SYLLABUS for M. Sc. Medicinal Plants
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2018-2019

Candidates opting for this course are advised to go through the direction relating to the course "DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CHOICE BASED CREDIT SYSTEM) AND DEGREE OF MASTER OF SCIENCE AND TECHNOLOGY (APPLIED GEOLOGY). SEMESTER PATTERN, (CHOICE BASED CREDIT SYSTEM) (FACULTY OF SCIENCE & TECHNOLOGY)" which is available on R. T. M. Nagpur University website.

The direction will provide details on admission criteria, rules for ATKT, scheme of examination, absorption scheme for CBS students into CBCS pattern, elective papers, foundation course papers, subject centric papers, coding pattern, pattern of question papers, practicals, distribution of marks, seminars, project work, internal assessment, calculation of SGPA and CGPA, etc.

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Medicinal Plants

M. Sc. Medicinal Plants Semester I												
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme						
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks		
		Theory	Practical	Total			External Marks	Internal Ass		Theory	Practical	
Core 1 **(1T1)**	**paper 1: Indian System of Medicines (ISM)**	4	-	4	4	3	80	20	100	40		
Core 2 **(1T2)**	**paper II: Systematics of Plants (SOP)**	4	-	4	4	3	80	20	100	40		
Core 3 **(1T3)**	**Paper III: Cell and Molecular Biology (CMB)**	4	-	4	4	3	80	20	100	40		
Core 4 **(1T4)**	**Paper IV: Modern Analytical Techniques (MAT)**	4	-	4	4	3	80	20	100	40		
Pract. Core 1 & 2 **(1P1)**	**Practical I**	-	8	8	4	6	100	-	100		40	
Pract. Core 3 & 4 **(1P2)**	**Practical II**	-	8	8	4	6	100	-	100		40	

Seminar 1 **(1S1)**	**seminar**	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Medicinal Plants Semester II											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory	Practical	Total			External Marks	Internal Assesmt.		Theory	Practical
Core 5 **(2T1)**	**paper V: Fundamentals of Pharmacognosy (FOP)**	4	-	4	4	3	80	20	100	40	
Core 6 **(2T2)**	**paper VI: Plant Biochemistry (PBC)**	4	-	4	4	3	80	20	100	40	
Core 7 **(2T3)**	**paper VII: Plant Metabolism and Development (PMD)**	4	-	4	4	3	80	20	100	40	
Core 8 **(2T4)**	**paper VIII: Medicinal Plant Biotechnology (MPB)**	4	-	4	4	3	80	20	100	40	
Pract. Core 5 & 6 **(2P1)**	**Practical III**	-	8	8	4	6	100	-	100		40
Pract. Core 7 & 8 **(2P2)**	**Practical IV**	-	8	8	4	6	100	-	100		40
Seminar 2 **(2S1)**	**Seminar**	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Medicinal Plants Semester III											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory	Practical	Total			External Marks	Internal Ass		Theory	Practical
Core 9 **(3T1)**	**paper IX: Immunology and Microbiology (IMM)**	4	-	4	4	3	80	20	100	40	
Core 10 **(3T2)**	**paper X: Herbal Cosmetics (HCT)**	4	-	4	4	3	80	20	100	40	
Core Elective 1 **(3T3)**	**paper XI: Core Elective 1. Natural Plant Products & Phytochemistry – I (NPP -I)**	4	-	4	4	3	80	20	100	40	
Foundation Course 1 / Core Subject Centric 1 **(3T4)**	**paper XII: Foundation Course 1. Fermentation Technology (FMT)**	4	-	4	4	3	80	20	100	40	
Pract. Core 9 & 10 **(3P1)**	**Practical V**	-	8	8	4	6	100	-	100		40
Pract. Core Elective 1 **(3P2)**	**Practical VI**	-	8	8	4	6	100	-	100		40
Seminar 3 **(3S1)**	**Seminar**	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

M. Sc. Medicinal Plants Semester IV											
Code	Theory / Practical	Teaching scheme (Hours / Week)			Credits	Examination Scheme					
						Duration in hrs.	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory	Practical	Total			External Marks	Internal Ass		Theory	Practical
Core 11 **(4T1)**	**paper XIII: Herbal Drug Technology &Development (HDD)**	4	-	4	4	3	80	20	100	40	
Core 12 **(4T2)**	**paper XIV: Core 12. Drug Standardization and Regulations (DSR)**	4	-	4	4	3	80	20	100	40	
Core Elective 2 **(4T3)**	**paper XV: Core Elective 2. Natural Plant Products & Phytochemistry - II (NPP –II)**	4	-	4	4	3	80	20	100	40	
Foundation Course 2 / Core Subject Centric 2 **(4T4)**	**paper XVI: Foundation Course 2. Ethnobotany (ETH)**	4	-	4	4	3	80	20	100	40	
Pract. Core 11, 12 & Elective 2 **(4P1)**	**Practical VII**	-	8	8	4	6	100	-	100		40
Project **(4 PROJ 1)**	**Practical VII- Project**	-	8	8	4	6	100	-	100		40
Seminar 4 **(4S1)**	**Seminar**	2	-	2	1			25	25	10	
	TOTAL	**18**	**16**	**34**	**25**		**520**	**105**	**625**	**170**	**80**

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-I

1T1: paper 1: Indian System of Medicines (ISM)

Unit-I.
Ayurvedic System of Medicine:
Principles with merits and demerits.
Methods of preparation of Ayurvedic medicines.
Standardization of Ayurvedic medicines.
Unit-II
Siddha System of Medicines:
Principles with merits and demerits.
Method of preparation of Siddha medicines.
Standardization of Siddha medicines.
Unani System of Medicines:
Principles with merits and demerits.
Method of preparation of Unani medicines.
Standardization of Unani medicines.
Unit-III
Homeopathy System of Medicines:
Principles with merits and demerits.
Method of preparation of Homeopathic medicines.
Standardization of Homeopathic medicines.
Unit-IV
Tribal medicine: Principles, Importance, Merits and Demerits of Tribal Medicines.
Complimentary Medicines:
Medicinal sources—Herbal sources, Mineral sources, Animal sources, their collection, purification and processing.
Rules and Regulations to Safeguard the Complimentary Medicines.
Note: Practicals based on above theory syllabus.
Suggested Readings:
1.Ayurvedic Pharmacopoeia.
2.Ayurvedic Formulary of India, the Indian Medical Practitioners Co-operativePharmacy and Stores Ltd, IMPCOPS.
3.Hand Book on Ayurvedic Medicines, H.Panda National Institute of IndustrialResearch, Delhi-7.
4.Ayurvedic system of medicine, 2nd edition, Kaviraj, Nagendranath Sengupata,vol. I &II.
5.Siddha Pharmacopoeia by Dr.S. Chidambarathanu pillai, Ist edition.
6.Unani Pharmacopoeia.
7. Homeopathic Pharmacopoeia.
8. Homeopathic Pharmacy An introduction & Hand book by Steven B. Kayne.
9. Alternative medicine, by Dr. K.B. Nangia.
10. Aromatherapy, Valerie Gennari Cooksley.
11. Indian Herbal Pharmacopoeia vol. I &II Indian Drug Manufacturer's association,Mumbai.
12. British Herbal Pharmacopoeia British Herbal Medicine Association,1990 vol.I.
13. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Businesshorizons, New Delhi, First edition, 2003. Robert Verpoorte, Pulok K Mukharjee.
14. Screening methods of Pharmacology by Robert turner.
15. Toxicology and Clinical Pharmacology of Herbal Products, Melanie Johns Cupp.

SEMESTER –I
Practical I
INDIAN SYSTEM OF MEDICINES

Suggested Laboratory Exercise:

1. Demonstration of various dosage forms available in each system.
2. Simple preparations used in Ayurvedic System and their Standardization (with special emphasis on TLC/HPTLC).
3. Simple preparations used in Siddha system and their Standardization (with special emphasis on TLC/HPTLC).
4. Simple preparations used in Unani system and their Standardization (with special emphasis on TLC/HPTLC).
5. Simple preparations used in Homeopathy system and their Standardization (with special emphasis on TLC/HPTLC).
6. Ethnomedicinal Survey & documentations.

Suggested Laboratory Readings.

1. Ayurvedic Pharmacopoeia.
2. Ayurvedic Formulary of India, the Indian Medical Practitioners Co-operativePharmacy and Stores Ltd, IMPCOPS.
3. Hand Book on Ayurvedic Medicines, H.Panda National Institute of Industria Research, Delhi-7.
4. Ayurvedic system of medicine, 2nd edition, Kaviraj, Nagendranath Sengupata,vol. I &II.
5. Siddha Pharmacopoeia by Dr.S. Chidambarathanu pillai, Ist edition.
6. Unani Pharmacopoeia.
7. Homeopathic Pharmacopoeia.
8. Homeopathic Pharmacy An introduction & Hand book by Steven B. Kayne.
9. Alternative medicine, by Dr. K.B. Nangia.
10. Aromatherapy, Valerie Gennari Cooksley.
11. Indian Herbal Pharmacopoeia vol. I &II Indian Drug Manufacturer's associationMumbai.
12. British Herbal Pharmacopoeia British Herbal Medicine Association,1990 vol.I.
13. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Busines horizons, New Delhi, First edition,
2003. Robert Verpoorte, Pulok K Mukharjee.
14. Screening methods of Pharmacology by Robert turner.
15. Toxicology and Clinical Pharmacology of Herbal Products, Melanie Johns Cupp.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-I
(1T2): paper II: Systematics of Plants (SOP)

Unit I

Angiosperm Morphology, structural units and floral symmetry, dicot and monocot flower; structure, diversity origin and evolution of stamen, carpels; placentation types and evolution.
Floral adaptation to different pollinators.
Angiosperm Taxonomy: Scope, aims, principles of taxonomy, historical development of plant taxonomy, Taxonomic structure: taxonomic hierarchy, concept of taxa, concept of species, concept of genus and family.

