

Syllabus Prescribed for the year 2024-25		
Programme M. Sc. Herbal Science	PG Programme Semester-III	
Code of the Course Subject DSC I.3	Title of the Course/ Subject Contemporary Applied Technological Advancements in Herbal Science	No. of Periods/week 04 Credits = 04
COs :		
<ol style="list-style-type: none"> Students will understand the basics of research in related subjects. Students will be acquainted with the skills of herbal processing, extraction and estimations. Students will gain the skills in various chromatographic techniques Students will be able to understand the basics of herbal formulations and development. 		
Unit: I:	Methods of Herb Processing:	
	<ol style="list-style-type: none"> 1.1 Definition, sources, identification, and authentication of herbs, 1.2 Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions, 1.3 Methods of drying – Natural and artificial drying methods with their merits and demerits. 	
Unit- II:	Preparation of Herbal Extracts:	
	<ol style="list-style-type: none"> 2.1 Principles of extraction and selection of suitable extraction method, 2.2 Different extraction methods including- maceration, percolation, hot continuous extraction, pilot scale extraction and supercritical fluid extraction with their merits and demerits, 2.3 Purification and Recovery of Solvents. 	
Unit- III:	Isolation and Estimation of Phytoconstituents:	
	(with special emphasis on TLC, HPLC and HPTLC), <ol style="list-style-type: none"> 1. Hypericin / Hyperforin from <i>Hypericum</i> species. 2. Forskolin from <i>Coleus forskoli</i>. 3. Catechins from Green tea. 4. L-Hydroxy citric acid from <i>Garcinia combogia</i>. 	
Unit- IV:	Isolation and Estimation of Phytoconstituents :	
	(with special emphasis on TLC, HPLC and HPTLC), <ol style="list-style-type: none"> 1. Alicin from Garlic. 2. Piperine from Piper nigrum / Piper longum. 3. Bacosides from Bacopa monnieri. 4. L-Dopa from Mucuna pruriens 	
Unit- V:	Herbal Formulation and Evaluation:	
	<ol style="list-style-type: none"> 4.1 Selection of herbal ingredients, 4.2 Different dosage forms of herbal drugs, 4.3 Evaluation of different dosage forms, 4.4 Stability Studies of Herbal Formulations 	
Unit- VI	Scientific Writing and Publication:	
	<ol style="list-style-type: none"> 6.1 Familiarization with journal guidelines (Journal specific- any 03 journals) 6.2 Various types of referencing Styles/ methods (APA, MLA, IEEE) 6.3 Thesis / Dissertations: structure and content 6.4 Structuring research article: IMRAD (Introduction, Material and Methods, Research Results and Discussion). 	
Practicals:		
<ol style="list-style-type: none"> 1) Demonstration of different extraction methods 2) Thin-layer chromatography of plant pigments 3) Thin layer chromatography of plant extracts (03 medicinal plants) in various solvents. 		

<p>4) Demonstration of HPLC 5) Demonstration of HPTLC 6) Pharmacogenetic study of market available drug samples (Any two) 7) Qualitative phytochemical analysis of medicinal plants (Any two) 8) Each student have to submit a manuscript to center as a part of internal assessment.</p>
<p>Suggested Reading: Acharya, D. and Srivastava, A. (2018) Indigenous Herbal medicine, tribal formulations and traditional herbal practices. Avishkar Publisher and Distributors. Agrawal, N. and Sharma, N. (2020) A textbook of Pharmacognosy and Phytochemistry, Vol-I and II. R. Narain Publisher and Distributor. Bhattacharya, S. K. (2020) Handbook of Medicinal Plants. Pointer Publisher. Kalia, A. N. (2016) Text Book of Pharmacognosy and Phytochemistry, Vol. I, CBS Publication Kalia, A. N. (2016) Text Book of Pharmacognosy and Phytochemistry, Vol. II, CBS Publication Kapoor, L. D. (2020) Handbook of Ayurvedic medicinal plants. Herbal reference library. Khare, C. P. (2017) Indian Herbal remedies, Rational Western therapy, Ayurvedic and other traditional Uses and Botany, Springer Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- I, Career Publication, India Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- II, Career Publication, India Sen, Saikat, and Chakraborty R. (2021) Herbal Medicine in India, Indigenous knowledge, practice, innovation, and values. Springer publication. Sherma, J. and Bernard, F. (2010) Handbook of Thin layer chromatography, Third Edition, Revised and Expanded. Shukla P, K., and Gupta, P. K. (2020) A practical book of Pharmacognosy and Phytochemistry Vol- 1 & 2, Nirali Publication Srivastava, H. C. (2018) Medicinal and Aromatic plants (ICAR, New Delhi) Tondon, N. and Sharma, P. (2012) Quality standard of Indian medicinal plants Vol. 1-10. Vedam Books, India Touchstone, J. C. (1983) Practice of Thin layer chromatography, Wiley and Sons Trivedi, P. C. (2017) Indian Medicinal Plants. Avishkar Publisher and Distributors. Trivedi, P. C. (2018) Herbal Drugs and Biotechnology, Avishkar Publisher and Distributors.</p>
<p>Learning Outcomes: 1. Students will acquire analytical technical skills such as chromatography and spectroscopy. 2. Students will have expertise in the field of drug analysis, formulation, and final development.</p>

M. Sc. I, Semester- III (Herbal Science)

Practical: IX / Lab- IX

(Contemporary Applied Technological Advancements in Herbal Science (DSC I.3)

(2hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50

(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

1. A review writing on any related topic of DSC I.3.	10
2. Seminar presentation of any one topic of the paper	10
3. Formative Assessment	05
Total	25 M

External Practical Examination:

1. Thin layer chromatography of given plant extract/ sample	10 M
2. Major instrumentation (HPTLC/ HPLC)	05 M
3. <i>Viva- voce</i>	05 M

