

# GUJARAT TECHNOLOGICAL UNIVERSITY

M.Pharm  
SEMESTER: I

**Subject Name: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES**

**Subject Code: MAT101T**

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

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

Sr No	Course Contents	Total Hrs
1	<b>UV-Visible spectroscopy:</b> Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UVVisible Spectroscopy <b>IR spectroscopy:</b> Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy <b>Spectrofluorimetry:</b> Theory of Fluorescence, Factors affecting fluorescence, Quenchers, Instrumentation and Applications of fluorescence spectrophotometer <b>Flame emission spectroscopy and Atomic absorption spectroscopy:</b> Principle, Instrumentation, Interferences and Applications	11
2	<b>NMR spectroscopy:</b> Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and <sup>13</sup> C NMR. Applications of NMR spectroscopy	10
3	<b>Mass Spectroscopy:</b> 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	10
4	<b>Chromatography:</b> Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following: a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography	11
5	a. <b>Electrophoresis:</b> Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing b. <b>X ray Crystallography:</b> 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 Xray diffraction.	9

<b>6</b>	<p><b>Potentiometry:</b> Principle, thermal transitions and instrumentation (heat flux and power compensation and designs) working, Ion selective Electrodes and Application of potentiometry.</p> <p><b>Thermal Analysis:</b> Polymer behavior, factors affecting and instrumentation, and working, application of TGA</p>	9
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**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, 4<sup>th</sup> 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, 3<sup>rd</sup> Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

# GUJARAT TECHNOLOGICAL UNIVERSITY

## M.Pharm PHARMACOGNOSY SEMESTER: I

**Subject Name:** ADVANCED PHARMACOGNOSY - I

**Subject Code:** MPG102T

**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:** After Completion of course student will be able to know:

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

Sr No	Course Contents	Total Hrs
1	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 Insitu conservation of medicinal plants.	12
2	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.	12
3	Nutraceuticals and dietary supplements: Current trends and future scope, Inorganic mineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibres, Cereals and grains, Health drinks of natural origin, Antioxidants, Polyunsaturated fatty acids, Herbs as functional foods, Formulation and standardization of neutraceuticals, Regulatory aspects, FSSAI guidelines, Sources, name of marker compounds and their chemical nature, medicinal uses and health benefits of following i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi) Green and Herbal Tea vii) Flax seeds viii) Black cohosh ix) Turmeric. x) Tinospora xi) Moringa xii) Ginger xiii) Amla xiv) Harde xv) Ashwagandha	12
4	Phytopharmaceuticals: Occurrence, isolation and characteristic features (Chemical nature, uses in pharmacy, medicinal and health benefits) of following. a) Carotenoids – i) $\alpha$ and $\beta$ - Carotene ii) Xanthophyll (Lutein) b) Limonoids – i) d-Limonene ii) $\alpha$ - Terpeneol c) Saponins – i) Shatavarins d) Flavonoids – i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin e) Phenolic acids- Ellagic acid	12

	f) Vitamins g) Tocotrienols and Tocopherols h) Andrographolide, Glycolipids, Gugulipids, Withanolides, Vascine, Taxol i) Miscellaneous	
<b>5</b>	Pharmacovigilance of drugs of natural origin: WHO and AYUSH guidelines for safety monitoring of natural medicine, Spontaneous reporting schemes for biodrug adverse reactions, bio drug-drug and bio drug-food interactions with suitable examples.	12

#### REFERENCES (Latest Editions of)

1. Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
2. Pharmacognosy-Tyler, Brady, Robbers
3. Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II
4. Text Book of Pharmacognosy by T.E. Wallis
5. Marine Natural Products-Vol.I to IV.
6. Natural products: A lab guide by Raphael Ikan , Academic Press 1991.
7. Glimpses of Indian Ethano Pharmacology, P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute, 1995.
8. Medicinal natural products (a biosynthetic approach), Paul M. Dewick, John Wiley & Sons Ltd., England, 1998.
9. Chemistry of Marine Natural Products- Paul J. Schewer 1973.
10. Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi, 1996.
11. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
12. Cultivation and Utilization of Aromatic Plants, C.K. Atal & B.M. Kapoor
13. Cultivation of medicinal and aromatic crops, AA Farooqui and B.S. Sreeramu. University Press, 2001.
14. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRC Press, New York, 1998
15. Recent Advances in Phytochemistry- Vol. 1&4: Scikel Runeckles- Appleton Century crofts.
16. Text book of Pharmacognosy, C.K.Kokate, Purohit, Ghokhale, Nirali Prakasshan, 1996.
17. Pharmacognosy and Pharmacobiotechnology, Ashutoshkar, New Age Publications, New Delhi.Publications.
18. Quality Standards of Indian Medicinal Plants, Indian Council of Medical Research, New Delhi, 2008

