

DEPARTMENT OF PHARMACY  
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)  
(A CENTRAL UNIVERSITY)

**M.PHARM. (PHARMACOGNOSY)**  
**(W.E.F. SESSION 2023-24)**

**Course of study for M. Pharm. (Pharmacognosy)**

Course Code	Course	Credit Hours	Credit Points	Hrs./w k	Marks
<b>Semester I</b>					
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
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650
<b>Semester II</b>					
MPG201T	Medicinal Plant biotechnology	4	4	4	100
MPG102T	Advanced Pharmacognosy-II	4	4	4	100
MPG203T	Indian system of medicine	4	4	4	100
MPG204T	Herbal cosmetics	4	4	4	100
MPG205P	Pharmacognosy Practical II	12	6	12	150
-	Seminar/Assignment	7	4	7	100
	Total	35	26	35	650

**(Pharmacognosy- MPH)**

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continu ous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
<b>Semester I</b>								
MPG101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100
MPG102T	Advanced Pharmacognosy-I	10	15	1 Hr	25	75	3 Hrs	100
MPG103T	Phytochemistry	10	15	1 Hr	25	75	3 Hrs	100
MPG104T	Industrial Pharmacognostical Technology	10	15	1 Hr	25	75	3 Hrs	100
MPG105P	Pharmacognosy Practical I	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar/Assignment	-	-	-	-	-	-	100
Total								650
<b>Semester II</b>								
MPG201T	Medicinal Plant biotechnology	10	15	1 Hr	25	75	3 Hrs	100
MPG102T	Advanced Pharmacognosy-II	10	15	1 Hr	25	75	3 Hrs	100
MPG203T	Indian system of medicine	10	15	1 Hr	25	75	3 Hrs	100
MPG204T	Herbal cosmetics	10	15	1 Hr	25	75	3 Hrs	100
MPG205P	Pharmacognosy Practical II	20	30	6 Hrs	50	100	6 Hrs	150
-	Seminar/Assignment	-	-	-	-	-	-	100
Total								650

**Course of study for M. Pharm. III Semester (Common for All Specializations)**

<b>Course Code</b>	<b>Course</b>	<b>Credit Hours</b>	<b>Credit Points</b>
MRM 301T	Research Methodology and Biostatistics*	4	4
MRM 302P	Journal club	1	1
MRM 303P	Discussion / Presentation (Proposal Presentation)	2	2
MRM 304P	Research Work	28	14
	<b>Total</b>	<b>35</b>	<b>21</b>

*\*Non University Examination*

**Course of study for M. Pharm. IV Semester (Common for All Specializations)**

<b>Course Code</b>	<b>Course</b>	<b>Credit Hours</b>	<b>Credit Points</b>
MRM 401P	Journal club	1	1
MRM 402P	Research Work	31	16
MRM 403P	Discussion / Final Presentation	3	3
	<b>Total</b>	<b>35</b>	<b>20</b>

**Semester wise credits distribution**

<b>Semester</b>	<b>Credit Points</b>
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
<b>Total Credit Points</b>	<b>Minimum=95 Maximum=100*</b>

*\*Credit Points for Co-curricular Activities*

**Schemes for internal assessments and end semester examinations (Semester III & IV)**

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continu ous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
Semester III								
MRM301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3 Hrs	100
MRM 302P	Journal club	-	-	-	25	-	-	25
MRM 303P	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
MRM 304P	Research work*	-	-	-	-	350	1 hr	350
Total								525
Semester IV								
MRM401P	Journal club	-	-	-	25	-	-	25
MRM402P	Discussion / Presentation (Proposal Presentation)	-	-	-	75	-	-	75
MRM403P	Research work and Colloquium	-	-	-	-	400	1 hr	400
Total								500

\*Non University Examination

## M. Pharm. (Pharmacognosy)

### Programme Outcomes

**Postgraduate's students will be able to:**

**PO1: Fundamentals on advanced analytical instrumental techniques:** UV-Visible, IR, Spectrofluorimetry, Flame emission and atomic absorption spectroscopy, NMR spectroscopy, Mass Spectroscopy, Chromatography, Electrophoresis and Immunological assays methods.

**PO2: Advances in the field of cultivation and isolation of drugs of natural origin:** Plant drug cultivation, Marine natural products, Recent advances in research in marine drugs, Nutraceuticals, Phytopharmaceuticals, Pharmacovigilance of drugs of natural origin, Validation, screening technique and procedures for detection of the herbal and natural drugs.