Unit II

Classification of angiosperms: Natural, Artificial, Phylogenetic system of classification
Systems of classification: Linnaeus, Bentham & Hooker and Hutchinson (merits and demerits)
Taxonomic tools: herbarium, floras, monographs, botanical gardens, biochemical and molecular techniques, computers and GIS.

Unit III

Plant nomenclature: Salient features of ICBN
Probable ancestors of angiosperms, primitive living angiosperms, speciation and extinction,
IUCN categories of threat, distribution and global pattern of biodiversity.

Unit IV

Study of Families (Dicot): Ranunculaceae, Fabaceae (Papilionoideae, Caesalpinioidae, Mimosoidae) Cucurbitaceae, Lamiaceae, Asteraceae, Apocynaceae, Euphorbiaceae, Amaranthaceae.

Study of Families (Monocot): Liliaceae, Poaceae, Orchidaceae.

Note: Practicals based on above theory syllabus.

Suggested Readings

1. Devis, P.H. and Heywood, V. H. 1973.Principles of angiosperms taxonomy. Robert E. Kreiger Pub. Co. Newyork.
2. Grant, V. 1971.Plant Speciation, Columbia University press, London.
3. Grant W. F. 1984**.** Plant Biosystematics.Academic press, London.
4. Harisson, H.J. 1971. New concept in flowering plant Taxonomy. Hickman educational books Ltd. London.
5. Hislop-Harisson, J. 1967.Plant Taxonomy.English Language Book Sco.And Edward Arnold Pub.Ltd, UK.
6. Heywood, V. H. and Moore, D. M. 1984. Current concepts in Plant Taxonomy. Academic Press, London.
7. Joncs, A. D. and Wibins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co. New York.
8. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw- Hill Book Co., New York.
9. Nordentam, B., El Gazaly, G. and kassas, M. 2000.Plant systematic for 2ft century.Portlant press.Ltd, London.
10. Radford, A. E. 1986. Fundamentals of plant systematic.Harper and Raw publication,USA.
11. Solbrig, O.T. 1970. Principles and methods of plant Sytematics. The Macmillan Co. Publication Co. Inc., USA.
12. Woodland, D. W. 1991. Contemporary Plant Syatematics, Pentice Hall, New Jersery.
13. Takhtajan, A. L. 1997. Diversity and classification of Flowering Plants. Columbia University Press, New York.
14. Stebbins, G. L. 1974. Flowering Plants-evolution Above species Level. Edvard Arnold Ltd, London.

SEMESTER-I
Practicals
SYSTEMATICS OF PLANTS

Suggested Laboratory Exercise:

1. To study the floral symmetry in various taxa.
2. To study and work out the differences in dicot and monocot flower.
3. To study the variation in stamens and carpels.
4. To study placentation types in various taxa.
5. To study the floral adaptations for pollination.
6. To study anatomical features of various taxa.
7. To study embryological features of various taxa.
8. To study palynological features of various taxa.
9. To study cytological features of various taxa.
10. To prepare a cladogram on the basis of various morphological features of the species belonging to a genus.
11. Description of a specimen from representative, locally available families.
12. Location of key characters and use of keys at genera & family level.
13. Field trips within and around the campus; compilation of field notes and preparation herbarium sheets of medicinal plants.
14. Training in using floras herbaria for identification of specimens described in the class.
15. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

Note: Frequent field visits are expected for the observation of plants in local and nearby areas.

Suggested Laboratory Readings.

1. Devis, P.H. and Heywood, V. H. 1973.Principles of angiosperms taxonomy. Robert E.Kreiger Pub. Co. Newyork.
2. Grant, V. 1971.Plant Speciation, Columbia University press, London.
3. Grant W. F. 1984**.** Plant Biosystematics.Academic press, London.
4. Harisson, H.J. 1971. New concept in flowering plant Taxonomy. Hickman educational books Ltd. London.
5. Hislop-Harisson, J. 1967.Plant Taxonomy.English Language Book Sco.And Edward ArnoldPub.Ltd, UK.
6. Heywood, V. H. and Moore, D. M. 1984. Current concepts in Plant Taxonomy. AcademicPress, London.
7. Joncs, A. D. and Wibins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co. New York.
8. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw- HillBook Co., New York.
9. Nordentam, B., El Gazaly, G. and kassas, M. 2000.Plant systematic for 2ft century.Portlantpress.Ltd, London.
10. Radford, A. E. 1986. Fundamentals of plant systematic.Harper and Raw publication, USA.
11. Solbrig, O.T. 1970. Principles and methods of plant Sytematics. The Macmillan Co Publication Co. Inc., USA.
12. Woodland, D. W. 1991. Contemporary Plant Syatematics, Pentice Hall, New Jersery.
13. Takhtajan, A. L. 1997. Diversity and classification of Flowering Plants. Columbia University Press, New York.
14. Stebbins, G. L. 1974. Flowering Plants-evolution Above species Level. Edvard Arnold Ltd,

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-I
(1T3): Paper III: Cell and Molecular Biology (CMB)

UNIT-I
Cell wall: Structure; function; biogenesis and growth; cell differentiation
Plasma membrane: Membrane architecture (fluid mosaic model); sites for ATPases;membrane transport - ion carriers, channels, pumps and aquaporins; receptors.
Plasmodesmata: Structure, role in movement of molecules and macromolecules; comparisonwith gap junction.
Cellular organelles: Ultra-structure and function of golgi complex, lysosomes, peroxisomes,Endoplasmicreticulum, mitochondria, chloroplast and plant vacuoles.
UNIT-II
Cell shape and motility: The cytoskeleton; organization and role of microtubules andmicrofilaments; motor movements, implications in flagellar & other movements, cell division.
Protein sorting: Machinery involved, vesicles, coat proteins; protein targeting toplastids, mitochondria, peroxisomes, nucleus, vacuoles; modification during transport.
UNIT-III
Nucleus- Ultra structure and functions, Chromosome structure and types,
DNA- Denaturation and Renaturation, C-value paradox, DNA replication - polymerases, primers and mechanism - molecular methods of DNA replication.
RNA - Types, molecular organization, genetic code, transcription mechanism in prokaryotes and post transcription processing, enzyme system in transcription, transcription process in eukaryotes. Ribosomes and Translation in Prokaryotes and Eukaryotes
UNIT-IV
Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin dependentkinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; programmed cell death in plants; regulation in plant growth and development.
Signal transduction: Overview, receptors and G- proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascades, diversity in protein kinases and phosphatases, specific signaling mechanisms e.g. two-component sensor-regulator system in bacteria and plants, sucrose

sensing mechanism

Techniques: Electrophoresis, immunotechniques, FISH, GISH, confocal microscopy, Gene amplification - PCR, DNA finger printing.

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Atherly, A.G., Griton, J.R. and Mc Donald, J. F. 1999. The Science of Genetics. Saunders College Pub. Fort Worth, USA
2. Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.
3. Bush, H. Rothblum, L. 1982. Vol. X. The Cell Nucleus RDNA part A. Academic Press.
4. Dc, D. N. 2000 Plant cell vacuoles: An introduction. CSIRO Publication, Collingwood, Australia.
5. Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.
6. Kleinsmith, L.J. and Kish, V.M. 1995 Principles of Cell and Molecular Biology (2ndEdi.) Harper Collins Coll. Publisher, New York, USA.
7. Krishnamurthy, K.V. 2000 Methods in Cell wall Cyto-chemistry. CRC Press, Boca Raton, Florida
8. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA
9. Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc., USA
10. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA
11. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999.
12. Molecular Biology of Cell, Garland Publishing, Inc., New York.
13. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8th Ed. B. IWaverly Pvt. Ltd., New Delhi.
14. Khush, G.s. 1973 Cytogenetics of Aneuploids, Academic Press, New York, London
15. Kleinsmith, L.J. and Kish, V.M. 1995 Principles of Cell and Molecular Biology (2ndEdi.) Harper Collins Coll. Publisher, New York, USA.
16. Lewin, B. 2000 Gene VII Oxford Univ. press, New York.
17. Malacinski, G. M. and Freifelder, D. 1998 Essentials of Molecular Biology (3rd Edi.)Jones and Bartiet Pub. Inc., London.
18. Russel, P. J. 1998 Genetics (5th Edi.) The Banjamin/ Cummings Publishing Com. Inc.,USA
19. Sunstad, D. P. and Simmons, M. J. 2000 Principles of Genetics (2nd Edi.) John Wiley& Sons Inc., USA.
20. Tamarin, R. H. 2001 Principles of Genetics 7th Edi. The McGraw−Hill Companies.
21. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co.,California, USA.

SEMESTER-I
Practicals
CELL & MOLECULAR BIOLOGY

Suggested Laboratory Exercise:

1. Observation of salivary gland chromosomes of Chironomus or Drosophila.
2. Cell fractionation & isolation of Chloroplast and mitochondria.
3. Isolation of plant DNA and its quantification by spectrophotometric method.
4. Isolation of DNA and preparation of Cot-curve.
5. Demonstration of vital structure and functions of cell
6. Isolation of chloroplast and demonstration of two subunits of RUBISCO by SDSPAGE
7. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis,visualization by ethidium bromide staining.
8. To study in vitro transcription.
9. To study in vitro translation.
10. Isolation of RNA and quantification by spectrophotometric method.
11. Observation of prokaryotic and eukaryotic cells and cell types - Living Cells/Temporary/Permanent Preparations.
12. Isolation, determination, purification and separation of protein.
13. PCR amplification of desired gene

Suggested Laboratory Readings.