4. Practical record submission

05 M

Total 25 M

Syllabus Prescribed for the year 2024-25 (NEP)		
Programme M. Sc. Herbal Science		PG Programme Semester-III
Code of the Course Subject	Title of the Course/ Subject	No. of Periods/week
DSC II.3	Indian System of Medicine: Ayurveda	04 Credits = 04
COs :		
<ol style="list-style-type: none"> 1. Students will understand the basics of Ayurveda 2. They will get acquainted with various Ayurvedic formulation and their mode of preparation. 3. Students will also get familiar with various National institutes related to Indian Medicinal systems. 		
Unit: I:	Introduction to Ayurveda-I	
	<ol style="list-style-type: none"> 1.1 History, Philosophy of Ayurveda 1.2 The Panchmahabhuta and Their Attributes 1.3 The Basic Attributes of Tridosha—Vjta, Pitta, Kapha and their subtypes 1.4 The Doshas and Their Subtypes 	
Unit- II:	Introduction to Ayurveda-II	
	<ol style="list-style-type: none"> 2.1 Introduction to IKS related to Ayurveda 2.2 Prakruti: Your Unique Body Type and their characteristics 2.3 Agni, Dhātu, updhātu and Mala. Description of basics of Srotas. The Six Tastes and their significance. 2.4 Four types of methods for examination in Ayurveda (ChaturvidhaParikshavidhi), Pramana in Ayurveda. 	
Unit- III:	Common Ayurvedic formulations- I	
	<ol style="list-style-type: none"> 3.1 Churna- Triphala, Sitopaladi, Hingvashtaka, Avipattikara 3.2 Kashaya- Dashamula, Rasnasaptaka, Asanadi, Pathyadi, 3.3 Asavas-Arista- Amritarishta, Chitrakasava, Saraswatarishta, Ashwagandharishta. 3.4 Vati- Sanjivani, Chandraprabha, and Guggula-Kalpana-Triphalaguggula, 	
Unit- IV:	Common Ayurvedic formulations- II	
	<ol style="list-style-type: none"> 4.1 Rasaushadhi- Tribhuvanakirti Rasa, Arogyavardhini Rasa, Rasamanikya Rasa, 4.2 Taila- MahanarayanaTaila, Pindataila, AmritadiTaila. 4.3 Ghrita- MahatriphaladiGhrita, BrahmiGhrita, KantakariGhrita. 4.4 Lehya- ChyavanaprashaAvaleha, KushmandaAvaleha, AshwagandhaAvaleha, 	
Unit- V:	Major Indian Ayurvedic Organizations :	
	<ol style="list-style-type: none"> 5.1 Department of AYUSH, 5.2 Central Council for Research in Ayurvedic Sciences, 5.3 Ayurvedic Pharmacopeia Commission, 5.4 National Medicinal Plants Board, Traditional Knowledge Digital Library (TKDL) 	
Unit- VI	Practical Applicability :	
	<ol style="list-style-type: none"> 6.1 Principles of Samkhya-Yoga, Nyaya Vaishesika, 6.2 Principles of Vedanta and Mimansa 6.3 Principles of Charvak, Jain and Buddha Darshana. 6.4 Current status of Ayurveda as a system of medicine 	
Practicals: Ayurvedic Systems of Medicine- I		
Methods of preparation of the following drug formulations and their properties :		
<ol style="list-style-type: none"> 1) Churna (Any two) 2) Asavas-Arishta (Any one) 		

3) Vati (Any two) 4) Avaleha (Any one) 5) Satva (Any two) 6) Bhasma (Any two)
Suggested Reading:
A glossary of Ayurvedic, Tibetan and Unani medicine (1999) Shri Satguru Publication. Choudhary, B. (2016) The handbook of Ayurvedic medicine, Choukhamba Orientalia Varanasi. Farooqui, M. I. H. (2010) Plants in Ayurvedic and Unani Medicine. Idara Publication. Pathak, R. R. (2018) Therapeutic guide of Ayurvedic medicine. Shri Baidyanath Ayurved Bhavan Pvt. Ltd. Rabb, U. N. (2020) Therapeutic uses of medicinal plants. Choukhamba Krishnadas Academy, Varanasi. Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- I, Career Publication, India Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- II, Career Publication, India Sen, Saikat, and Chakraborty R. (2021) Herbal Medicine in India, Indigenous knowledge, practice, innovation, and values. Springer publication. Sengupta, K. N. N. (2016) The Ayurvedic system of medicine. Shri Satguru Publications. Sharma H. and Clark, C. (2011) Ayurvedic healing, contemporary Maharshi Ayurveda Medicine and Science. Sharma, S. (2004) Ayurveda, Indian system of Medicine. Cosmo Books, India. Williamson, E. M. (2002) Major herbs of Ayurveda. Churchill Livingstone.
Learning Outcomes:
<ul style="list-style-type: none"> • Students will analyze the different crude drug samples. • Students will be skilled in developing and preparing various Ayurvedic formulations.

M. Sc. Herbal Science, Semester- III

Practical: X / Lab- X

Indian System of Medicine: Ayurveda (DSC I.3)

(2hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50

(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

1. A report submission of report on Ayurvedic medicine practice in the area.	10 M
2. Submission of locally available Ayurvedic plants.	10 M
3. Formative Assessment	05 M
Total	25 M

External Practical Examination:

1. Preparation of Churna/ Vati / Satva etc.	10 M
2. Comment on Minor instruments	05 M
5. <i>Viva- voce</i>	05 M
6. Practical record submission	05 M