**PO3: Advanced knowledge of natural product drug discovery:** Biosynthetic pathways and Radio tracing techniques, alkaloids, glycosides, steroids, coumarin, terpenoids, Extraction and Phytochemical studies, Separation of phytoconstituents by latest CCCET, SCFE techniques, HPTLC and LCMS/GCMS applications in the characterization of herbal extracts, Structure elucidation of compounds by spectroscopic techniques like UV, IR, MS, NMR (<sup>1</sup>H, <sup>13</sup>C).

**PO4: Understanding Industrial and commercial potential of drugs of natural origin:** Infrastructure of herbal drug industry involved in production of standardized extracts, Global marketing management, Concepts of TQM, GMP, GLP, ISO-9000, Monographs of herbal drugs, Ayurvedic, Siddha and Unani, American herbal and British herbal pharmacopoeia, Indian and international patent laws.

**PO5: Advanced knowledge of Biotechnology and its application:** Introduction to Plant biotechnology, Different tissue culture techniques, Immobilisation techniques, Biotransformation and Transgenesis, Fermentation technology,

**PO6: Study of preparation and standardization of herbal/natural cosmetics:** Herbal/natural cosmetics, Classification & Economic aspects, Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail, possible interactions between chemicals and herbs, Tonic, Bleaches, Dentifrices and Mouth washes & Toothpastes, Analysis of Cosmetics, Quality control and toxicity studies as per Drug and Cosmetics Act.

**PO7: Knowledge of Indian systems of medicine:** Ayurveda, Siddha, Unani and Homoeopathy systems of medicine, Ayurvedic Pharmacopoeia, Naturopathy, Yoga and Aromatherapy practices, Schedule T, AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU, Shelf life and Stability studies of ISM formulations.

**PO8: Knowledge about Research Methodology & Biostatistics:** review of literature, strategies to eliminate errors/bias, values in medical ethics, CPCSEA guidelines for laboratory animal facility, Declaration of Helsinki.

## First Semester

### MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPG 101T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG101T	3	1	-	4 hours	25	75	100	4

#### Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs.

Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

#### Objectives

After completion of course student is able to know,

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

#### THEORY

60 HOURS

1. UV-Visible spectroscopy: Introduction, Theory, Laws, 11 Hrs  
Instrumentation associated with UV-Visible spectroscopy. Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy.  
IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier – Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy.  
Spectrofluorimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.  
Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.
2. NMR spectroscopy: Quantum numbers and their role in NMR, 11 Hrs  
Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and <sup>13</sup>C NMR. Applications of NMR spectroscopy.

3. 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 11 Hrs
- 4 Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: 11 Hrs
  - 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
- 5 Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: 11 Hrs
  - 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 diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.
- 6 Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry. 5Hrs
 

Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and

cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.

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

#### REFERENCES

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

#### COURSE OUTCOMES

**CO1** Recognize, utilize and explain theoretical concepts. instrumentation and applications of Spectroscopic techniques like UV, IR, Fluorimetry, FES and AAS.

**CO2** Acknowledge, apply and clarify theoretical ideas, equipment, and uses of spectroscopic methods such as NMR.

**CO3** Understand, apply and clarify the theoretical ideas, instrumentation and uses of spectroscopic methods such as Mass Spectroscopy (MS).

**CO4** Acknowledge, apply and clarify theoretical ideas, equipment, and uses of chromatographic methods such as gel chromatography, electrophoresis, TLC, HPTLC, Ion exchange, column GC, HPLC, affinity and X-ray crystallography.

**CO5** Recognize, utilize, and explain theoretical concepts, instrumentation and applications of Electrophoresis and X ray.