1. Cell and molecular biology-Concept and experiment. 2nd edn., Harris,D(Ed.), Karp, G.1999. John wiley & sons,
sons, New York.
2. Principles of cell and molecular biology. 2nd edn., Mclaughlin,S., Trost,K., Mac Elree,E.(eds)., Kleinsmith,L.J.&
Kish, V.M., 1995. Harper Collins Publisher, New York.
3. Molecular biology of the cell.3nd edn., Alberts,B., Bray,D., Lawis,J., Raff,M., Roberta, K., Watson, J.d(eds.), 1994.
Garland Publication, Inc., New York.
4. Cell and Molecular Biology. 8th edn., De Robertis, E.D.P. and De Roberts, E, M.F.1995. B.I.Waverly Pvt. Ltd.,
New Delhi.
5. Glick, B. R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology andBiotechnology. CRC Press, Boca
Raton, Florida USA.
6. Goswami, H. K. 1986. Practical cytology – Applied Genetics and BiostatisticsHimalaya Pub. House, Bombay.
7. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and FunctionJones and Barlett Publishers,
Boston, Massachusetts.
8. Hall, J.L. and Moore, A.L. 1983.Isolation of Membranes and Organelles from Plant Cells Academic Press, London,
U.K.
9. Harris,N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRLPress, at Oxford University Press,
Oxford, U.K.
10. Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation andEngineering. Har Academic
Publishers, Australia.
11. Shaw, C.H. (Ed.), 1988. Plant Molecular Biology: A Practical Approach. IRL Press,

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-I
(1T4): Paper IV: Modern Analytical Techniques (MAT)

Unit - I

UV-Visible Spectroscopy: Principle of UV-Visible Spectroscopy, Chromophores and their interaction with UV-visible radiation and their utilization in structural, qualitative and quantitative analysis of drug molecules. Fundamentals of Optical Rotatory Dispersion. Cotton effect curves, octant rule, circular dichroism.

Unit - II

Infrared Spectroscopy: Infrared radiation and its interaction with organic molecules, vibrational mode of bonds, instrumentation and applications, interpretation of IR spectra. FTIR and ATR, X-ray diffraction methods.

Unit - III

Nuclear magnetic resonance spectroscopy: Magnetic properties of nuclei, field and precession, chemical shift concept, isotopic nuclei, reference standards and solvents.

^{1}H NMR spectra, chemical shifts,
multiplicity, coupling constants, integration of signals, interpretation of spectra, decoupling-double resonance and shift reagent methods; APT and DEPT techniques.

Unit - IV

Chromatographic techniques: Principles of separation and application of Column, Paper, Thin layer and

Gas chromatography, HPLC, HPTLC, Size exclusion chromatography, Affinity chromatography, Electrophoresis. Instrumentation of HPLC, Preparative and micropore columns, Reverse phase columns, Mobile phase selection and detectors in HPLC.

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Spectrometric identification of Organic Compounds, Robert. M. Silverstein, Basseler, Morril (John Wiley and Sons. N.Y).
2. Spectroscopy of Organic Compounds by P. S. Kalsi.
3. Principles of Instrumental Analysis by Donglas A. Skoog, James, J. Leary, 4th Edition.
4. Pharmaceutical Analysis – Modern Methods – Part A, Part B, James W. Munson 2001.
5. Organic Spectroscopy – William Kemp, 3rd Edition.
6. Chromatographic Analysis of Pharmaceuticals, John A. Adamovics, 2nd Edition.
7. Practical Pharmaceutical Chemistry, Part two, A. H. Beckett & J. B. Stenlake – 4th Edition.
8. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.
9. Instrumental Methods of Analysis – Willard, Merritt, Dean, CBS, Delhi.
10. Techniques and Practice of Chromatography – Raymond P. W. Scott, Vol. 70.
11. Liquid Chromatography – Mass Spectrometry, W. M. A. Niessen, J. Van Der Greef, Vol. 58.
12. Modern Methods of Pharmaceutical Analysis, Vol 1,2,RE Schirmer,Franklin Book
13. Colorimetric Methods of analysis- F. D. Snell and C. T. Snell (Van Nostrand Reinhold Company, N.Y.).
14. Indian Pharmacopoeia
15. British Pharmacopoeia
16. U.S. Pharmacopoeia
17. Clarke's Analysis of Drugs and Poisons, A.C.Moffat, M. David Osselton, Brain Widdop, L. Y. Galichet.
3rd edition, Pharmaceutical Press
18. Text book of Pharmaceutical Analysis, K. A. connors, 3rd Ed. Johnwiley & sons, New York
19. Spectrometric identification of Organic Compounds, Robert. M. Silverstein et al, 7th Edition, 1981.
20. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor.
21. Principles of Instrumental Analysis by Donglas A. Skoog, James, J. Leary, 4th Edition.
22. Pharmaceutical Analysis – Modern Methods – Part A, Part B, James W. Munson – 2001.
23. Vogel's Text Book of Quantitative Chemical Analysis, 6th Edition, 2004.
24. Chromatographic Analysis of Pharmaceuticals, John A. Adamovics, 2nd Edition.
25. Practical Pharmaceutical Chemistry, Part two, A. H. Beckett & J. B. Stenlake – 4th Edition.
26. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.
27. Organic Spectroscopy – William Kemp, 3rd Edition.
28. Techniques and Practice of Chromatography – Raymond P. W. Scott, Vol. 70.
29. Identification of Drugs and Pharmaceutical Formulations by Thin Layer Chromatography – P. D. Sethi,
Dilip Charegaonkar, 2nd Edition.
30. HPTLC – Quantitative Analysis of Pharmaceutical Formulations – P. D. Sethi.
31. Liquid Chromatography **–** Mass Spectrometry, W. M. A. Niessen, J. Van Der Greef, Vol. 58.
32. Stereo Chemistry – Conformation and Mechanism by P. S. Kalsi, 2nd Edition.

SEMESTER –I

Practicals

MODERN ANALYTICAL TECHNIQUES

Suggested Laboratory Exercise:

1. UV/Visible spectrum scanning of a few organic compounds for UV- absorption and correlations of structures and isobestic point in case of mixtures.
2. Estimation of single drug (raw material/ formulations) by UV spectrophotometry.
3. Estimation of multicomponent formulation by UV- Spectrophotometer in formulations.
4. Effect of pH and solvent on UV Spectrum of certain drugs.
5. Calibration of IR Spectrophotometer using polystyrene film and checking the performance of the instrument.

6. Interpretation of structure of drugs by Infra red spectra.
7. Experiments based on the application of derivative spectroscopy.
8. Standardization and dissolution studies of solid dosage form.
9. Experiments using HPLC: Determination of chromatographic parameters- capacity factor, selectivity, resolution, efficiency of column HETP, asymmetric factor.
10. Estimation of drugs in biological fluids by HPLC.
11. Experiments based on application of HPTLC for quantification of Berberin from *Berberis aristata* and Andrographolide from *Andrographis paniculata.*

Suggested Laboratory Readings.

1. Skoog, DA, Holler, FJ, Crouch, SR. Principles of instrumental analysis. 6th ed., Baba Barkha Nath Printers, Haryana,
2007.
2. Silverstein, RM, Webstar, FX. Spectrometric identification of organic compounds. 6th ed., John Wiley and Sons (Asia)
Pvt. Ltd., Singapore, 2005.
3. William Kemp. Organic Spectroscopy, 3rd ed., Palgrave, New York, 2006
4. Conners KA. Text book of Pharmaceutical analysis, 3rd ed., John Wiley and Sons, Singapore, 2004
5. Willard HH, Merritt LL, Settle FA. Instrumental methods of analysis, 7th ed., CBS Publishers and Distributors, New
Delhi, 1986
6. Sharma BK. Instrumental methods of chemical analysis, 25th ed., Goel Publishing House, Meerut, 2006.
7. Beckett, AH, Stenlake, JB. Practical Pharmaceutical Chemistry, Part I and Part II, 4th ed., CBS Publishers and
Distributors, New Delhi, 2004.
8. Ewing, GW. Instrumental methods of chemical analysis, 5th ed., McGraw Hill Book Company, New York, 1985.
9. Houghton P, Mukherjee PK. Evaluation of Herbal Medicinal Product, Pharmaceutical Press, London, 2009.
10. Kalsi, P S. Spectroscopy of Organic Compounds, 2nd ed., Wiley Estern Ltd., Delhi
11. Instrumental methods of chemical analysis by chatwal. K, anand, 5th edition.
12. Organic spectroscopy by Y.R.Sharma.
13. Text book of pharmaceutical analysis by S.Ravishankar.
14. Spectrometric identification of Organic Compounds, Robert. M. Silverstein et al, 7thEdition, 1981.
15. Principles of Instrumental Analysis by Donglas A. Skoog, James, J. Leary, 4th Edition.
16. Pharmaceutical Analysis – Modern Methods – Part A, Part B, James W. Munson –2001.
17. Practical Pharmaceutical Chemistry, Part two, A. H. Beckett & J. B. Stenlake – 4thEdition.
18. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.
19. Chromatography – P. D. Sethi, Dilip Charegaonkar, 2nd Edition.