Total 25 M

Syllabus prescribed for the year 2024-25		
M. Sc. Herbal Science	Semester-III	
Code of the Course Subject DSC III.3	Title of the Course/ Subject Pharmacognosy and Pharmacology	No. of Periods/week 03 Credits = 03
COs :		
<ol style="list-style-type: none"> 1. Students will be able to understand the basis of plant-based drugs. 2. They will understand the basics of enzymes and their role in life metabolism 3. They will analyze and compare major phytoconstituents. 		
Unit- I:	Introduction to Pharmacognosy- I: <ol style="list-style-type: none"> 1.1 Definition and Scope of Pharmacognosy 1.2 Historical Account of Pharmacognosy (Primitive era, Pre-Christian era, Era after Christ, Modern era) 1.3 Various sources of crude drugs (Plant, Animal. Plant tissue culture & Marine sources) 1.4 Types of Crude Drugs (Organized and Unorganized) 	
Unit- II:	Introduction to Pharmacognosy- II <ol style="list-style-type: none"> 2.1 General phytochemical study of given sample 2.2 Quantitative phytochemical analysis (Alkaloids, phenolics, Flavonoids) 2.3 Crude powder analysis and fluorescence study 2.4 Additional features for pharmacognostic study 	
Unit- III:	Phytochemical and pharmacological profiling of the following medicinal plants. <ol style="list-style-type: none"> 3.1 <i>Gymnema Sylvester, Momordica charantia</i> 3.2 <i>Phyllanthus amarus, Eclipta alba</i> 3.3 <i>Tribulus terrestris, Boerhaviadiiffusa</i> 	
Unit- IV:	Phytochemical and pharmacological profiling of following medicinal plants- <ol style="list-style-type: none"> 4.1 <i>Ocimum sanctum, Tinospora cordifolia</i> 4.2 <i>Coleus forskohli, Artemisia annua</i> 4.3 <i>Argeria nervosa, Costusspeciosus</i> 	
Unit- V:	Secondary Metabolite Separation/ Isolation: <ol style="list-style-type: none"> 5.1 Separation and isolation of natural secondary metabolites using TLC(Alkaloids, phenolics, flavonoids, tannins and saponins) 5.2 Use of Column Chromatography for separation of Secondary metabolites with example. 	
Unit- VI:	Isolation and Purification of Natural Products: <ol style="list-style-type: none"> 6.1 Piperine from Black Pepper 6.2 Caffeine from Tea Powder 6.3 Quinine from Cinchona 6.4 Eugenol from Clove oil 	
Laboratory Exercises:		
<ol style="list-style-type: none"> 1) Qualitative Phytochemical tests for any three medicinal plants 2) Quantitative phytochemical analysis of any two phytoconstituents from given medicinal plants. 3) Fluorescence study of any three medicinal plant powder 4) TLC analysis of any two medicinal plants for (alkaloids, Phenolics, Flavonoids, Saponins etc.) 5) Demonstration of column chromatography for secondary metabolite isolation 		
Suggested Reading:		

Acharya, D. and Srivastava, A. (2018) Indigenous Herbal medicine, tribal formulations and traditional herbal practices. Avishkar Publisher and Distributors.

Agrawal, N. and Sharma, N. (2020) A textbook of Pharmacognosy and Phytochemistry, Vol-I and II. R. Narain Publisher and Distributor.

Bhattacharya, S. K. (2020) Handbook of Medicinal Plants. Pointer Publisher.

Kalia, A. N. (2016) Text Book of Pharmacognosy and Phytochemistry, Vol. I, CBS Publication

Kalia, A. N. (2016) Text Book of Pharmacognosy and Phytochemistry, Vol. II, CBS Publication

Kapoor, L. D. (2020) Handbook of Ayurvedic medicinal plants. Herbal reference library.

Khare, C. P. (2017) Indian Herbal remedies, Rational Western therapy, Ayurvedic and other traditional Uses and Botany, Springer

Nelson, D. L. and Cox, M. M. (2004) Lehninger Principles of Biochemistry, 4th edition, Freeman and Company, W& H

Palmer, T. and Bonner, P. (2017) Enzymes: Biochemistry, Biotechnology and clinical chemistry. East- West Press.

Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- I, Career Publication, India

Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- II, Career Publication, India

Shukla P, K., and Gupta, P. K. (2020) A practical book of Pharmacognosy and Phytochemistry Vol- 1 & 2, Nirali Publication

Srivastava, H. C. (2018) Medicinal and Aromatic plants (ICAR, New Delhi)

Tondon, N. and Sharma, P. (2012) Quality standard of Indian medicinal plants Vol. 1-10. Vedam Books, India

Trivedi, P. C. (2017) Indian Medicinal Plants. Avishkar Publisher and Distributors.

Trivedi, P. C. (2018) Herbal Drugs and Biotechnology, Avishkar Publisher and Distributors.

Learning Outcomes:

1. Students become experts in analyzing crude drug material
2. Students will understand the role of enzymes
3. Students can develop expertise in isolating the major plant drugs.

M. Sc. Herbal Science, Semester- III

Practical: XI / Lab- XI

Phytochemistry and Pharmacognosy (DSCIII.3)

(2hrs/ week; Credits= 1)

Time: 3.00 Hrs]

[Total Marks: 50

(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

- | | |
|--|------|
| 1. A report submission of a report on Ayurvedic medicine practice in the area. | 10 M |
| 2. Submission of locally available Ayurvedic plants. | 05 M |
| 3. Formative Assessment | 05 M |
| 4. Attendance | 05 M |

Total 25 M

External Practical Examination:

- | | |
|---|------|
| 1. Phytochemical profiling of given medicinal plant (Any one) | 10 M |
| 2. Fluorescence study of given drug powder | 05 M |
| 5. <i>Viva- voce</i> | 05 M |
| 6. Practical record submission | 05 M |

Total 25 M

Syllabus Prescribed for the year 2024-25		
Programme M. Sc. Herbal Science	PG Programme Semester-III	
Code of the Course Subject DSE III	Title of the Course/ Subject Phytochemistry and Pharmacognosy	No. of Periods/week 03 Credits = 03
COs :		
<ol style="list-style-type: none"> To expose the students to various pathways of biosynthesis of secondary metabolites. To impart analytical skills to students. To make the students to analyze and interpret the results with accuracy. 		
Unit: I:	1.1 Basic metabolic pathways and formation of various secondary metabolites: <ol style="list-style-type: none"> 1.1.1 Shikimic acid pathway, 1.1.2 Acetate pathways 1.2 Use of radioisotopes in biogenic studies.	
Unit- II:	Chemistry, composition, therapeutic applications of- <ol style="list-style-type: none"> 2.1 Alkaloid: Belladonna, Rauwolfia 2.2 Phenylpropanoids and flavonoids: Tea and Ruta 2.3 Steroids and cardiac glycosides: Liquorice and Dioscoria 	
Unit- III:	Chemistry, composition, therapeutic applications of- <ol style="list-style-type: none"> 3.1 Volatile oil: Mentha and Clove 3.2 Tannins: Catechu and Pterocarpus 3.3 Resin: Guggul, Asafoetida 3.4 Glycosides: Senna and Aloe 	
Unit- IV:	Isolation, identification and Analysis of phytoconstituents: - <ol style="list-style-type: none"> 4.1 Alkaloids: Atropine, Quinine and Reserpine 4.2 Glycosides: Glycirhethinic acid and Rutin 	
Unit- V:	Isolation, identification and Analysis of phytoconstituents: - <ol style="list-style-type: none"> 5.1 Terpenoids: Menthol and Citral 5.2 Resins: Podophyllotoxin, Artemisinin and Curcumin 	
Unit- VI:	Industrial Production and Utilization of- <ol style="list-style-type: none"> 6.1 Artemisinin 6.2 Digoxin 6.3 Atropine 6.4 Taxol 6.5 Vincristine 	
Laboratory Exercises:		
<ol style="list-style-type: none"> Extraction and identification of alkaloids from a given plant sample Extraction and identification of flavonoids from given plant sample Extraction and identification of steroids from a given plant sample Extraction and identification of cardiac glycosides from given plant sample. Phytochemical analysis of given plant powder/ fresh material for Alkaloid/ flavonoid/ glycosides/ terpenoids and resins. 		
Suggested Reading:		
Mark, F. Vitha (2016) Chromatography: Principles and Instrumentation, Wiley Publication. Nikalje, A. P. and Bhosale, D. (2017) A Handbook of Chromatography, Scholars Press, Germany. Sharma, J. and Fried, B. (2003) Edn. Handbook of Thin-Layer Chromatography Third Edition, Revised and Expanded. Marcel Decker, Inc. Kafle, B. P. (2019) Chemical analysis and material characterization by spectrophotometry,		