**CO6** ystallography. Explain theoretical concepts, instrumentation and applications of Potentiometry and Thermal Techniques



**Course Outcomes and their mapping with Programme Outcomes**

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

## ADVANCED PHARMACOGNOSY – I (MPG 102T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 102T	3	1	-	4 hours	25	75	100	4

### SCOPE

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

### OBJECTIVES

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

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

### THEORY

60 Hrs

1. Plant drug cultivation: General introduction to the importance of 12  
Pharmacognosy in herbal drug industry, Indian Council of Hrs  
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
2. Marine natural products: General methods of isolation and 12  
purification, Study of Marine toxins, Recent advances in research Hrs  
in marine drugs, Problems faced in research on marine drugs  
such as taxonomical identification, chemical screening and their  
solution.
3. Nutraceuticals: Current trends and future scope, Inorganic 12  
mineral supplements, Vitamin supplements, Digestive enzymes, Hrs  
Dietary fibres, Cereals and grains, Health drinks of natural origin,  
Antioxidants, Polyunsaturated fatty acids, Herbs as functional  
foods, Formulation and standardization of neutraceuticals,  
Regulatory aspects, FSSAI guidelines, Sources, name of marker  
compounds and their chemical nature, medicinal uses and health  
benefits of following  
i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi)

Green and Herbal Tea vii) Flax seeds viii) Black cohosh ix) Turmeric.

- 4 Phytopharmaceuticals: Occurrence, isolation and characteristic 12 features (Chemical nature, uses in pharmacy, medicinal and Hrs health benefits) of following.
- Carotenoids – i)  $\alpha$  and  $\beta$  – Carotene ii) Xanthophyll (Lutein)
  - Limonoids – i) d-Limonene ii)  $\alpha$  – Terpineol
  - Saponins – i) Shatavarins
  - Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin
  - Phenolic acids– Ellagic acid
  - Vitamins
  - Tocotrienols and Tocopherols
  - Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol
  - Miscellaneous
- 5 Pharmacovigilance of drugs of natural origin: WHO and 12 AYUSH guidelines for safety monitoring of natural medicine, Hrs Spontaneous reporting schemes for biodrug adverse reactions, bio drug–drug and bio drug–food interactions with suitable examples.

#### REFERENCES (Latest Editions of)

- Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
- Pharmacognosy-Tyler, Brady, Robbers
- Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II
- Text Book of Pharmacognosy by T.E. Wallis
- Marine Natural Products-Vol.I to IV.
- Natural products: A lab guide by Raphael Ikan , Academic Press 1991.
- Glimpses of Indian Ethano Pharmacology, P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute, 1995.
- Medicinal natural products (a biosynthetic approach), Paul M. Dewick, John Wiley & Sons Ltd., England, 1998.
- Chemistry of Marine Natural Products- Paul J. Schewer 1973.
- Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi, 1996.
- Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
- 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.

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 Pharmacobiotechnology, Ashutoshkar, New Age Publications, New Delhi.

## **COURSE OUTCOMES**

**CO1** To get Knowledge of significance, cultivation, collection, processing and storage of medicinal plants along with their preservation.

**CO2** To comprehend the concepts and recent development in marine drug research.

**CO3** To analyse the significance various nutraceuticals/herbs and their health benefits.

**CO4** To acquire knowledge on occurrence, isolation and applications of different natural bioactive molecules.

**CO5** To create/ establish and summarise the significance and guidelines for pharmacovigilance of herbal.

### **Course Outcomes and their mapping with Programme Outcomes**

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

### PHYTOCHEMISTRY (MPG 103T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 103T	3	1	-	4 hours	25	75	100	4

#### SCOPE

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

#### OBJECTIVES

Upon completion of the course, 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.

#### THEORY

60 HRS

1. Biosynthetic pathways and Radio tracing techniques: 12 Hrs  
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: Cucurbitacin
2. Drug discovery and development: History of herbs as source of 12 Hrs  
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.
3. Extraction and Phytochemical studies: Recent advances in 12 Hrs  
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

- |   |   |        |
|---|---|--------|
| 4 | Phytochemical finger printing: HPTLC and LCMS/GCMS applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents. | 12 Hrs |
| 5 | Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (1H, 13C)   | 12 Hrs |
|   | a. Carvone, Citral, Menthol   |        |
|   | b. Luteolin, Kaempferol   |        |
|   | c. Nicotine, Caffeine iv) Glycyrrhizin.   |        |