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER– I
Practical –I

Time: 6 hours. Full Marks: 100
Q. 1 Onequestion from Sr. No 1-3 of Core-1 15
Q. 2 Onequestion from Sr. No 4-6 of Core-1 15
Q. 3 Onequestion from Sr. No 1-7 of Core-2 15
Q. 4 Onequestion from Sr. No 8-15 of Core-2 15
Q. 5 Spotting (2 spots from each core) 20
Q. 6 Viva-voce 10
Q. 7 Practical Record 10

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER- I
Practical –II

Time: 6 hours. Full Marks: 100
Q. 1 Onequestion from Sr. No 1-7 of Core-3 15
Q. 2 Onequestion from Sr. No 8-13 of Core-3 15
Q. 3 Onequestion from Sr. No 1-5 of Core-4 15
Q. 4 Onequestion from Sr. No 6-11 of Core-4 15
Q. 5 Spotting (2 spots from each core) 20
Q. 6 Viva-voce 10
Q. 7 Practical Record 10

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
(2T1): paper V: Fundamentals of Pharmacognosy (FOP)

Unit I
Definition, history and scope of pharmacognosy including indigenous system ofmedicine.
Various system of classification of drugs of natural origin.
Adulteration and drug evaluation; significance of pharmacopoeial standards.

Unit-II
Occurrence, distribution, organoleptic evaluation, microscopical evaluation,chemicalconstituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.
a) Laxatives: Aloes, Castor oil, Isapgol, Senna
b) Cardiotonics – Digitalis, Arjuna
c) Carminatives & G.I. regulators – Umbelliferous fruits, Coriander, Fennel, Ajwaen, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg,Cinnamon, Clove.
d) Astringents – Catechu

Unit-III
Occurrence, distribution, Organoleptic evaluation, Microscopical evaluation,chemical constituents including tests wherever applicable and Therapeutic efficacyof following categories of drugs.
a) Drugs acting on nervous system – Hyoscyamus, Ashwagandha, Opium, Cannabis,
b) Antihypertensives – Rauwolfia
c) Antitussives – Vasaka, tolu balsam, Tulsi
d) Antirheumatics – Guggul, Colchicum
e) Antitumour – Vinca
f) Antileprotics – Chaulmoogra Oil
g) Antidysenterics – Holarhaena
h) Antiseptics and Disinfectants - Benzoin, Murraya, Neem, Curcuma.
i) Antimalarials – Cinchona, Andrographis

j) Oxytocics – Ergot
k) Vitamins – Shark liver oil and Amla
l) Enzymes – Papaya, diastase yeast

Unit-IV

Gross anatomical studies of: Senna, Cinchona, Fennel, Clove, Ginger, Nuxvomica&Ipecacuanha.Brief outline of occurrence, distribution outline of isolation, identification tests,therapeutic effects and pharmaceutical applications of alkaloids, terpenoids' glycosides, volatile oils tannins and resins.

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. W.C.Evans & Trease, Pharmacognosy, 15th edn.2008, W.B. Saunders & Co.Ltd., London.
2. Guidelines for the Assessment of herbal medicines, 1991,WHO Report, Geneva.
3. Quality Control Methods for Medicinal Plant material, 1992, WHO Guidelines.
4. Indian Pharmacopoeia, 1996, Govt. of India, Ministry of Health and family welfare, Delhi.
5. A.N. Kalia, Textbook of Industrial Pharmacognosy, 2005, CBS Publishers, New Delhi.
6. Dr.C.K. Kokate, Practical Pharmacognosy, 1988, Vallabh Prakashan, Delhi.
7. Dr.P.Mukherjee, Quality control herbal drugs, 2005, Business Horizons, New Delhi
8. Trease and Evans Pharmacognosy, W.C. Evans.
9. Pharmacognosy, Varro E.Tyler, Lynn. R.Brady, James E.Robbers
10. Text Book of Pharmacognosy, T.E. Wallis, CBS Pub. Delhi.
11. Ramstad - Modem Pharmacognosy.
12. John - Dodds - Lorin - Experiments in Plant Tissue Culture.
13. CSIR- Cultivation and Utilization of Medicinal Plants.
14. Handa S.S. & Kaul. K.L. Supplement to cultivation & utilization of
15. CSIR - Wealth of India, Raw Materials.
16. Bartz - Reinhard - Zenk - Plant Tissue Culture and its Biotechnical Applications.
17. Pharmacognosy, C.K. Kokate, A.P. Purohit, and S.B. Gokhale.
18. Quality Standards of Indian Medicinal Plants Vol-I, ICMR, New Delhi.
19. WHO guide lines for the quality control of Herbal plant materials.
20. The Practical evaluation of phytopharmaceutical by brain & turner.
21. Harborne - Comparative Biochemistry of Flavonoids.
22. Biological standardization by J.N.Barn, D.J.Finley and L.G. Good win.
16. Indian pharmacopoea, Indian Herbal Pharmacopoea and other pharmacopoeia.
17. Ayurvedic Formulary of India.
18. British Herbal Pharmacopoeia.
19. Screening methods of Pharmacology By Robert turner.

SEMESTER-II

Practicals

FUNDAMENTALS OF PHARMACOGNOSY

Suggested Laboratory Exercise:

1. Identification of crude drugs containing ***Carbohydrate*** by morphological characters.
2. Identification of crude drugs containing ***Lipids*** by morphological characters.
3. Identification of crude drugs containing ***Glycosides*** by morphological characters.
4. Identification of crude drugs containing ***Volatile Oils*** by morphological characters.
5. Identification of crude drugs containing ***Alkaloids*** by morphological characters.
6. Physical and chemical tests for evaluation of crude drugs wherever applicable
7. Microscopic studies of Senna leaf, Rauwolfia root, Cinamon bark, Datura flower and stem.
8. Measurement of length and width of different constituents (starch grains, oxalate crystals, phloem fibres) in powdered crude drugs.
9. Determination of ash value of different powdered crude drugs.
10. Determination of Antibacterial activities of different powdered crude drugs.
11. Determination of Antifungal activities of different powdered crude drugs.

Note: One Pharmaceutical industry visits is compulsory for the observation of various processes in industry.

Suggested Laboratory Readings:

1. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.

2. Advances in Natural Product Chemistry, extraction and isolation of biologically active compounds. S. Natori et al.,
Wiley, New York.
3. Phytochemical methods by J.B. Harborne, Chapman and Hall, International Ed., London.
4. Modern methods of plant analysis by Peach and Tracey, Vol. II, IV, Springer Verlag.
5. G.E. Trease and W.C. Evans., Pharmacognosy, W.B. Saunders Co. Ltd., Harcourt Publishers Ltd. UK.
6. Chaudhari R.D., Herbal Drug Industry, Eastern Publication.
7. Quality Control Methods for medicinal plant material, WHO Geneva.
8. Wagner H, Bladt S, 1996. Plant Drug Analysis- A Thin Layer Chromatography Atlas, 2nd Ed., Springer-Verlag, Berlin.
9. Stahl Egon, Thin layer chromatography, 2nd Edition, Springer Publication.
10. Herbal Drug technology by SS Agrawal and M Paridhavi, Orient Longman
11. Indian Herbal Pharmacopoeia, Vol. I- II, SS Handa, RRL Jammu Tawi, and IDMA Mumbai.
12. The Aurvedic Pharmacopoeia of India, 1999. Government of India, Ministry of Health and Family Welfare, Department
of Indian Systems of Medicine and Homeopathy, New Delhi.
13. Standardization of Botanicals by V. Rajpal, Vol. I and Vol II, Eastern Publishers, New Delhi.
14. Practical Evaluation of Phytopharmaceuticals by K.R. Brain and T.D. Turner, Wright-Scientechnica, Bristol.
15. Houghton P, Mukherjee PK. Evaluation of Herbal Medicinal Product, Pharmaceutical Press, London, 2009.
16. British pharmacopoeia, 2008. The department of Health, Vol I- IV, British Pharmacopoeia Commission, London.
17. Neutraceuticals by Lisa Rapport and Brain Lockwood.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
(2T2): paper VI: Plant Biochemistry (PBC)

Unit I
Biochemical organisation of the cell and transport processes across cell membrane.
The concept of free energy, determination of change in free energy fromequilibrium constant and reduction potential, bioenergetics, production of ATP andits biological significance.
Introduction to 3D structure of protein, stability and denaturation of protein,allosteric proteins.
Unit-II
Enzymes : Nomenclature, enzyme kinetics and its mechanism of action,mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.
Co-enzymes : Vitamins as co-enzymes and their significance, Metals as coenzymesand their significance.
Unit-III
Lipids Metabolism : Oxidation of fatty acids, a-oxidation & energetic, B-oxidation, μ-oxidation, Biosynthesis of ketone bodies and their utilization,
Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism,Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes) phospholipids, and sphingolipids.
Unit-IV
Biological Oxidation : Redox-Potential, enzymes and co-enzymes involved inoxidation reduction & its control, The respiratory chain, its role in energy captureand its control, Energetic of oxidative phosphorylation, Inhibitors of respiratorychain and oxidative phosphorylation, Mechanism of oxidative phosphorylation.
Note: Practicals based on above theory syllabus.
Suggested Readings:
1. Buchanan, B. B., Gruissem, W. and Jones, R.L. 1989. Biochemistry and Molecular Biology of plants. American Society of Plant Physiologists, Maryland, USA. 24

2. Dennis, D.T., Turpin, D. H., Lefebvrc, D.D. and Layzell, D.B. (eds).1997. Plant Metabolism (2nd Ed.)
Longman, Essex, England.
3. Gaiston, A.W.1989. Life Processes in Plants. Scientific American Library, Springer- Verlag, New York,
USA.
4. Hooykass P.J.J., Hall, M. A. and Libbenga, K.R.(eds).1999. Biochemistry and Molecular Biology of plant
Horm. Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Lodish, H., Berk, A., Zipursky S.L., Matsudaira, P., Baltimore, D and Darnell, J. 2000. Molecular Cell
Biology (4thed). W. H. Freeman and Company. New York ,USA.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nded). Springer Verlag, New York,
USA.
8. Nobel, P.S.1999. Physicochemical and Environmental Plant Physiology (2nd ed). Academic Press, Diego,
USA.
9. Salisbury, F.B. and Ross, C.W.1992: Plant Physiology (4thed). Wadsworth Publishing Co., California, USA.