Elsevier Inc.
 Heinz- Helmut, P. (1992) UV- Visible spectroscopy and its applications. Springer Ltd.
 Kashi, A. R., Ramchandran, S. and Sukumaran, B. (2012) Text book of Industrial Pharmacognosy, Oriental Blackswan Private Limited New Delhi.
 Kokate, C. K., Purohit, A. P. and Gokhale, S. B. (2023) Pharmacognosy, 58thEdn. Nirali Publication.
 Mark, F. Vitha (2018) Spectroscopy: Principles and Instrumentation. John Wiley & Sons Inc.
 Pullaiah, R. (2023) Phytochemistry and Pharmacology of medicinal plants, 2 volumes, Apple Academic Press.
 Shah, B. and Seth, A. K. (2019) A Text book of Pharmacognosy and Phytochemistry, 2 End. CBS Publication.
 Tariq, L., Bhat, B.A., Hamdani, S.S., Mir, R.A. (2021). Phytochemistry, Pharmacology and Toxicity of Medicinal Plants. In: Aftab, T., Hakeem, K.R. (eds) Medicinal and Aromatic Plants. Springer, Cham.

Learning Outcomes:

1. The students will learn about biosynthesis of various secondary metabolites through different pathways.
2. The students will achieve expertise in analyzing crude drug material

M. Sc. II, Semester- IV (Herbal Science)
Practical: XV/ Lab- XV
Phytochemistry and Pharmacognosy (DSE- III)
(2 hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50
(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

1. Overall performance	05 M
2. Visit to any National Institute/ Industry	10 M
3. Assignment	05 M
4. Attendance	05 M
Total	25 M

External Practical Examination:

1. Extraction and identification of phytochemicals of given plant samples.	10 M
2. Principle, working and applications of any one major instrument	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

Programme M. Sc. Herbal Science	PG Programme Semester-IV	No. of Periods/week 03 Credits = 03
Code of the Course Subject DSE IV	Title of the Course/ Subject Herbal Drug Technology	
COs :		
1. To expose the students to various modern drug assessment techniques. 2. To impart analytical skills to students. 3. To make the students analyze and standardize given drug material.		
Unit: I:	Study of Herbal Extracts:	
	1.1 Extraction of Herbal drugs/ extracts. 1.2 Processing of Herbal extracts 1.3 Storage (stability and preservation) of Herbal extracts	
Unit- II:	Assessment of Crude drugs- I:	
	2.1 Evaluation of identity, purity and quality of crude drugs 2.2 Determination of pesticide residues in crude drugs.	
Unit- III:	Assessment of Crude drugs- II:	
	3.1 Determination of Arsenic and heavy metals in crude drugs 3.2 Determination of any microbial contamination in crude drugs.	
Unit- IV:	Screening for Pharmacological activity:	
	4.1 Analgesic and anti-inflammatory activity 4.2 Anti-ulcer and anti-cancer activity 4.3 Anti-oxidant and anti-fertility activity	
Unit- V:	Biological Drug Standardization:	
	5.1 Statistical treatment of model problems in the evaluation of drugs. 5.2 Methods of biological assay, principles of biological assays with certain examples. 5.3 Development of new bioassay methods.	
Unit- VI:	Modern aspects of drug and therapy:	
	6.1 Concept of gene therapy and recent development in the treatment of various hereditary diseases. 6.2 Transgenic mouse and its applications. 6.3 Human genome mapping and its potential in drug research.	
Laboratory Exercises :		
1. Extraction of drug material from given plant material 2. To check the stability of the given drug material. 3. Determination of heavy metals in given drug material. 4. Determination of microbial contamination in given drug material. 5. To study pesticide adulteration in given drug sample. 6. Screening given drug material for various pharmacological activities.		
Suggested Reading:		
1. Trease and Evans, Pharmacognosy, Saunders Company, London. 2. Tyler, Brady, and Robbers, Pharmacognosy, Lea Febiger, USA. 3. Wallis T. E., Text Book of Pharmacognosy, CBS publishers & distribution, Delhi. 4. Kokate, Purohit, Gokhale, Pharmacognosy, Nirali Prakashan, Pune. 5. Rangari V.D., Pharmacognosy & Phytochemistry, Vol I, II, Career Publication, Nashik. 6. Agrawal O.P., Chemistry of Organic Natural Product, Goel Publication House, UP. 7. E. Ramstad, Modern Pharmacognosy, Mc-graw hill Book Company. 8. Shah and Quadri Text Book of Pharmacognosy. 9. Chopra, Indigenous drug of India. 10. Wealth of India. 11. Nadkarni, Material Medica. 12. Chaudhari R D, Herbal Drug Industry, Eastern publication. 13. WHO, Quality Control methods for medicinal plant material.		

14. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons.
15. Ayurvedic Pharmacopoeia.
16. Indian Pharmacopoeia.
17. British Pharmacopoeia.
18. Martindale Extra Pharmacopoeia.
19. Wagner, Plant Drug Analysis.
20. Stal Egon, Thin layer chromatography.

Learning Outcomes:

1. The students will learn various extraction and assessment methods for drug analysis.
2. Students will be able to screen drugs for their pharmacological activity.
3. Students will be able to develop new bioassay methods for given drug samples.