#### REFERENCES (Latest Editions of)

1. Organic chemistry by I.L. Finar Vol.II
2. Pharmacognosy by Trease and Evans, ELBS.
3. Pharmacognosy by Tylor and Brady.
4. Text book of Pharmacognosy by Wallis.
5. Clark's isolation and Identification of drugs by A.C. Mottal.
6. Plant Drug Analysis by Wagner & Bladt.
7. Wilson and Gisvolds text book of Organic Medicinnal and Pharmaceutical Chemistry by Deorge. R.F.
8. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer International Edn. 1994.
9. Natural Products Chemistry Practical Manual by Anees A Siddiqui and SeemiSiddiqui
10. Organic Chemistry of Natural Products, Vol. 1&2. Gurdeep R Chatwal.
11. Chemistry of Natural Products– Vol. 1 onwards IWPAC.
12. Modem Methods of Plant Analysis– Peach & M.V. Tracey, Vol. I&II
13. Medicinal Natural products – a biosynthetic approach, Dewick PM, John Wiley & Sons, Toronto, 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

#### **COURSE OUTCOMES**

**CO1** Discuss the Biosynthetic pathways and Radio tracing techniques.

**CO2** To understand the Drug discovery and development.

**CO3** To understand the Extraction and Phytochemical studies.

**CO4** To understand the Phytochemical finger printing.

**CO5** To know about Structure elucidation of compounds by spectroscopic techniques like UV, IR, MS, NMR (<sup>1</sup>H, <sup>13</sup>C) i.e., Carvone, Citral, Menthol

**Course Outcomes and their mapping with Programme Outcomes**

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

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## INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY (MPG 104T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 104T	3	1	-	4 hours	25	75	100	4

### Scope

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

### Objectives:

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

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

### THEORY

60 Hrs

1. 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. 12 Hr s
2. 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 12 Hr s
3. Monographs of herbal drugs: General parameters of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, 12 Hr s



- American herbal pharmacopoeia, British herbal pharmacopoeia, WHO guidelines in quality assessment of herbal drugs.
- 4 Testing of natural products and drugs: Herbal medicines – clinical laboratory testing. Stability testing of natural products, protocols.
  - 5 Patents: Indian and international patent laws, proposed amendments as applicable to herbal/natural products and process. Geographical indication, Copyright, Patentable subjects, novelty, non obviousness, utility, enablement and best mode, procedure for Indian patent filing, patent processing, grant of patents, rights of patents, cases of patents, opposition and revocation of patents, patent search and literature, Controllers of patents

#### REFERENCES (Latest Editions of)

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

#### COURSE OUTCOMES

**CO1** To obtain an overview of herbal drug industry, including an exposure to understanding entrepreneurship spirit.

**CO2** To understand various concepts of global marketing management so that the same can be applied to understand the process of opening and running an herbal drug industry

**CO3** To understand the role of various pharmacopoeial monographs in quality assessment of herbal drugs.

**CO4** Recognize, utilize, and explain theoretical concepts, instrumentation and applications of Electrophoresis and X ray Crystallography.

**CO5** Explain theoretical concepts, instrumentation and applications of Potentiometry and Thermal Techniques.

**Course Outcomes and their mapping with Programme Outcomes**

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

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## PHARMACOGNOSY PRACTICAL – I (MPG I05P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG I05P	-	-	12	12 hours	50	100	150	6

1. Analysis of Pharmacopoeial compounds of natural origin and their formulations by UV Vis spectrophotometer
2. Analysis of recorded spectra of simple phytoconstituents
3. Experiments based on Gas Chromatography
4. Estimation of sodium/potassium by flame photometry
5. Development of fingerprint of selected medicinal plant extracts commonly used in herbal drug industry viz. Ashwagandha, Tulsi, Bael, Amla, Ginger, Aloe, Vidang, Senna, Lawsonia by TLC/HPTLC method.
6. Methods of extraction
7. Phytochemical screening
8. Demonstration of HPLC- estimation of glycerrhizin
9. Monograph analysis of clove oil
10. Monograph analysis of castor oil.
11. Identification of bioactive constituents from plant extracts
11. Formulation of different dosage forms and their standardisation.

### COURSE OUTCOMES

**CO1** To get Knowledge of significance, cultivation, collection, processing and storage of medicinal plants along with their preservation.

**CO2** To comprehend the concepts and recent development in marine drug research.

**CO3** To analyse the significance various nutraceuticals/herbs and their health benefits.

**CO4** To acquire knowledge on occurrence, isolation and applications of different natural bioactive molecules.

**CO5** To create/ establish and summarise the significance and guidelines for pharmacovigilance of herbal.

### Course Outcomes and their mapping with Programme Outcomes

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Slightly; 2-Moderately; 3-Strongly**

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## Second Semester

### MEDICINAL PLANT BIOTECHNOLOGY (MPG 201T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 201T	3	1	-	4 hours	25	75	100	4

#### Scope

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

#### Objectives

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

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

#### THEORY

60 Hrs

1. 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. 12 Hrs
2. 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
3. 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
4. Biotransformation and Transgenesis: Biotransformation, bioreactors for pilot and large scale cultures of plant cells and 13 Hrs

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.