# GUJARAT TECHNOLOGICAL UNIVERSITY

## M.Pharm PHARMACOGNOSY SEMESTER: I

**Subject Name:** Phytochemistry

**Subject Code:** MPG103T

**Scope:** Students shall be equipped with the knowledge of natural product drug discovery and will be able to isolate, identify and extract and the phytoconstituents

**Objectives:** Upon completion of this course the student should be able to

- 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

Sr No	Course Contents	Total Hrs
1	Biosynthetic pathways and Radio tracing techniques: Constituents & their Biosynthesis, Isolation, Characterization and purification with a special reference to their importance in herbal industries of following phyto pharmaceuticals containing drugs: a) Alkaloids: Ephedrine, Quinine, Strychnine, Piperine, Berberine, Taxol, Vinca alkaloids. b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercitin. c) Steroids: Hecogenin, guggulosterone and withanolides d) Coumarin: Umbelliferone. e) Terpenoids: Cucurbitacins	12
2	Drug discovery and development: History of herbs as source of drugs and drug discovery, the lead structure selection process, structure development, product discovery process and drug registration, Selection and optimization of lead compounds with suitable examples from the following source : artemesin, andrographolides. Clinical studies emphasising on phases of clinical trials, protocol design for lead molecules.	12
3	Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods of extraction commonly used like microwave assisted extraction, Methods of fractionation. Separation of phytoconstituents by latest CCCET, SCFE techniques including preparative HPLC and Flash column chromatography	12
4	Phytochemical finger printing: HPTLC and LCMS/GCMS applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents.	12
5	Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (1H, 13C) a. Carvone, Citral, Menthol b. Luteolin, Kaempferol c. Nicotine, Caffeine iv) Glycyrrhizin.	12

## REFERENCES (Latest Editions of)

1. Organic Chemistry, Volume 2: Stereochemistry and the Chemistry Natural Products - I.L. Finar, 5<sup>th</sup> Edition, Pearson Education, Delhi, 1956
2. Trease and Evans' Pharmacognosy - William Charles Evans, 16<sup>th</sup> Edition, Elsevier Health Sciences, 2009
3. Pharmacognosy-Tyler, Brady, Robbers, 9<sup>th</sup> Edition, Wolters Kluwer New Delhi, 1988
4. Text Book of Pharmacognosy - T.E. Wallis, 5<sup>th</sup> Edition, CBS Publishers, New Delhi, 2005
5. Clarke's Isolation and Identification of Drugs: In Pharmaceuticals, Body Fluids and Post Mortem Material - E.G.C. Clarke and A.C. Moffat., 2<sup>nd</sup> Revised Edition, Pharmaceutical Press, 1986
6. Plant Drug Analysis - Hildebert Wagner and Sabine Bladt, 2nd Edition, Springer, NY, 1996
7. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams & Wilkins, 2010  
Deorge. R.F. and John H. Block, 12<sup>th</sup> Edition, Lippincott Williams & Wilkin, 2010
8. The Chemistry of Natural Products - Edited by R.H. Thomson, Springer International Edn. 1993
9. Natural Products Chemistry Practical Manual by Anees A Siddiqui and SeemiSiddiqui
10. Organic Chemistry of Natural Products, Vol. 1 & 2. - Gurdeep R Chatwal, 4<sup>th</sup> Edition, Himalaya Publishing House, 2016
11. Modern Methods of Plant Analysis Vol. I & II – Peach K. and M.V. Tracey, Springer-Verlag Berlin Heidelberg, 1956
12. Medicinal Natural Products: A Biosynthetic Approach - Paul M. Dewick, 3<sup>rd</sup> Edition, John Wiley & Sons Ltd., England, 2009.
13. Chemistry of Natural Products - S. V. Bhat, B. A. Naga Sampagi, M. Shivakumar, Narosa Publishing House, New Delhi, 2015
14. Pharmacognosy, Phytochemistry, Medicinal Plants - Jean-Noel Bruneton, 2<sup>nd</sup> Edition, Intercept Ltd., New York, 1999.
15. **Phytochemical Methods A Guide to Modern Techniques of Plant Analysis** by A.J. Harborne, 3<sup>rd</sup> Edition, Chapman & Hall, London, 1998