M. Sc. II, Semester- IV (Herbal Science)
Practical: XV/ Lab- XV
Phytochemistry and Pharmacognosy (DSE- IV)
(2 hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50
(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

1. Overall Performance	05 M
2. Report of Visit to any National Institute/ Industry	10 M
3. Assignment	05 M
4. Attendance	05 M
Total	25 M

External Practical Examination:

1. Evaluation of given drug material for purity and quality check	10 M
2. Detection contamination in given drug sample (pesticide/ heavy metal/ microbial)	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

Syllabus prescribed for 2024-25		
M. Sc. Herbal Science	Semester-IV	
Code of the Course Subject DSC I.4	Title of the Course/ Subject Plant Nutraceuticals and Cosmetics	No. of Periods/week 04 Credits = 04
COs :		
<ol style="list-style-type: none"> 1. Students will understand the basics of nutraceuticals and cosmetics. 2. Students will learn about various plant-based nutraceuticals and their health importance. 3. Students will have focal idea about plant-based cosmetics and their applications. 		
Unit: I:	Kinds of Nutrients in natural foods:	
	<ol style="list-style-type: none"> 1.1 Carbohydrates: Sources, properties and benefits 1.2 Proteins: Sources, properties and benefits 1.3 Vitamins and Minerals: Sources , properties and benefits 1.4 Dietary fibers : Sources, Properties and benefits 	
Unit- II:	Nutraceuticals- I:	
	<ol style="list-style-type: none"> 2.1 Introduction, classification, and sources of Nutraceuticals, 2.2 Functional Foods: Definition, Relation of functional foods and Nutraceuticals to Food and drugs, 2.3 Application of herbs as functional foods, 	
Unit- III:	Nutraceuticals- II:	
	<ol style="list-style-type: none"> 3.1 Concept of free radicals and antioxidants, 3.2 Nutritive and Non-nutritive food components with potential health effects 3.3 Herbal nutraceuticals as an alternative to pharmaceuticals 	
Unit- IV:	Nutraceuticals III:	
	<ol style="list-style-type: none"> 4.1 Pigments as nutraceuticals (Curcumin, Chlorophyll and Carotene) 4.2 Anti-nutritional factors (Lectins, Tannins and Phytic acid) 4.3 Fortified foods. 	
Unit- V:	Cosmetics- I	
	<ol style="list-style-type: none"> 5.1 Fundamentals of Cosmetic technology 5.2 Classification of cosmetics 5.3 Raw materials used for cosmetics- Surfactants, cream bases, aerosol propellants and perfumes. 	
Unit- VI	Cosmetics- II	
	<ol style="list-style-type: none"> 6.1 Self-life, effects of environmental factors on cosmetic product stability. 6.2 Quality control tests for various cosmetic products. 6.3 Packaging of different cosmetics. 	
Practical's: Plant Nutraceuticals and Cosmetics:		
<ol style="list-style-type: none"> 1) Estimation of vitamin C from Citrus/amla fruits 2) Separation of plant pigments Chlorophylls and carotenes by Paper chromatography/ TLC 3) Estimation of chlorophyll, anthocyanins and carotenes 4) Preparation of Soymilk 5) Determine/ test the availability of vitamins 6) Determine the antioxidant activity of the given plant sample 7) Preparation of Shampoos 8) Preparation of Hair creams 9) Preparation of Nail polish 10) Preparation of Tooth powder/ tooth paste 		
Suggested Reading:		
Alamgir, A. L. M. (2017) Therapeutic use of medicinal plants and their extracts: Vol.1, Pharmacognosy. Springer publication		
Daley, D. K. (2017) Plant Crude Drugs. Pharmacognosy, 2017, 81-89.		
Kamboj, A. (2012). Analytical Evaluation of Herbal Drugs, Drug Discovery Research in		

Pharmacognosy, Prof. OmboonVallisuta (Ed.), ISBN: 978-953-51-0213-7, InTech
 Koche, D., Shirsat, R. and Kawale, M (2016) An overview of major classes of phytochemicals: Their types and role in disease prevention.
 Mishra, A.P. *et al.* (2022). The Role of Nutraceuticals as Food and Medicine, Types and Sources. In: Egbuna, C., Sawicka, B., Khan, J. (eds) Food and Agricultural Byproducts as Important Source of Valuable Nutraceuticals. Springer, Cham
 Nasri H, Baradaran A, Shirzad H, Rafieian-Kopaei M. (2014) New concepts in nutraceuticals as an alternative for pharmaceuticals. *Int J Prev Med*;5(12):1487-99.
 Pise, A. G., Pise, S., Sreedhar, D., Ligade, V., Janodia, M. Udupa, N. (2000) Nutraceuticals and Pharmaceuticals: A comparative analysis, *Research and Reviews*, 2: 3-6.
 Ramesh, S. V. and Praveen, S. (2022) Plant based Nutraceuticals In SVR., Praveen S. (Eds) Conceptualizing plant based nutrition. Springer, Singapore.
 Ronis MJJ, Pedersen KB, Watt J. (2018) Adverse Effects of Nutraceuticals and Dietary Supplements. *Annu Rev PharmacolToxicol.* 2018, 58:583-601.
 Sofowora A, Ogunbodede E, Onayade A. The role and place of medicinal plants in the strategies for disease prevention. *Afr J Tradit Complement Altern Med.* 2013 Aug 12;10(5):210-29.

Learning Outcomes:

- Students will be able to analyze various plant drug samples available in the market
- Students could differentiate various nutraceuticals and their use in health maintenance and could perceive a career as a dietician and cosmetologist.

M. Sc. II, Semester- IV (Herbal Science)

**Practical: XIII/ Lab- XIII
 (Plant Nutraceuticals) (DSC I.4)
 (2 hrs/ week; Credits= 01)**

Time: 3.00 Hrs]

**[Total Marks: 50
 (Internal: 25 Marks and External: 25 marks)**

Internal Practical Examination:

1. Overall performance	10 M
2. Report of visit to any National Institute/ Industry/Assignment/Survey	10 M
3. Attendance	05 M
Total	25 M

External Practical Examination:

1. To determine antioxidant activity	10 M
2. Estimation of Vitamins in given sample	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