- 5 Fermentation technology: Application of Fermentation 05  
technology, Production of ergot alkaloids, single cell proteins, Hrs  
enzymes of pharmaceutical interest.

#### REFERENCES (Latest Editions of)

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

#### COURSE OUTCOMES

**CO1** Know the process like genetic engineering in Medicinal plants for higher yield of Phytopharmaceuticals.

**CO2** Discuss the various plant tissue culture techniques.

**CO3** Describe the methods of production of Secondary Plant Metabolites.

**CO4** Plant Genetic Engineering and production of Transgenics.

**CO5** Discuss the recent trends and fermentation technology.

**Course Outcomes and their mapping with Programme Outcomes**

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

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## ADVANCED PHARMACOGNOSY – II (MPG 202T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 202T	3	1	-	4 hours	25	75	100	4

### Scope

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

### Objectives

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

- 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

### THEORY

60 Hrs

1. Herbal remedies – Toxicity and Regulations: Herbals vs 12  
Conventional drugs, Efficacy of Herbal medicine products, Hrs  
Validation of herbal therapies, Pharmacodynamic and  
Pharmacokinetic issues
2. Adulteration and Deterioration: Introduction, Types of 12  
Adulteration/ Substitution of Herbal drugs, Causes and Measures Hrs  
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.
3. Ethnobotany and Ethnopharmacology: Ethnobotany in herbal 12  
drug evaluation, Impact of Ethnobotany in traditional medicine, Hrs  
New development in herbals, Bio-prospecting tools for drug  
discovery, Role of Ethnopharmacology in drug evaluation,  
Reverse Pharmacology.
4. Analytical Profiles of herbal drugs: Andrographis paniculata, 12  
Boswellia serata, Coleus forskholii, Curcuma longa, Embelica Hrs  
officinalis, Psoralea corylifolia.
5. Biological screening of herbal drugs: Introduction and Need for 12

Phyto-Pharmacological Screening, New Strategies for evaluating Hrs 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

#### REFERENCES (Latest Editions of)

1. Glimpses of Indian Ethano Pharmacology by P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute.
2. Natural products: A lab guide by Raphael Ikan, Academic Press.
3. Pharmacognosy – G. E. Trease and W.C. Evans. WB. Saunders Edinburgh, New York.
4. Pharmacognosy–Tyler, Brady, Robbers, Lee & Fetiger.
5. Modern Methods of Plant Analysis– Peach & M.V. Tracey, Vol. I & II, Springer Publishers.
6. Herbal Drug Industry by RD. Choudhary, Eastern Publishers, New Delhi.
7. Text book of Pharmacognosy by C.K.Kokate, Purohit, Ghokhale, 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. Rangarl, 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.

#### COURSE OUTCOMES

- CO1** Discuss the Herbal remedies.
- CO2** Discuss the Adulteration and Deterioration.
- CO3** Describe the Ethnobotany and Ethnopharmacology.
- CO4** To know about the Analytical Profiles of herbal drugs.
- CO5** Discuss the Biological screening of herbal drugs.



**Course Outcomes and their mapping with Programme Outcomes**

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

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## INDIAN SYSTEMS OF MEDICINE (MPG 203T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG203T	3	1	-	4 hours	25	75	100	4

### Scope

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

### Objectives

After completion of the course, student is able to

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

### THEORY

60 Hrs

1. Fundamental concepts of Ayurveda, Siddha, Unani and Homoeopathy systems of medicine 12 Hrs  
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).
2. Naturopathy, Yoga and Aromatherapy practices 12 Hrs
  - 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.
3. Formulation development of various systems of medicine 12 Hrs  
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	
4	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
5	TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU	12 Hrs

#### REFERENCES (Latest Editions of )

1. Ayurvedic Pharmacopoeia, The Controller of Publications, Civil Lines, Govt. of India, New Delhi.
2. Hand Book on Ayurvedic Medicines, H. Panda, National Institute of Industrial Research, New Delhi.
3. Ayurvedic System of Medicine, 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 Dietetics and Nutrition, F.P. Antia, Oxford University Press, Delhi.
13. Yoga – The Science of Holistic Living by V.K.Yoga, Vivekananda Yoga Prakashna Publishing, Bangalore.