# GUJARAT TECHNOLOGICAL UNIVERSITY

## M.Pharm PHARMACOGNOSY SEMESTER: I

**Subject Name: INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY**

**Subject Code: MPG104T**

**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 this course the student should be able to

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

Sr No	Course Contents	Total 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
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
3	Monographs of herbal drugs: General parameters of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, American herbal pharmacopoeia, British herbal pharmacopoeia, WHO guidelines in quality assessment of herbal drugs.	12
4	Testing of natural products and drugs: Herbal medicines - clinical laboratory testing. Stability testing of natural products, protocols.	12
5	Patents: Indian and international patent laws, proposed amendments as applicable to herbal/natural products and process. Geographical indication, Copyright, Patentable subject matters, novelty, non obviousness, utility, enablement and best mode, procedure for Indian patent filing, patent processing, grant of patents, rights of patents, cases of patents, opposition and revocation of patents, patent search and literature, Controllers of patents.	12

### 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.



# GUJARAT TECHNOLOGICAL UNIVERSITY

M.Pharm  
PHARMACOGNOSY  
SEMESTER: I

**Subject Name: PHARMACOGNOSY PRACTICAL - I**

**Subject Code: MPG105T**

**List of Practicals:**

**PART A:**

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry

**PART B:**

1. 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.
2. Methods of extraction
3. Phytochemical screening
4. Demonstration of HPLC- estimation of glycyrrhizin
5. Monograph analysis of clove oil
6. Monograph analysis of castor oil.
7. Identification of bioactive constituents from plant extracts
8. Formulation of different dosage forms and their standardisation.

# GUJARAT TECHNOLOGICAL UNIVERSITY

## M.Pharm PHARMACOGNOSY SEMESTER: II

**Subject Name:** MEDICINAL PLANT BIOTECHNOLOGY

**Subject Code:** MPG201T

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

**Objectives:** After Completion of course student will be able to know:

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

Sr No	Course Contents	Total 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
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
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 elicitorson production of secondary metabolites	15
4	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	13
5	Fermentation technology: Application of Fermentation technology, Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest	5

References:

1. Plant Tissue Culture: Theory and Practice, Volume 5 - S.S. Bhojwani M.K. Razdan Elsevier Publishers, 1996
2. Plant Cell and Tissue Culture: A Laboratory Manual - J. Reinert and M.M. Yeoman, 1<sup>st</sup> Edition, Springer, 2012
3. Elements in Biotechnology – P. K.Gupta, 2<sup>nd</sup> Edition, Rastogi Publications, New Delhi., 2015-16.
4. An introduction to Plant Tissue Culture – M.K. Razdan, 2<sup>nd</sup> Edition, Oxford & Ibh Publishing Co. Pvt Ltd, 2010
5. Experiments in Plant Tissue Culture - J. Heslop-Harrison (Foreword), John H. Dodds (Author), Lorin W. Roberts (Author), 3<sup>rd</sup> Edition, Cambridge University Press, 1955.
6. Pharmaceutical Biotechnology – S.P. Vyas and V.K. Dixit, 1<sup>st</sup> Edition, CBS Publishers & Distributors, 2016
7. Plant Cell and Tissue Culture (Methods in Molecular Biology) Vol. 6 - Jeffrey W. Pollard and John M Walker, Humana press, 2014.
8. Plant cell culture: a practical approach by R. A. Dixon, Robert A. Gonzales, 2, illustrated, reprint, Oxford University Press, 1994
9. Plant tissue and cell culture by Street. H E, 2<sup>nd</sup> Edition University of California Press, 1977
10. Trease and Evans' Pharmacognosy - William Charles Evans, 16<sup>th</sup> Edition, Elsevier Health Sciences, 2009
11. Biotechnology: Fundamentals and Applications - S. S. Purohit and S.K. Mathur (Author) 2<sup>nd</sup> Revised edition, Agro- Bios, 1998.
12. Biotechnological applications of tissue culture by Peter D. Shargool, That Tjien Ngo, CRC Press, 1994
13. Pharmacognosy-Tyler, Brady, Robbers, 9<sup>th</sup> Edition, Wolters Kluwer New Delhi, 1988.
14. Plant Biotechnology - Ciddi Veeresham, CBS Publishers and Distributers, New Delhi 2004.