M. Sc. Herbal Science		Semester-IV	
Code of the Course	Subject	Title of the Course/ Subject	No. of Periods/week
DSC II.4		Indian System of Medicine-II (Siddha, Unani and Tibetan)	04 Credits = 04
COs :			
<ul style="list-style-type: none"> The students will acquire the basic knowledge of Siddha, Unani and Tibetan systems of medicine. They can compare formulations of different systems. The students will learn about various formulations in alternative traditional medicine. 			
Unit: I:	Introduction to Siddha:		
	1.1 Principles and practice- basis of the Siddha system, the concept of disease, Siddha diagnosis, and treatment.		
	1.2 Classification of treatment according to the Siddha system of medicine –		
	1.2.1 Purgative therapy, Emetic therapy, Fasting therapy,		
	1.2.2 Steam therapy, Oleation therapy, Solar therapy,		
	1.2.3 Blood-letting therapy and Yoga therapy		
Unit- II:	Siddha medicines:		
	2.1 Types of drug formulations-		
	2.1.1 Herbal, inorganic and animal products with examples,		
	2.1.2 Internal and external medicines with examples.		
	2.1.3 Raw material to finished product—		
	2.1.3.1 Solid preparations- with two examples		
	2.1.3.2 Liquid preparations- with two examples		
	2.1.3.3 Gaseous preparations- with two examples		
Unit- III:	Unani system of Medicine:		
	3.1 History, objectives, basic principles of Unani medicine system.		
	3.2 Maintenance of health, the concept of disease, concept of sabab, marz and arz, diagnosis and treatment Sources of drugs- plants, animals and minerals		
	3.3 Types of drug formulations		
	3.3.1 Solid preparations		
	3.3.2 Semisolid preparations		
	3.3.3 Liquid preparations		
	3.3.4 Gaseous preparations		
Unit- IV:	Unani Medicine (Manufacturing and case study):		
	4.1 Methods of manufacture- raw material to finished product-		
	4.2 Manufacturing of Hab, Qurs, Sufoof and Majoon.		
	4.3 Study of a disease and its treatment with Unani system of medicine, example-Asthama.		
Unit- V:	Tibetan System of Medicine:		
	5.1 Historical Account (Sowa Rigpa)		
	5.2 Theory of three factors		
	5.3 Principles of Tibetan Medicine		
	5.4 Major Formulation Types in the Tibetan medicine system		
Unit- VI	Trends and utility:		
	6.1 Current trends and applications of Siddha medicines		
	6.2 Current trends and applications of Unani medicine		
	6.3 Current trends and Applications of Tibetan medicine		
Practicals- Indian Systems of Medicine- II (Siddha, Unani and Tibetan)			
1) Preparation & Characterization of a Siddha formulation (Any 3 examples)			
2) Preparation & Characterization of an Unani formulation (Any 3 examples)			
3) Preparation & Characterization of Tibetan medicine formulation (Any 3 examples)			
Suggested Reading:			

Farooqui, M. I. H. (2017) Plants in Ayurveda and Unani Medicine.
 Forde, R. Q. (2008) The book of Tibetan Medicine : How to use Tibetan healing for personal wellbeing. Octopus Publishing Group.
 Hakim, C. and Gyatso, T. (2015) Essentials of Tibetan Traditional Medicine, North Atlantic Disc.
 Kapoor, L. D. (2020) Handbook of Ayurvedic medicinal plants. Herbal reference library.
 Khare, C. P. (2017) Indian Herbal remedies, Rational Western therapy, Ayurvedic and other traditional Uses and Botany, Springer
 National Formulary of Unani Medicine (2010) Published by AYUSH
 Palpandian R., (2019) Siddhas: Masters of Nature, Devotees of Shri Shri Ravishankar Ashram
 Ramchandran, J (2005) Herbs of Siddha Medicine. Murugan Siddha publication
 Salima Akhtar et al., (2021) Alternative medicine: a recent review. Chapter, IntechOpne
 Sen, Saikat, and Chakraborty R. (2021) Herbal Medicine in India, Indigenous knowledge, practice, innovation, and values. Springer publication.
 Thottam, P. J. (2012) Siddha medicine: Handbook of traditional remedies, Thottam Publisher.
 Unwan M et al., (2022) The textbook of Moalajat: Master the Unani Medicine with confidence. Notion Press India

Learning Outcomes:

- The students will acquire knowledge about different alternative medicine,
- The students will skilled in preparing Siddha, Unani and Tibetan formulation,

M. Sc. II, Semester- IV (Herbal Science)

Practical: XIV/ Lab- XIV

Indian System of Medicine-II (Siddha, Unani and Tibetan) (DSC II.4)

(2 hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50

(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

4. Overall performance	10 M
5. Report of visit to any National Institute/ Industry/Assignment/Survey	10 M
6. Attendance	05 M
Total	25 M

External Practical Examination:

1. To prepare any two Siddha samples	10 M
2. Preparation of Unani sample	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

M. Sc. Herbal Science		Semester-IV
Code of the Course Subject	Title of the Course/ Subject	No. of Periods/week
DSC III.4	Medicinal Plants -Case Studies	03 Credits = 03
COs :		
<ul style="list-style-type: none"> • Students will be able to identify various human diseases and disorders and acquire knowledge about the medicinal plants responsible for specific disorders. • Students will be able to analyze different formulations available in the local market. • Students will understand the basic factors use in herbal formulation. 		
Unit: I:	Medicinal Plants Against Disorders and Diseases- I: 1.1 Phytoconstituents and mode of action of medicinal plants used against the following Disorders: 1.1.1 Cold, Cough, Fever 1.1.2 Asthma and skin problems 1.1.3 Gynecological Disorders 1.1.4 Rheumatism and Arthritis	
Unit- II:	Medicinal Plants Against Disorders and Diseases -II 2.1 Phytoconstituents and mode of action of medicinal plants used against the following Disorders: 2.1.1 Cardiac 2.1.2 Diabetes 2.1.3 Gastrointestinal disorders 2.1.4 Liver disorders	
Unit- III:	Herbal Tinctures and Formulations: 3.1 Commercial production of herbal tinctures and herbal extracts by using Solvents of different polarity. 3.2 Principles of Extraction, Selection of solvent, Solid Phase Extraction (SPE) Super Critical Fluid Extraction (SCFE)	
Unit- IV:	Herbal Tinctures and Formulations: 4.1 Herbal formulations for: 4.1.1 Medicated Powders 4.1.2 Medicated Oils 4.1.3 Toiletries	
Unit- V:	Herbal Drug Design and Efficacy: 5.1 Principles and practice, 5.2 Evolution of new drug molecule, steps involved in designing a drug molecule, 5.3 Drug formulation, 5.4 Efficacy testing.	
Unit- VI	Drug candidates from plants: 1. Andrographolides from <i>Andrographis paniculata</i> 2. Bacosides from <i>Bacopa monnieri</i> 3. Berberine from <i>Berberis aristata</i>	
Practical: Medicinal Plants as Pharma Resource 1) Preparation of Monographs of Medicinal Plants (any five) 2) Preliminary phytochemistry of medicinal plants (any five) 3) Demonstration of herbal extraction methods.		
Suggested Reading:		

Agrawal, N. and Sharma, N. (2020) A textbook of Pharmacognosy and Phytochemistry, Vol-I and II. R. Narain Publisher and Distributor.