SEMESTER-II
Practicals
PLANT BIOCHEMISTRY

Suggested Laboratory Exercise:

1. pH measurements and preparation of buffers.
2. Determination of saponification number of lipids.
3. Estimation of amino acids.
4. Separation and identification of sugars and amino acids by chromatography.
5. Determination of amylase, peroxidase, catalase activity using spectrophotometer.
6. To study the effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. phosphatase, nitrate reductase).
7. To study the effect of substrate concentration on activity of enzyme and determination of its Km value.
8. Determination of succinate dehydrogenase activity, its kinetics and sensitivity tinhibitors.
9. To determine the total carbohydrate content in the given sample.
10. Estimation of Pectic Substances-gravitic mthod.
11. To prove Beer-Lambert's law using a suitable solution.
12. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophyll and carotenoids.
13. Preparation of standard curve of protein (BSA) and estimation of protein content in extracts of plant material by Lowry's or Bradford's method.
14. Preparation of Leaf Protein Concentrates from green vegetables.
15. Determination of reducing sugars by Nelson – Somogyi Method.

Suggested Laboratory Readings:

1. Bajracharya, D. 1999.Experiments in Plant Physiology: A Laboratory Manual. NarosaPublishing House, New Delhi.
2. Cooper, T.G. 1977.Tools in Biochemistry. John Wiley, New York, USA.
3. Copeland, R.A. 1996**.** Enzymes: A Practical Introduction to Structure, Mechanism andData Analysis. VCH Publishers,
New York.

4. Dennison C. 1999.A guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht, The Netherland.
5. Devi, P. 2000.Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur,
6. Dryer, R. L. and Lata, G. F. 1989.Experimental Biochemistry. Oxford University Press, New York.
7. Hames, B.D.(Ed.).1998.Gel Electrophoresis of Proteins: A Practical Approach, 8thedition. PAS, Oxford University
Press, Oxford, UK.
8. Harborne, T.C. 1981.Phytochemical Methods: A Guide to Modern Techniques of Plants Analysis. Chapman& Hall,
London.
9. Moore, T.C. 1974.Research Experiences in Plant Physiology: A Laboratory Manual.Springer-Verlag, Berlin.
10. Ninfa, A. J. and Ballou, D. P. 1998.Fundamental Laboratory Approaches forBiochemistry and Biotechnology.
Fitzgerald Science Press, Inc., Maryland, USA.
11. Plummer, D.F. 1988. An Introduction to Practical Biochemistry. Tata McGraw-HillPublishing Co. Ltd., New Delhi.
12. Scott, R.P.W. 1995.Techniques and Practice of Chromatography. Marcel Dekker, Inc.,New York.
13. Wilson, K. and Goulding, K.H.(Eds), 1986.A Biologists Guide to Principles andTechniques of Practical Biochemistry.
Edward Arnold, London,UK.
14. Wilson, K. and Walker, J. 1994.Practical Biochemistry: Principles and Techniques, 4th edition. Cambridge University
Press, Cambridge, UK.
15. Sadasivam and Manikum: Biochemical Methos , New Age International (p) Limited Publishers 4835/24, Ansari Road,
Daryaganj, New Delhi- 110002
16. Physiology Chemistry, Oser.B.L.Hawks, 1965. TATA McGrew Hill.
17. Laboratory manual in biochemistry, Strolve, B.L.A., Mzka vora, V.C., 1989. MIR Publisher, Moscow.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
(2T3): paper VII: Plant Metabolism and Development (PMD)

Unit I

Plant-water relations: Properties of water, diffusion, diffusion pressure deficit and its significance; Osmosis: Concept, types, osmotic potential and its significance; Imbibition: concept and significance
Water conduction through xylem: Root pressure theory, cohesion-adhesion theory; transpiration; stomatal opening mechanism with reference to K+-malate hypothesis
Phloem transport: Munch hypothesis

Unit II

Mineral nutrition: Role and deficiency symptoms of macro- and micro- nutrients (N, P, Fe, Mn, B, Ca); Solute transport: passive (Donnan's equilibrium), active (carrier concept)
Respiration: Structure of ATP, types (aerobic and anaerobic respiration), respiratory substrates and Respiration quotient, glycolysis, Kreb's cycle, oxidative phosphorylation (ETS), chemiosmotic potential theory; fermentation (alcohol and lactic acid), photorespiration

Unit III

Photosynthesis: concept, definition, significance, photosynthetic pigments and their role, action spectra, Emerson's enhancement effect, red drop mechanism; photolysis of water (Hill's reaction), cyclic and non-cyclic photophosphorylation, Light independent reactions: C3, C4 and CAM pathways and their

significance; factors affecting photosynthesis
Nitrogen metabolism: Mechanism of biological nitrogen fixation, importance of nitrate reductase

Unit IV

Phytochromes: Pr and Pfr forms, their role, Circadian rhythms and biological clock
Plant growth regulators: Role of auxin, cytokinins, gibberilins, ABA and ethylene
Plant movements: Tropic and nastic movements
Photoperiodism: physiology of flowering, photoperiodism and vernalization, role of florigen
Senescence and abscission
Seed dormancy: Causes and role, methods to break seed dormancy
Plant defence: Definition: Hypersensitive response and Systemic acquired resistance; Role of secondary metabolites (Terpenes and phenolic compounds)

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Buchanan, B. B., Gruissem, W. and Jones, R.L. 1989. Biochemistry and Molecular Biology of plants. American Society of Plant Physiologists, Maryland, USA. 24
2. Dennis, D.T., Turpin, D. H., Lefebvrc, D.D. and Layzell, D.B. (eds).1997. Plant Metabolism (2nd Ed.)
Longman, Essex, England.
3. Gaiston, A.W.1989. Life Processes in Plants. Scientific American Library, Springer- Verlag, New York,
USA.
4. Hooykass P.J.J., Hall, M. A. and Libbenga, K.R.(eds).1999. Biochemistry and Molecular Biology of plant
Horm. Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Lodish, H., Berk, A., Zipursky S.L., Matsudaira, P., Baltimore, D and Darnell, J. 2000. Molecular Cell
Biology (4thed). W. H. Freeman and Company. New York ,USA.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nded). Springer Verlag, New York,
USA.
8. Nobel, P.S.1999. Physicochemical and Environmental Plant Physiology (2nd ed). Academic Press, Diego,
USA.
9. Salisbury, F.B. and Ross, C.W.1992: Plant Physiology (4thed). Wadsworth Publishing Co., California, USA.
10. Singhal G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee.1999: Cocepts in Photobiol Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L. and Zeiger, E. 1998: Plant Physiology. Sinaucr Associates, Inc., Publishers, Massachus, USA.
12. Thomas,B. and Vince-Prue,D.1997: Photoperiodism in Plants (2nd ed). Academic Press,San Diego, USA.
13. Westhoff, P.1998: Molecular Plant Development: From gene to plant. Oxford University Press, Oxford, UK.
14. Dey, P. M. And Harborne, J. B. 2000: Plant Biochemistry ,Harcourt Asia PTE Ltd. A
15. Harcourt Publishers International Company, 583 Orchard Road 09-01 Forum Singapore 238884
16. Ranjan, purohit, Prasad 2003: Plant Hormones Action and Application,
17. Agrobios(India), agro house, behind Nasrani cinema Chopasani Road, Jodhpur -34
18. Fosket, D.E. 1994. Plant Growth and Development.A molecular Approach. Academic Press, San Diego.
19. Howell, S.H. 1998, Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
20. Lyndon, R.F., 1990. Plant Development.The Cellular Basis. Unnin Hyman, London.
21. Murphy, T.M. and Thompson, W.F. 1988. Molecular Plant Development. Prentice Hall, New Jersey.

SEMESTER-II

Practicals

PLANT METABOLISM AND DEVELOPMENT

Suggested Laboratory Exercise:

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determine water potential of given tissue by weight method and falling drop method.
3. Study of the effect of various environmental factors on transpiration in an excised twig/leaf.
4. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophyte.
5. Study of the mechanism of stomatal opening and closing
6. Bolting experiment / Avena coleoptiles bioassay.
7. Study of seed dormancy and methods to break seed dormancy.
8. Detection of the presence of plant enzymes amylase, catalase, nitrate reductase urease (in vivo) in various sources.
9. To study properties (thermolability, proteinaceous nature and specificity) of any one of the enzymes (catalase/urease).
10. To study the effect of various factors (concentration, temperature, pH, inhibitor) on the activity of catalase enzyme.
11. Demonstration of dye reduction by isolated chloroplasts.
12. Study the effect of different factors on O2evolution during photosynthesis and demonstrate the law of limiting factors.
13. Chemical separation of chloroplast pigments and determination of their absorption spectra.
14. To extract anthocyanin pigments and study the effect of pH on their absorption spectra.
15. Study of the rate of aerobic respiration and respiratory quotient in different plant parts/materials.
16. Identification tests for carbohydrates (Fehling's test, Benedict test) and proteins (Ninhydrin test, Xanthoproteic test).