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## M.Pharm PHARMACOGNOSY SEMESTER: II

**Subject Name:** ADVANCED PHARMACOGNOSY - II

**Subject Code:** MPG202T

**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:** After Completion of course student will be able to know:

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

Sr No	Course Contents	Total Hrs
1	Herbal remedies – Toxicity and Regulations: Herbals vs Conventional drugs, Efficacy of Herbal medicine products, Validation of herbal therapies, Pharmacodynamic and Pharmacokinetic issues	12
2	Adulteration and Deterioration: Introduction, Types of Adulteration/ Substitution of Herbal drugs, Causes and Measures of Adulteration, Sampling Procedures, Determination of Foreign Matter, DNA Finger printing techniques in identification of drugs of natural origin, detection of heavy metals, pesticide residues, phytotoxin, microbial contamination in herbs and their formulations.	12
3	Ethnobotany and Ethnopharmacology: Ethnobotany in herbal drug evaluation, Impact of Ethnobotany in traditional medicine, New development in herbals, Bio-prospecting tools for drug discovery, Role of Ethnopharmacology in drug evaluation, Reverse Pharmacology	12
4	Analytical Profiles of herbal drugs: <i>Andrographis paniculata</i> , <i>Boswellia serata</i> , <i>Coleus forskholii</i> , <i>Curcuma longa</i> , <i>Embelica officinalis</i> , <i>Psoralea corylifolia</i>	12
5	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	12

### REFERENCES:

1. Glimpses of Indian Ethano Pharmacology - Palpu Pushpangadam, Ulf Nyman, V.George Tropical Botanic Garden & Research Institute, 1995.
2. Natural Products: A laboratory guide - Raphael Ikan , 2nd Edition, Academic Press, 2013
3. Trease and Evans' Pharmacognosy - William Charles Evans, 16th Edition, Elsevier Health Sciences,

2009

4. Pharmacognosy-Tyler, Brady, Robbers, 9th Edition, Wolters Kluwer New Delhi, 1988
5. Modern Methods of Plant Analysis Vol. I & VII – Peach K. and M.V. Tracey, Springer-Verlag Berlin Heidelberg, 1956
6. Herbal Drug Industry: A Practical Approach to Industrial Pharmacognosy by RD. Choudhary, Eastern Publishers, New Delhi 1996.
7. Text book of Pharmacognosy – A. P. Purohit, C. K. Kokate, S. B. Gokhale, 53rd Edition, Nirali Prakasshan, Pune 2016.
8. Text Book of Pharmacognosy - T.E. Wallis, 5th Edition, CBS Publishers, New Delhi, 2005
9. Quality control of Herbal Drugs - Pulok K Mukarjee, Business Horizons Pharmaceutical Publisher, New Delhi, 2012.
10. Indian Herbal Pharmacopoeia, IDMA, 1st Revised Edition, IDMA, Mumbai, 2002
11. Text book of Pharmacognosy and Phytochemistry Part I & II - Vinod D. RangarI, , 3rd Edition, Career Publication, Nasik, 2014.
12. Plant Drug Analysis - Hildebert Wagner and Sabine Bladt, 2nd Edition, Springer, NY, 1996
13. Standardization of Botanicals: Testing and Extraction Methods of Medicinal Herbs Vol. I - V. Rajpal Business Horizons, 2011
14. Herbal Medicine. Expanded Commission E Monographs - Mark Blumenthal (Editor), Alicia Goldberg (Editor), Josef Brinckman , Churchill Livingstone, 2000

# GUJARAT TECHNOLOGICAL UNIVERSITY

## M.Pharm PHARMACOGNOSY SEMESTER: II

**Subject Name:** INDIAN SYSTEMS OF MEDICINE

**Subject Code:** MPG203T

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

**Objectives:** Upon completion of this course the student should be able to

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

Sr No	Course Contents	Total Hrs
1	Fundamental concepts of Ayurveda, Siddha, Unani and Homoeopathy systems of medicine Different dosage forms of the ISM. Ayurveda: Ayurvedic Pharmacopoeia, Analysis of formulations and biocrude drugs with references to: Identity, purity and quality. Siddha: Gunapadam (Siddha Pharmacology), raw drugs/Dhatu/Jeevam in Siddha system of medicine, Purification process(Suddhi).	12
2	Naturopathy, Yoga and Aromatherapy practices a) Naturopathy - Introduction, basic principles and treatment modalities. b)Yoga-Introduction and Streams ofYoga. Asanas, Pranayama, Meditations and Relaxation techniques. c)Aromatherapy– Introduction, aroma oils for common problems, carrier oils	12
3	Formulation development of various systems of medicine Salient features of the techniques of preparation of someof the important class of Formulations as per Ayurveda, Siddha, Homeopathy and Unani Pharmacopoeia and texts. Standardization, Shelf life and Stability studies of ISM formulations	12
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
5	TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU	12