Bhattacharya, S. K. (2020) Handbook of Medicinal Plants. Pointer Publisher.

Kalia, A. N. (2016) Text Book of Pharmacognosy and Phytochemistry, Vol. I, CBS Publication

Kapoor, L. D. (2020) Handbook of Ayurvedic medicinal plants. Herbal reference library.

Khare, C. P. (2017) Indian Herbal remedies, Rational Western therapy, Ayurvedic and other traditional Uses and Botany, Springer

Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- I, Career Publication, India

Rangari, V. D. (2015) Pharmacognosy and phytochemistry, Volume- II, Career Publication, India

Sen, Saikat, and Chakraborty R. (2021) Herbal Medicine in India, Indigenous knowledge, practice, innovation, and values. Springer publication.

Sherma, J. and Bernard, F. (2010) Handbook of Thin layer chromatography, Third Edition, Revised and Expanded.

Shukla P, K., and Gupta, P. K. (2020) A practical book of Pharmacognosy and Phytochemistry Vol- 1 & 2, Nirali Publication

Srivastava, H. C. (2018) Medicinal and Aromatic plants (ICAR, New Delhi)

Tondon, N. and Sharma, P. (2012) Quality standard of Indian medicinal plants Vol. 1-10. Vedam Books, India

Touchstone, J. C. (1983) Practice of Thin layer chromatography, Wiley and Sons

Trivedi, P. C. (2018) Herbal Drugs and Biotechnology, Avishkar Publisher and Distributors.

Learning Outcomes:

- Students will acquire knowledge about medicinal plants used against specific diseases or disorders.
- Students will become expert in the formulation of herbal tinctures.

M. Sc. II, Semester- IV (Herbal Science)
Practical: XV/ Lab- XV
Medicinal Plants: Case Studies (DSC III.4)
(2 hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50
(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

7. Overall performance	10 M
8. Report of visit to any National Institute/ Industry/Assignment/Survey	10 M
9. Attendance	05 M
Total	25 M

External Practical Examination:

1. Monograph of any two medicinal plants	10 M
2. Preliminary phytochemistry of given plant sample	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

Syllabus Prescribed for the year 2024-25		
Programme M. Sc. Herbal Science	PG Programme Semester-IV	
Code of the Course Subject DSE IV	Title of the Course/ Subject Phytochemistry and Pharmacognosy	No. of Periods/week 03 Credits = 03
COs :		
<ol style="list-style-type: none"> To expose the students to various modern techniques used for plant authentication. To impart analytical skills to students. To make the students to analyze and interpret the results with accuracy. 		
Unit: I:	<ul style="list-style-type: none"> Chromatography <ol style="list-style-type: none"> 1.1 Introduction to Chromatography techniques 1.2 Overview of various types of Chromatography techniques. 1.3 Paper chromatography, Thin layer chromatography, Liquid chromatography 	
Unit- II:	<ul style="list-style-type: none"> Chromatography <ol style="list-style-type: none"> Principles, Instrumentation, processes, applications of – <ol style="list-style-type: none"> HPTLC, GC and Gas-liquid chromatography, Affinity Chromatography 	
Unit- III:	<ul style="list-style-type: none"> Electrophoresis: <ol style="list-style-type: none"> Principles of Electrophoresis, Agarose Gel Electrophoresis and PAGE Basic protein chemistry, Principle of separation and electro-focusing. 	
Unit- IV:	<ul style="list-style-type: none"> Spectroscopy: <p>Principle, working and applications of-</p> <ol style="list-style-type: none"> UV and Visible spectrophotometer, Turbidometry, IR, MS 	
Unit- V:	<ul style="list-style-type: none"> Spectroscopy: <p>Principle, working and applications of-</p> <ol style="list-style-type: none"> AAA NMR X-ray diffractometry 	
Unit- VI:	<ul style="list-style-type: none"> Techniques in plant authentication <ol style="list-style-type: none"> Role of chromatography and spectroscopy in plant authentication (Chemotaxonomic approach) Role of electrophoresis and DNA barcoding/ sequencing in plant authentication (Genomic approach) 	
Laboratory Exercises:		
<ol style="list-style-type: none"> Sample preparation, processing and Separation of Phytochemicals using different methods of Chromatography <ul style="list-style-type: none"> - Paper Chromatography - Thin Layer Chromatograph, - Liquid Chromatography - Column chromatography. Extraction and separation of Proteins from the given raw material/products using PAGE. Extraction and separation of Nucleic acid by Gel electrophoresis. Principles, working, and applications of UV and Visible spectrophotometer. Principles, working, and applications of IR Spectroscopy. Principal, working, and applications of XRD. 		
Suggested Reading:		

Mark, F. Vitha (2016) Chromatography: Principles and Instrumentation, Wiley Publication.
 McNair, H. M. and Miller, J. M. (2009) Basic Gas Chromatography, Wiley- Blackwell Publisher.
 Scott, R. P. W. (1995) Techniques and Practice of Chromatography, CRC Press
 Nikalje, A. P. and Bhosale, D. (2017) A Handbook of Chromatography, Scholars Press, Germany.
 Robards, K., Haddad, P. R. and Jackson, P. E. (1994) Principles and Practice of Modern Chromatographic Methods. Elsevier Ltd.
 Sharma, J. and Fried, B. (2003) Edn. Handbook of Thin-Layer Chromatography Third Edition, Revised and Expanded. Marcel Decker, Inc.
 Coskun, O. (2016) Separation techniques: Chromatography. North Clinic.Instamb. 3(2): 156- 160
 Mitchell, G. H. (2017) Gel electrophoresis: Types, Applications and Research, Nova Science Publishers Inc.
 Westernmier, R. (2004) Electrophoresis in practice: A guide to methods and applications of DNA and Protein separation, Wiley VCH Publisher
 Magdeldin, Sameh (2012) Gel electrophoresis: Principles and Basics, Open access –Peer reviewed edited volume, IntechOpen
 Bier, M. (2013) Electrophoresis: Theory, method, and applications. Elsevier Publication
 Kafle, B. P. (2019) Chemical analysis and material characterization by spectrophotometry, Elsevier Inc.
 Heinz- Helmut, P. (1992) UV- Visible spectroscopy and its applications. Springer Ltd.
 Mark, F. Vitha (2018) Spectroscopy: Principles and Instrumentation. John Wiley & Sons Inc.