Suggested Laboratory Readings:

1. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
2. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th
3. Conn, E.E., Stumpf, P.K. and Bruening, G. (2006) Outlines of Biochemistry, 4th
4. Elliot (2009) Biochemistry and Molecular Biology. Oxford Publishers.
5. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th
6. Taiz, L. and Zeiger, E. (2006) Plant Physiology, 4 Edition, WH Freeman and Company, New York, USA.
7. Dennis, D.T., Layzell, D.B., Lefebre, D.D. and Turpin, D.H. (1997) Plant Metabolism. Addison Wesley Longman.

Edition Sinauer Associates Inc. Publishers, Massachusetts, USA

8. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
9. Kaul RP (2009) Plant Metabolism. Swastik Publishers and Distributors.
10. Fosket, D.E. 1994. Plant Growth and Development.A molecular Approach. Academic Press, San Diego.
11. Howell, S.H. 1998, Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
12. Leins, P., Tucker, S.C. and Endress, P.K. 1988. Aspects of Floral Development. J. Cramer, Germany.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
(2T4): paper VIII: Medicinal Plant Biotechnology (MPB)

UNIT-I

Scope and Definitions, Plant genome organization, structural features of a representative plant gene. Organization of chloroplast genome and mitochondrial genome - Plant genetic diversity - variation allozyme, RFLP and RAPD techniques - A general account of IBPGR and NBPGR.

UNIT-II

Cell and tissue culture - plant tissue culture media, plant hormones and growth regulators in tissue culture, preparation of suitable explants - Immunodiagnostics and molecular diagnostics in selection of elite plant species - Callus culture, suspension cultures, embryo culture; anther, pollen and ovary cultures. Micropropagation of plants - somatic embryogenesis, protoplast culture, somatic hybridization and synthetic seeds.

UNIT-III

Symbiotic nitrogen fixation in legumes by rhizobia - biochemistry and molecular biology; Agrobacterium and crown gall tumours - mechanism of T-DNA transfer to plants - Ti plasmid vectors for plant transformation - Agroinfection - molecular biology of plant stress response (stress genes).

UNIT-IV

Genetic engineering in plants, selectable markers, reporter genes and promoters used in plant vectors - direct transformation of plants by physical methods.

Application of DNA technology - transgenic plants with reference to virus and pest resistances - herbicidal resistance - stress tolerance (heat & salt) - cytoplasmic male sterility - resistance to fungi and bacteria - delay of fruit ripening - secondary metabolite production.

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. andStormo, G. D. 2008 Current Protocols in Bioinformatics, John-Wiley and SonsPublications, New York.
2. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to theanalysis of genes and proteins. John-Wiley and Sons Publications, New York.
3. Brown, T. A. 1999. Genomes, John Wiley &Sons(Asia) Pvt. Ltd., Singapore.
4. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology andPlant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
5. Chrispeeels, M. J. and Sadava, D. E. 1994, Plants, Genes and Agriculture. Jones &Barlett Publishers, Boston, USA.
6. Glazer, A. N. and Nikaido, H. 1995. Microbial Biotechnology. W. H. Freeman &Company, New York, USA.
7. Gustafson, R. J. 2000. Genomes. Kluwer Academic Plenum Publishers, New York,USA.
8. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman &Hall, London, UK.
9. Jain, S. M., Sopory, S. K. and Veilleux, R.E. 1996. *In vitro* Haploid Production inHigher Plants, Vols. 1-5, Fundamental Aspects and Methods. Kluwer AcademicPublishers, Dordrecht, The Netherlands.
10. Jolles, O. and Jornvall, H. (eds) 2000. Proteomics in Functional Genomics.Birkhauser Verlag, Basel, Switzerland.
11. Kartha, K. K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, BocaRaton, Florida USA.
12. Kingsman, S. M. Genetic Engineering : An Introduction to Gene Analysis andExploitation in Eukaryotes, Blackwell Scientific Publications, Oxford, 1998
13. Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub.New Delhi
14. Old, R. W. and Primrose, S. B. 1989. Principles of Genome Analysis. BlackwellScientific Publications. Oxford, UK.
15. Primrose, S. B.1995. Principles of Genome Analysis. Blackwell Scientific Ltd.,Oxford, UK.
16. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge UniversityPress, New York, USA.

17. Watson, J. , Tooze and Kurtz Recombinant DNA: A short course
18. Biotechnology and Plant Improvement Dr. Arun K. Zingare 978-81-921419-5-4, Satyam, 2013
19. Plant Genetics, Biotechnology and Microbiology Vol. I & II Dr. Arun K. Zingare 978-93-82664-04-8,
Satyam , 2014

SEMESTER-II
Practicals
MEDICINAL PLANT BIOTECHNOLOGY

Suggested Laboratory Exercise:

1. Tissue culture methodsa)
Preparation of Media,
b) Sterilization Techniques,
c) Inoculation of Explants,
d) Callus Culture,
e) Suspension Cultures,
f) Anther Cultures.
g) Surface sterilization of the given seeds/explants.
2. Isolation of protoplasts, viability test for protoplasts & protoplast culture.
3. Protoplast fusion for somatic hybrid production.
4. Working gel documentation system and analysis of electrophoretic gels.
5. Growth characteristics of *E.coli* using plating and turbidimetric methods.
6. Isolation of plasmid from *E.coli* and its quantification.
7. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
8. Cloning of a DNA fragment in a plasmid vector
9. Bacterial transformation and selection of transformed cells.
10. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.

Suggested Laboratory Readings:

1. Plant molecular biology, Grierson and S.N. Convey, l988. Blackie
2. Genetic engineering of crop plants, G.W. Lycett and D. Grierson (Eds.), l990.
3. Plants, Genes and Agriculture, M. J. Chrispeeds and D.F. Sadava, l994. Jones and Barlettt.
4. Molecular Biotechnology - Principles and Applications in Recombinant DNA, Glick and Paster mark, 2002. Panima Publishing Co-operation.
5. Molecular cloning- a lab manual, Manites Vol I-III.
6. Biotechnology - V, Rajeshwari S. Setty and G. R. Veena, 2003. New age International Publishers (p) Ltd., New Delhi.
7. Genetic engineering of plants, Kosuage, T. and Meredit, C.P., 1989. Hollaender Plenum Press.
8. Conservation and genetic resources, Virchow, D., l998. Springer Verlag, Berlin.
9. Molecular plant development from gene to plant, Pester Westhoff.
10. Molecular genetics of plant development, Howell, S. H.
11. Methods in Plant molecular biology. A laboratory course manual by (Ed.) Oak Nakuga, l995. Cold spring Harbour Laboratory Press.
12. Plant Genetic Transformation and Gene expression, (Eds.) J. Draper et al., l988. Blackwell scientific publications, Oxford.
13. Plant molecular biology. Manual, S.B. Gelvin, R.A. Sehil Peroort and D.P.S. Verma (Eds.), 1991. Kluwer Academic Publishers, Doredrect.

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER – II
Practical –III

Time: 6 hours. Full Marks: 100
Q. 1 Onequestion from Sr. No 1-6 of Core-5 15
Q. 2 Onequestion from Sr. No 7-11 of Core-5 15
Q. 3 Onequestion from Sr. No 1-8 of Core-6 15
Q. 4 Onequestion from Sr. No 9-15 of Core-6 15
Q. 5 Spotting (2 spots from each core) 20
Q. 6 Viva-voce 10
Q. 7 Practical Record 10

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER- II
Practical –IV

Time: 6 hours. Full Marks: 100
Q. 1 Onequestion from Sr. No 1-8 of Core-7 15
Q. 2 Onequestion from Sr. No 9-16 of Core-7 15
Q. 3 Onequestion from Sr. No 1-5 of Core-8 15
Q. 4 Onequestion from Sr. No 6-10 of Core-8 15
Q. 5 Spotting (2 spots from each core) 20
Q. 6 Viva-voce 10
Q. 7 Practical Record 10

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-III
(3T1): paper IX: Immunology and Microbiology (IMM)

UNIT-I: - Overview of the Immune system and CMI
Cells involved in Immune system: Hematopoiesis, Lymphocytes, mononuclear phagocytes, Antigenpresenting cells, Granulocytes.
Lymphoid organ: Lymphatic system, Primary and Secondary lymphoid organs.
Complement System: Pathways of complement activation, regulation of complement system,Biological functions of complement system.
Inflammation: Intracellular cell adhesion molecules, Mechanism of cell migration, Inflammation.Pathways of antigen processing and presentation.
UNIT-II: -
Cell Mediated Immunity: General properties of effector T cells, Cytotoxic T Cells ,Natural Killercells, Antibody-Dependent cell mediated cytotoxicity. T-Cell dependent and T-cell independentdefense mechanisms.
Cancer and the Immune system: Origin and Terminology ,Malignant Transformation of cells,oncogenes and cancer induction, Tumor Antigens, Immune surveillance theory, Tumor evasion of theImmune system, Cancer Immunotherapy.
Unit-III
Introduction to the scope of microbiology, Structure of bacterial cell,Classification of microbes and their taxonomy. Actinomycetes bacteria, rickettsiae,spirochetes and viruses.Identification of Microbes : Stains and types of staining techniques, electronmicroscope.Nutrition, cultivation, isolation of bacteria, actinomycetes, fungi, viruses, etc.Microbial genetics and variation.
Unit-IV
Control of microbes by physical and chemical methods.
a) Disinfection, factors influencing disinfectants, dynamics of disinfection,disinfectants and antiseptics

and their evaluation.
b) Sterilization, different methods, validation of sterilization methods &experiments.
Sterility testing of all Pharmaceutical products.Immunity, primary and secondary, defensive mechanisms of body, microbialresistance, interferon.
Microbial assays of antibiotics, Vitamins (Vitamin B12 & Niacin), amino acids.Diseases and diseaseproducing
microorganisms, like Staphylococcus aureus,Streptococcus pyrogenes, E. coli, Sulmonella typhi, Vibrio choleri and Yersiniapestis; virulence factors.