### REFERENCES

1. Ayurvedic Pharmacopoeia - The Controller of Publications, Civil Lines, Govt. of

- India, New Delhi, 2004.
2. Handbook on Ayurvedic Medicines with Formulae, Processes & Their Uses - H. Panda 2nd Revised Edition, NIIR PROJECT CONSULTANCY SERVICES, New Delhi, 2013.
  3. The Ayurvedic System of Medicine: (In 2 Volumes) - Kaviraj Nagendra Nath Sengupta, Sri Satguru Publications, New Delhi, 1999.
  4. Ayurvedic Pharmacopoeia. Formulary of Ayurvedic Medicines, Government of India, Ministry of Health and Family Welfare, Department of ISM & H., 2006.
  5. Homeopathic Pharmacopoeia of India, Controller of Publications, Government of India, Ministry of Health and Family Welfare, Department of ISM & H., 1974
  6. Homeopathic Pharmacy: Theory and Practice - Steven B. Kayne, 2nd Edition, Elsevier Churchill Livingstone, 2006
  7. Indian Herbal Pharmacopoeia, IDMA, 1st Revised Edition, IDMA, Mumbai, 2002
  8. British Herbal Pharmacopoeia, BRITISH Herbal Medicine Association, UK.
  9. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine - Robert Verpoorte and Pulok K. Mukherjee, Business Horizons, New Delhi, 2003.
  10. Essentials of Food and Nutrition - M. S. Swaminathan, Bangalore Print. and Pub., 1985
  11. Clinical Dietetics and Nutrition - Antia F P, 4th Edition, Oxford University Press, Delhi, 2002
  12. Yoga-the Science of Holistic Living - Vivekananda Kendra Prakashan, 1988, Bangalore.

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M.Pharm  
PHARMACOGNOSY  
SEMESTER: II

**Subject Name: HERBAL COSMETICS**

**Subject Code: MPG204T**

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

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

Sr No	Course Contents	Total Hrs
1	Introduction: Herbal/natural cosmetics, Classification & Economic aspects. Regulatory Provisions relation to manufacture of cosmetics: License, GMP, offences & Penalties, Import & Export of Herbal/natural cosmetics, Industries involved in the production of Herbal/natural cosmetics	12
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
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 standardization of the following: Tonic, Bleaches, Dentifrices and Mouth washes& Tooth Pastes, Cosmetics for Nails	12
4	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	12
5	Analysis of Cosmetics, Toxicity screening and test methods: Quality control and toxicity studies as per Drug and Cosmetics Act	12

## REFERENCES :

1. Herbal Cosmetics Handbook - H Panda, 3<sup>rd</sup> Revised Edition, Asia Pacific Business Press, 2004
2. Modern Cosmetics – E.G.Thomsen, Universal Publishing Corporation, Mumbai.
3. Cosmetics: Formulation, manufacturing and Quality Control – P.P.Sharma, 5<sup>th</sup> Edition, Vandana Publications, Delhi, 2014
4. Handbook of Aromatic Plants – S. K. Bhattacharjee, 2nd Revised Edition, Pointer Publishers, Jaipur, 2005
5. Aromatic Plants: Vol.01. Horticulture Science Series - Skaria, B.P. et.al. New India



Publishing Agency, New Delhi.

6. Aromatherapy: A Complete Guide to the Healing Art (Alternative Medicine) - Kathi Keville and Mindi Green, Sri Satguru Publications, New Delhi, 2002.
7. Herbal Cosmetics & Ayurvedic Medicines (EOU) - P. K. Chattopadhyay, NIIR Project Consultancy Services, Delhi, 2015
8. Cosmetics Science and Technology: 2 Vol Book Marvin S. Balsam and Edward Sagarin, 2<sup>nd</sup> Edition, Wiley India Pvt Ltd, New Delhi, 2008
9. Perfume, cosmetics and soap Vol-I –III, W. A. Poucher , 9 th Edition Chapman & Hall, London, 1991.