Learning Outcomes:

1. The students will learn about the principles, working, and applications of various analytical techniques including chromatography, spectroscopy, and electrophoresis.
2. The students will acquire the skill of handling various instruments at the laboratory level.
3. The students will be acquainted with various plant authentication techniques.
4. The students could analyze the samples and interpret the results with accuracy.

M. Sc. II, Semester- IV (Herbal Science)
Practical: XV/ Lab- XV
Phytochemistry and Pharmacognosy (DSE- IV)
(2 hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50
(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

10. Overall performance	10 M
11. Report of visit to any National Institute/ Industry/Assignment/Survey	10 M
12. Attendance	05 M
Total	25 M

External Practical Examination:

1. Separation of compounds using Paper chromatography/ TLC/ LC	10 M
2. Principle, working and applications of any one major instrument	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

Syllabus Prescribed for the year 2024-25		
Programme M. Sc. Herbal Science	PG Programme Semester-IV	
Code of the Course Subject DSE IV	Title of the Course/ Subject Herbal Drug Technology	No. of Periods/week 03 Credits = 03
COs :		
<ol style="list-style-type: none"> To expose the students to various modern techniques used for plant authentication. To impart analytical skills to students. To make the students analyze and interpret the results with accuracy. 		
Unit: I:	<ul style="list-style-type: none"> Chromatography <ol style="list-style-type: none"> Introduction to chromatography techniques and its types Principles, Instrumentation, processes, applications of – <ol style="list-style-type: none"> Paper Chromatography (PC), Thin Layer Chromatography (TLC) Liquid Chromatography (LC) 	
Unit- II:	<ul style="list-style-type: none"> Chromatography <ol style="list-style-type: none"> Principles, Instrumentation, processes, applications of – <ol style="list-style-type: none"> HPTLC, HPLC Gas Chromatography (GC) 	
Unit- III:	<ul style="list-style-type: none"> Spectroscopy: <ol style="list-style-type: none"> Principle, working, and applications of- <ol style="list-style-type: none"> UV and Visible spectrophotometer, Turbidometry, IR, 	
Unit- IV:	<ul style="list-style-type: none"> Spectroscopy: <ol style="list-style-type: none"> Principle, working and applications of- <ol style="list-style-type: none"> AAA NMR X-ray diffractometry 	
Unit- V:	Advanced Analytical techniques <ol style="list-style-type: none"> LC- MS GC- MS LC-NMR- MS 	
Unit- VI:	<ul style="list-style-type: none"> Techniques in plant authentication <ol style="list-style-type: none"> Explain role of chromatography and spectroscopy in plant authentication (Chemotaxonomic approach) and drug development Explain role of electrophoresis and DNA barcoding/ sequencing in plant authentication (Genomic approach) and drug development 	
Laboratory Exercise:		
<ol style="list-style-type: none"> Sample preparation, Processing and Separation of Phytochemicals using different methods of Chromatography <ul style="list-style-type: none"> Paper Chromatography Thin Layer Chromatograph, Liquid Chromatography Principles, working, and applications of UV and Visible spectrophotometer. Principles, working and applications of HPTLC/ HPLC. Principles, working, and applications of IR Spectroscopy. Principal, working, and applications of XRD. 		
Suggested Reading:		
Mark, F. Vitha (2016) Chromatography: Principles and Instrumentation, Wiley Publication. McNair, H. M. and Miller, J. M. (2009) Basic Gas Chromatography, Wiley- Blackwell Publisher. Scott, R. P. W. (1995) Techniques and Practice of Chromatography, CRC Press		

Nikalje, A. P. and Bhosale, D. (2017) A Handbook of Chromatography, Scholars Press, Germany.
 Robards, K., Haddad, P. R. and Jackson, P. E. (1994) Principles and Practice of Modern Chromatographic Methods. Elsevier Ltd.
 Sharma, J. and Fried, B. (2003) Edn. Handbook of Thin-Layer Chromatography Third Edition, Revised and Expanded. Marcel Decker, Inc.
 Coskun, O. (2016) Separation techniques: Chromatography. North Clinic.Instamb. 3(2): 156- 160
 Mitchell, G. H. (2017) Gel electrophoresis: Types, Applications and Research, Nova Science Publishers Inc.
 Westernmier, R. (2004) Electrophoresis in practice: A guide to methods and applications of DNA and Protein separation, Wiley VCH Publisher
 Magdeldin, Sameh (2012) Gel electrophoresis: Principles and Basics, Open access –Peer reviewed edited volume, IntechOpen
 Bier, M. (2013) Electrophoresis: Theory, method, and applications. Elsevier Publication
 Kafle, B. P. (2019) Chemical analysis and material characterization by spectrophotometry, Elsevier Inc.
 Heinz- Helmut, P. (1992) UV- Visible spectroscopy and its applications. Springer Ltd.
 Mark, F. Vitha (2018) Spectroscopy: Principles and Instrumentation. John Wiley & Sons Inc.

Learning Outcomes:

1. The students will learn about the principles, working, and applications of various analytical techniques including chromatography, spectroscopy, and electrophoresis.
2. The students will acquire the skill of handling various instruments at the laboratory level.
3. The students will be acquainted with various plant authentication techniques.
4. The students could analyze the samples and interpret the results with accuracy.

M. Sc. II, Semester- IV (Herbal Science)

Practical: XV/ Lab- XV

Phytochemistry and Pharmacognosy (DSE- IV)

(2 hrs/ week; Credits= 01)

Time: 3.00 Hrs]

[Total Marks: 50

(Internal: 25 Marks and External: 25 marks)

Internal Practical Examination:

1. Overall Performance	05 M
2. Visit to any National Institute/ Industry	10 M
3. Assignment	05 M
4. Attendance	05 M
Total	25 M

External Practical Examination:

1. Separation of compounds using Paper chromatography/ TLC/ LC	10 M
2. Principle, working and applications of any one major instrument	05 M
3. <i>Viva- voce</i>	05 M
4. Practical record submission	05 M
Total	25 M

