0**	**0**	**14**	**350**

Learning outcome: Students who successfully complete this course will be able to

Design a research problem and prepare synopsis

- **Plan and execute experiments in the laboratory**
- **Interpret and analyze the results**
-

Evaluation criteria:

- **Literature survey/background information**
- **Organization of content**
- **Physical presentation**
- **Questions and answers Report**
- **evaluation**

Semester IV

Course Title: Journal Club

Paper Code: MPG401T

L	T	P	Credits	Marks
0	0	0	1	25

Course Title: Discussion/ Presentation Paper
Code: MPG402T

L	T	P	Credits	Marks
0	0	0	3	75

Course Title: Research Work, Thesis and viva-voce

Paper Code: MPG599

L	T	P	Credits	Marks
0	0	0	16	400

Learning outcome: Students who successfully complete this course will be able to

- Design a research problem and prepare synopsis
- Plan and execute experiments in the laboratory
- Interpret and analyze the results
-

Evaluation criteria:

- Literature survey/background information
- Organization of content
- Physical presentation
- Questions and answers
- Thesis evaluation
- Viva-voce

The following are some of the classroom transactional modes

1. Lecture
2. Demonstration
3. Lecture cum demonstration
4. Project method
5. Seminar
6. Group Discussion
7. Focused group discussion
8. Team teaching
9. Experimentation
10. Tutorial
11. Problem solving
12. Self-learning

The following tools can be used in different transactional modes:

- PPT
- Facebook
- WhatsApp
- Video
- Multimedia packages
- google drive