# GUJARAT TECHNOLOGICAL UNIVERSITY

M.Pharm  
PHARMACOGNOSY  
SEMESTER: II

**Subject Name: PHARMACOGNOSY PRACTICAL - II**

**Subject Code: MPG2305T**

**List of Practicals:**

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. 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

# GUJARAT TECHNOLOGICAL UNIVERSITY

M.Pharm

SEMESTER: III

**Subject Name:** RESEARCH METHODOLOGY, BIOSTATISTICS AND IPR

**Subject Code:** MRM301T

Sr No	Course Contents	Total Hrs
1	<p><b>General Research Methodology</b>                      General Research Methodology: Research, objective, requirements, practical difficulties, Review of literature: Use of Library, books and journals-Medlines-Internet, and reprints of articles as a source for Literature survey. Selecting a problem and preparing Research proposals.                      The Research Report, Paper writing/ thesis writing, Different parts of the Research paper/Thesis                      Presentation oral/poster presentation) Importance, types, different skills, content, format of model, Poster, Gestures, eye contact, facial expressions, stage fright, volume- pitch, speed, pause &amp; language, Visual aids &amp; seating, Questionnaire.                      Sources for procurement research grants –National/ international agencies, Government and private bodies</p>	12
2	<p><b>Experimental Design (15 hours)</b>                      Terminology and definitions related to experimental design                      Study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques                      Sampling Designs: Introduction, types of sample designs, steps, criteria of selection, characteristics, random sampling, drop outs.                      Advantage and disadvantage of conventional design over experimental design.                      Basic steps in experimental design.                      Screening Designs:                          Screening of factors, General properties for independent factor selected for experimental design, Fractional factorial design(FFD): Purpose advantage and disadvantage of fractional factorial design, Concept of Aliased Effects and Design Aliasing Structure and constructing FFD                          Analysis of fractional factorial design: Concept of Design Resolution for FFD Case study of factorial design                      Plackett–Burman designs: Purpose advantage and disadvantage and construction of matrix , Comparison between placket-Burman and FFD design, Case study                      Full factorial design                      Optimization techniques and various method of optimization                      Introduction to contour plots                      Introduction of repose surface design: Classification                          Characteristic of design                          Matrix and analysis of design with case study</p>	15

	<p>Evolution of full and reduced mathematical models in experimental designs  Central composite designs  Taguchi and mixture design  Application of experimental design in pharmacology for reduction of animal</p>	
<b>3</b>	<p><b>Biostatistics</b>  Definition, application, 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, Kruskal Wallis test, Mann Whitney U test), null hypothesis, P values, degree of freedom, interpretation of P values, post hoc tests for parametric and non-parametric data (Dunnett’s test, Tukey’s test, Dunn’s test)</p>	8
<b>4</b>	<p><b>Regulatory perspectives of Medical research</b>  History of medical research (Nuremberg code, The declaration of Helsinki), initiation of ICH-GCP guidelines, advantages of ICH-GCP, core principles of ICH -GCP guidelines , Ethical Committee: Institutional Review Board, Ethical Guidelines by ICMR for Biomedical Research and Human Participants(ethical issues- informed consent process, confidentiality, payments, conflict of interest, vulnerable participants), Schedule Y, Preparation of clinical protocol, Investigator Brochure, Case Report Forms</p>	10
<b>5</b>	<p><b>CPCSEA guidelines for laboratory animal facility</b>  Objective and functions of IAEC, background and process of evolution of guidelines, statutory provisions regarding scientific experiments of animals, CPCSEA guidelines for animal experimentation and laboratory animal facility 2015, care and handling of animals, concept of 4 R, protocol preparation for Preclinical studies (Form B)</p>	5
<b>6</b>	<p><b>IPR and Patents</b>  Patents: Definition, Need for patenting, scope and importance of patents, Types of Patents, Condition to be satisfied by an invention to be patentable, Introduction to patent search and important websites, The essential elements of patents, Guidelines for preparations of laboratory notebook, non-obviousness in patents, Drafting of patent claims, important patent related websites. Copyrights and Trademark: Brief introduction to trademark protection and WTO patents, Introduction to “The Patents Act 1970” and “The Patents Rule 2003”, with special emphasis on the forms to be submitted along with a patent application</p>	10

REFERENCES:

1. Research Methodology by C.R. Kothari
2. Compendium of CPCSEA 2018
3. Presentation skills - Michael Hallon- Indian Society for Institute education
4. Pharmaceutics Statistics by Sanford Bolton, Charles Bon
5. Patent laws , By P. Narayan. Eastern law house publications
6. Pharmaceutical Experimental Design By Gareth Lewis and Didier Mathieu
7. www. ipindia.nic.in, www.uspto.gov
8. www.cpcsea.nic.in
9. www.icmr.nic.in