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Pelczar, T.B.of Microbiology.
2. R.Y. Steiner, General microbiology.
3. Zudykandal, Essential and application of microbiology.
4. Waxman S.A., Actionomycocytes.
5. Bhojwani SS, plant tissue culture: applications and limitations(edtion 1990).
6. Bhojwani SS and Rajdan MK (1983), plant tissue culture theory and practice.
7. Lewin R.(1988), Automated plant tissue culture for mass propagation, Biotechnology.
8. Street HE, (1977), plant cell and tissue culture, Balckwell, London.
9. Vasil IK (1986), cell culture and somatic cell genetics of plants, vol 1,2,3.
10. Ananthanarayan and Paniker, (2009), ―Textbook of Microbiology□, 8th Edition. Universal Press
11. Cedric Mims et al, ― Medical Microbiology□, 3rd Edition Mosby
12. Prescott, Harley, Klein, ―Microbiology□,. 6th Edition McGraw Hill
13 Konemann, ―Diagnostic Microbiology□, 5th and 6th Edition. Lippincott
14 Teri Shors Jones ―Understanding Viruses□ Bartlett Publishers
15. Richard A. Goldsby, Janis Kuby, ―Immunology□, , 6th and 7th Edition. W. H. Freeman and company.
16. Fahim Halim Khan, ―The elements of Immunology□,.Pearson Education.
17. Pathak, S., Palan U, ―Immunology Essential and Fundamental□ ,2nd Edition. Capital Publishing company
18. Ian R. Tizard, ―Immunology, An Introduction□, 4th - Edition, Saunders college publishing
19. Microbiology and Plant Pathology Dr. Arun K. Zingare 978-81-921419-4-7, Satyam , 2013

SEMESTER-III
Practicals
IMMUNOLOGY& MICROBIOLOGY

Suggested Laboratory Exercise:

A. Immunology Experiments

Precipitation reactions of antigen-antibody:

1. Immunoelectrophoresis
2. Rocket immunoelectrophoresis
3. Single and Double diffusion techniques

Agglutination techniques:

4. Preparation of O and H antigen of *Salmonella* and its testing using known antisera,
5. Titre determination of isoantibodies to human blood group antigens;

ELISA

6. ***Blood grouping***
7. ***Pregnancy test.***

B. Microbiology Experiments

1. Isolation, identification and characterization of actinomycetes, halophiles, cyanobacteria, molds andyeast.
2. Gram staining of bacteria.
3. Bioassay and Chemical estimation of penicillin

4. Aseptic techniques
5. Media preparation
6. Culture techniques
7. Microbial Assay of Antibiotics
8. Estimation of antimicrobial activity using standard guidelines (NCCLS/CLSA)
9. Study of plant virus diseases: Collecting data and samples,

Suggested Laboratory Readings:

1. Christian Barnett, Alan Smith, Bernard Scanlon and Cleanthes J. Israilide, (1998), *Pullulan production by*
Aureobasidium pullulans growing on hydrolysed potato starch waste, Elsevier Science Ltd.
2. Stanbury P.F., Whittaker A., Hall S.J., Principles of Fermentation Technology 2nd Edition.
3. Wilson & Walker, (1995) Practical Biochemistry, Principles & Techniques
4. Plummer David T., (1988), An introduction to practical biochemistry, 3rd Ed., Tata McGraw-Hill Publishing Co. Ltd.
New Delhi, 109-121
5. Talwar G. P. (1983) *Handbook of Immunology*, Vikas Publishing Pvt. Ltd. New Delhi
6. Sambrook J, Fritsch E F, Maniatis T (1989) Molecular cloning – a laboratory Manual 2nd ed. Cold spring harbour NY:
cold spring harbour laboratory press.
7. Ausbel F. M. and Brent R., (1994), Current protocols in Molecular biology, John Wiley & sons Inc, NY

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-III
(3T2): paper X: Herbal Cosmetics (HCT)

Unit I

Cosmetics preparations: Incorporating the herbal extracts in various cosmeticformulations like Skin care preparations (Creams and Lotions), Sunscreens andSunburn applications, Hair care preparations (Hair oils and Hair shampoos) andBeautifying preparations(Lipsticks, Face powders and Nail polish).
Skin care herbs :

a. Lipids : Appricot, Ranolin, Beesay, Olive oil, Seasome oil(Cleansing & emollent)
b. Glycosides : Almond Aloe, Ambiholds, Rhubers, (Emollent &Skin Pigmentation)
c. Alkaloids : Black peper, Vinca, Cinchona, Withania,(Antipimples, Antiallulite)
d. Volatile oils : Chandan Khus, Saffron, Cinnamon, (Fresshers,Pigmentations & perfumes)
e. Tannins : Amla , Netmeg, Tannic acid, Ashoka , Hirda,(Astrigents, Antibacterial)
f. Carbohydrades : Accacia, Agar, Tragacanth, Pectin Sland(Bindes, Golmorner, Emulgents)

Unit II

Standardization of herbs : Importance of standardization (asper WHO guidelines), assessment of Herbal extracts & informulations, methods employed for standardization of herbswith special reformes to industrial methods HPLC, HPTLC ; Flashchromatography, GLC etc.
Aromatherapy : Various Oils used in Aromatherapy with theirSignificance & skin texture.

Unit III

Nomenclature, characteristics & classification, chemicalconstitution, method of isolation & estimation of herbs used for haircare.
Hair grooming :-Apricot, Aloe
Hair growth promoter : Brahmi, Manjistha, Jatamansi,
Hair Tonics : Bawachi, Hibuscus, Amla , Almond oil, Coconut oilOlive oil
Antidandraff : Tulsi, Neem, Wheat Gram Oil, Beturla Pedula.
Hair Colorants :Amala, Heena, Bhringaraja (*Eclipta alba*), Comomite,Safflower (*Carthamus Officinatis*)
Hair cleansing : Ritha, Shikakai, Amla

Unit IV

Fruits & vegetables as hair & skin care : Apple, Apricot, Banona,Barli, Melon, Carrot, Cucumber, honey, lemon, peach, pudina, tomato,Yogurt, tea.Extraction & isolation of active principles of herbs &

theirincorporation in various cosmetics formulations like creams, lotions,powders & other cosmetics, formulations. Production trade & marketfor culinary herbs.

Analysis of herbs : General method of analysis of herbs – Determinationof standard values, qualitative & quantitative estimation of resin &sugars. Chromatographic techniques used in analysis of herbs &their constituents.

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Novel Cosmetic Drug Delivery Systems, by Magdassi and Touitou.
Cosmetics by Sagerin.
2. Perfumes, Cosmetics and Soaps by Poucher.
3. Drug and Cosmetic Act 1940 and rules.
4. Dr. A. Patani: The Drugs and Cosmetics Act 1940, Eastern Book Company, Lucknow.
5. Cosmetic Science and Technology Vol I, II, III by Sagarin.
6. Harry's Cosmetology
7. Theory and Practice of Industrial Pharmacy by Leon Lachman.
8. New Cosmetic Science
9. Indian Herbs by Chopra
10. Wealth of India by CSIR
11. Pharmacognosy Vol I & Vol II by Mohammed Ali
12. Materia medica
13. Herbs useful in dermatological Therapy, Behl P.N.
14. Dian Dinein Buchmans Herbal medicure , Gramercy, publication,company illustrated by Leaven Jarrett
15. Cosmetics Analysis selective methods with techniques by P. Bare.

SEMESTER-III
Practicals
HERBAL COSMETICS

Suggested Laboratory Exercise:

1. Study of Morphological & Microscopic characters of Herbs used in Skincare
2. Study of Morphological and Microscopic characters of various herbs used in hair care.
3. Phytochemical constituents identification & quality control and standardization.
4. Application of various methods for extraction, solvent systems & isolation of active constituents.
5. Study of Various oils used in Aromatherapy with special reference to its applications.
6. Study of various Extraction methods for active constituents from fruits and vegetable.

Suggested Laboratory Readings:

1) Pharmacognosy Vol I & Vol II by Mohammed Ali
2) Materia medica
3) Herbs useful in dermatological Therapy, Behl P.N.
4) Dian Dinein Buchmans Herbal medicure , Gramercy, publication, company illustrated by Leaven Jarrett
5) Wealth of India – C.S.P. Publications
6) The Ayurvedic Encyclopedia.
7) Herbs, Spices, and Medicinal plants Vol I, II, III & IV by Kyle , E. Craker & James E. Simon.
8) T.B. of Pharmacognosy by Trease & Evans
9) Hand Book of herbal products Vol I & II by NIIR Board of Technologist.
10) Pharmacopoeial standards of herbs by Dr. C.R. Karnik.
11) Cosmetics Analysis selective methods with techniques by P. Bare.
12) Pharmacognosy Vol I & II by Mohammed Ali CBS Publications, New Delhi.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-III
(3T3): paper XI: Natural Plant Products & Phytochemistry – I (NPP -I)

UNIT-I:
Extraction:Introduction, definition, factors influencing the choice of extraction,principles of extraction methods, types of extraction (Extraction of Plant drugs byMicrowave assisted techniques (wherever applicable) and their merits and demerits.Selection and Purification of Solvents For Extraction.Methods of isolation,(including industrial methods) purification and characterization ofsome natural products:Starch, Citric acid, Pectin, Sennosides, Phyllanthin, Curcumin, Lemon grass oil, Sandal wood oil , Emitine and Caffeine.