## **COURSE OUTCOMES**

**CO1** To understand the basic principles of various Indian systems of medicine.

**CO2** To understand the basic principles and treatment modalities of naturopathy, yoga and aromatherapy formulations as mentioned in official books

**CO3** To understand the preparation techniques of various traditional

**CO4** To understand the concept of GMP and quality assurance involved in the ISM formulation industry.

**CO5** To get an overview of Govt. bills associated with AYUSH. ISM. CCRAS, CCRS, CCRH, and CCRU so that the student can understand the basic objective behind such bodies and its application.

## **Course Outcomes and their mapping with Programme Outcomes**

<b>CO</b>	<b>PO</b>							
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Slightly; 2-Moderately; 3-Strongly**

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## HERBAL COSMETICS (MPG 204T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 204T	3	1	-	4 hours	25	75	100	4

### SCOPE

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

### OBJECTIVES

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

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

### THEORY

60 Hrs

1. Introduction: Herbal/natural cosmetics, Classification & Economic aspects. 12 Hrs  
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.
2. 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
3. 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 : 12 Hrs  
Tonic, Bleaches, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails.
4. Cosmeceuticals of herbal and natural origin: Hair growth formulations, Shampoos, Conditioners, Colorants & hair oils, Fairness formulations, vanishing & foundation creams, anti-sun 12 Hrs

burn preparations, moisturizing creams, deodorants.

- 5 Analysis of Cosmetics, Toxicity screening and test methods: 12  
Quality control and toxicity studies as per Drug and Cosmetics Hrs  
Act.

#### REFERENCES (Latest Editions of)

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

#### COURSE OUTCOMES

**CO1** To know about Herbal/natural cosmetics and Regulatory Provisions in relation to manufacture of cosmetics.

**CO2** To analyze the formulation requirements along with various raw materials for herbal cosmetic preparation

**CO3** To understand the basic principles of various herbal/ natural cosmetic preparations and standardisation of Tonic, Bleaches, Dentifrices etc.

**CO4** To know about the Cosmeceuticals of herbal and natural origin.

**CO5** To know about Analysis of Cosmetics, Toxicity screening and test methods.

#### Course Outcomes and their mapping with Programme Outcomes

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

## HERBAL COSMETICS PRACTICALS (MPG 205P)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MPG 205P	-	-	12	12 hours	50	100	150	6

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

### COURSE OUTCOMES

**CO1** To know about Herbal/natural cosmetics and Regulatory Provisions in relation to manufacture of cosmetics.

**CO2** To analyze the formulation requirements along with various raw materials for herbal cosmetic preparation

**CO3** To understand the basic principles of various herbal/ natural cosmetic preparations and standardisation of Tonic, Bleaches, Dentifrices etc.

**CO4** To know about the Cosmeceuticals of herbal and natural origin.

**CO5** To know about Analysis of Cosmetics, Toxicity screening and test methods.

### Course Outcomes and their mapping with Programme Outcomes

CO	PO							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO-1								

CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**

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### Third Semester

#### RESEARCH METHODOLOGY & BIOSTATISTICS- (MRM 301T)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MRM 301T	3	1	-	4 hours	25	75	100	4

##### UNIT – I

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

##### UNIT – II

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

##### UNIT – III

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

##### UNIT – IV

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.

##### UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

## **COURSE OUTCOMES**

**CO1** Describe the General Research Methodology.

**CO2** Explain Biostatistics i.e., sample size, statistical tests of significance, Biostatistics\* parametric tests, non-parametric tests, analysis of variance etc.

**CO3** To know about the Medical Research i.e., History, values in medical ethics, autonomy, beneficence, non- maleficence etc.

**CO4** Describe the CPCSEA guidelines for laboratory animal facility.

**CO5** Explain Declaration of Helsinki

### **Course Outcomes and their mapping with Programme Outcomes**

<b>CO</b>	<b>PO</b>							
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
CO-1								
CO-2								
CO-3								
CO-4								
CO-5								

**Weightage: 1-Sightly; 2-Moderately; 3-Strongly**