UNIT-II :
Carbohydrates:Introduction, Definition, Classification, Nomencleture, Sources (*Acacia arabica, Anogeissus latifolia,Plantago ovate, Zea mays*importance, Structure , chemistry , structural elucidation of Glucose & Sucrose .
Glycosides:Introduction, Definition, Classification, Nomenclature, Sources (*Cassia angustifolia, Aloe vera, Digitalis purpurea, Panax ginseng, Andrographis paniculata*,), importance,Structure , chemistry , structural elucidation of cardiac glycosides - digoxin, Anthraceneglycosides - Sennosides.
Vitamins:Introduction, Definition, Classification, Nomenclature, Source, importance,Structure , chemistry , structural elucidation of Ascorbic acid.

UNIT-III:
Steroids: Introduction, Definition, Classification, Nomenclature, Source, importance,Structure, chemistry, structural elucidation of cholesterol.
Plant Hormones: Introduction, Definition, Classification, Nomenclature, Source,importance, Structure, chemistry, structural elucidation of Auxins.

UNIT-IV:
Terpenoids: Introduction, Definition, Classification, Nomenclature, Source, importance, Structure, chemistry , structural elucidation of Citral, Menthol and Zingiberene.Isoprene and Special Isoprene rule.
Anti-biotics: Introduction, Definition, Classification, Nomenclature, Source, importance,Structure, chemistry, structural elucidation of Penicillin's.

Suggested Readings:
1. Nakanishi -Natural Products Chemistry, Vol. 1 & Vol. 2
2. Bonner - Plant Biochemistry.
3. Harborne - Comparative Biochemistry of Flavonoids.
4. Wagner - Wolf- New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutic
Activity
5. Sim - Medicinal Plant Glycosides.
6. Sim - Medicinal Plant Alkaloids.
7. Manske- The Alkaloid- Chemistry and Physiology
8. IUPAC - Chemistry of Natural Products - International symposium.
9. Zechmeister - Progress in the Chemistry of Organic Natural Products.
10. Chatwal G. Organic Chemistry ofNatural Products, Vol-I and II, 7th Reprint 1998, Himalaya Publishing
House, Mumbai
11. Indian Herbal Pharmacopoia, Volume I and II-1999, a Joint publication of IDMA and RRL Jannu Tawi.
12. Trease and Evants-Pharmacognosy, 14th Edition, 1997, W. B. Sounders Company, Singapore
13. Wallis, T. E. Textbook of Pharmacognosy, 5th Edition-1997, CBS Publisher
14. Tyler, Brady, Robberts-Pharmacognosy, 8th Edition-1981, K. M. Varghese Company, Mumbai
15. Sim. S. K. Medicinal Plant Alkaoids and Glycosides, 2nd Edition-1966 University of Toronto Press, Toronto.
16. Cultivation and Utilization of Medicinal Plants, Edited by Atal and Kapur, 1982, RRL Jammu Tawi

17. Cultivation and Utilization of Aromatic Plants, Edited by Atal and Kaur, 1982, RRL Jammu Tawi.
18. Harbone J. B. Phytochemical Methods, 3rd Edition-1998 Champan and Hall London
19. Natural products chemistry – Nakanishi Golo
20. Natural products – A Laboratory guide by Raphel Ikhan.
21. Organic Chemistry by I.L. Finar vol.ii
22. Chemistry of Natural Products by K.W. Bentley
23. Pharmacognosy by Trease and Evans, ELBS.
24. Practical Evaluation of Phytopharmaceuticals by K.r. Brain, T.D. Turner.
25. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer International Edn. 1994.
26. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRC Press, New York, 1998.
27. Natural products: A lab guide by Raphael Ikan , 2nd Edition, Academic Press1991.
28. The review of Natural products – Ara Dermarderosia.
29. Modern methods of plant analysis –High performance Liquid chromatography in plant science –H.F.Linskens and J.F.Jacksons.
30. Encyclopedia of Medicinal Flora, Dr. Arun K. Zingare 978-81-921419-1-6, Satyam , 2012
31. Medicinal and Poisonous Plants Dr. Arun K. Zingare 978-93-82664-09-3, Satyam , 2014
32. Handbook of Medicinal Plants Dr. Arun K. Zingare 978-93-82664-03-1, Satyam , 2014

SEMESTER-III

Elective Practicals

NATURAL PLANT PRODUCTS& PHYTOCHEMISTRY – I

Suggested Laboratory Exercise:

1. Chemical tests for Carbohydrates.
2. Chemical tests for Glycosides.
3. Chemical tests for Terpenoids.
4. Chemical tests for Steroids.
5. Study of Medicinal Plants mentioned in theory syllabus, at least TWO from Carbohydrates, Glycosides, Terpenoids.Steroids.
6. Methods of Cultivation, with respect to the Medicinal Plants mentioned in theory syllabus - Sexual method (Seed propagation) &Asexual method (Vegetative Propagation)
7. Study of Soil- Physical & Chemical characteristics, with respect to the Medicinal Plants mentioned in theory syllabus
8. Study of Pests & Pests control, with respect to the Medicinal Plants mentioned in theory syllabus
9. Isolation and characterization of Natural plant products.
10. Phytochemical screening of Natural plant products.

Suggested Laboratory Readings:

1. Cutler, Stephen J.; Cutler, Horace G. (2000). *Biologically active natural products: pharmaceuticals*. CRC Press.
2. Newman DJ, Cragg GM (2007) Natural products as sources of new drugs over the last 25 years. Journal of Natural Products 70, 461-477.
3. Dossey, Aaron (2010). "Insects and their chemical weaponry: New potential for drug discovery". *Natural Product Reports***27**: 1737–1757.
4. Dan Bensky, Steven Clavey, Erich Stoger, and Andrew Gamble (2004) *Chinese Herbal Medicine: Materia Medica, Third Edition*
5. Hernan Garcia, Antonio Sierra, Hilberto Balam, and Jeff Connant (1999) *Wind in the Blood: Mayan Healing & Chinese Medicine*.
6. "The American Society of Pharmacognosy – Story of Taxol".
7. El-Shemy HA, Aboul-Enein AM, Aboul-Enein KM, Fujita K (2007) *Willow Leaves' Extracts Contain Anti-Tumor*

Agents Effective against Three Cell Types.: PLoS ONE.;2:e178
8. G Brahmachari et Al. (2010), Natural Products in Drug Discovery: Impacts and Opportunities—An Assessment.,
9. AJ Giannini, AE Slaby. (1989) Drugs of Abuse. Oradell, NJ, Medical Economics Books,.
10. Dewick, P. M. (2009). Medicinal Natural Products: A Biosynthetic Approach. United Kingdom: John Wiley &
Sons. 335-336.
11. Barbier P, Schneider F (1987). "Syntheses of tetrahydrolipstatin and absolute configuration of tetrahydrolipstatin
and lipstatin". *Helvetica Chimica Acta***70** (1): 196–202.
12. Goodman, Jordan; Walsh, Vivien (2001). *The Story of Taxol: Nature and Politics in the Pursuit of an Anti-Cancer
Drug*. Cambridge University Press. p. 51.
13. Kinghorn, A. D., Chin, Y.-W., & Swanson, S. M. (2009). " *Discovery of Natural Product Anticancer Agents from
Biodiverse"*. Curr Opin Drug Discov Devel*: 189–196.*
14. Siddiqqui A. A. And Seemi siddiqui (2012) Natural Products Chemistry for Sci and Pharmacy Course. Eds. CBS
Publisher.
15. Praveen Kumar (2009) Natural Products: Practical Manual eds. Pharma Books Syndicate.
16. Miechel Verral (2011) Downstream processing of Natural Products. A Practical Handbook.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-III
(3T4): paper XII: Foundation Course 1. Fermentation Technology (FMT)

UNIT-I:- General Principles of Fermentation
Bioreactors: Bioreactor types, immobilized bioreactors, types of fermentation.
Fermentation kinetics and Monods Model:-Growth kinetics and Monod's Model, Substrateacceleratteddeath, specific growth rate ,stringent response, Ntr and Pho system, growth limitingsubstrate, maintenance energy, growth yield and product formation.
Process optimization: factors of optimization, rheology of fermentation fluid, oxygenation, andoxygen transfer kinetics. chemostat, turbidostat.
UNIT-II:- Downstream Processing and scale up.
Downstream processes: types of processing units and systems, Storage and packaging methods.
Scale up; scale down, criteria involved in scale upProductivity, power requirements Basic control theory.
UNIT-III: - Industrial Fermentation Products
Biofuels:-Ethanol, Hydrogen, Methane
Antibiotics:-β-lactum antibiotics (Synthetic penicillin), Streptomycin, Cephalosporin.
Biopreservative: Lactobacillus sakei. Biopolymers:-Xanthan, Polyhydroxyalkanotes.
Thermostable enzymes:-Proteases. Biosurfectants: a comparative account.
UNIT-IV:-Food and Healthcare products
SCP, various types and processes.Carotenoides
Aminoacids:-Lysine, Glutamic acid.
Vitamins:-riboflavin,Vit.B12. Fatty acids (Palmetate, oleate).
Note: Practicals based on above theory syllabus.
Suggested Readings:
1. Stanbury P.F., Whittaker A., Hall S.J., Principles of Fermentation Technology 2ndEdition.
2. Operational Modes of Bioreactors, (1992) BIOTOL series, Butterworths Heinemann.
3. Peppler H. J. and D. Perlman (1970) *Microbial Technology* Volume 1 and 2, Academic Press New York
4. Wiseman A.(1985) *Topics in Enzyme and Fermentation - Biotechnology*, Vol. 1 and 2, John Wiley and Sons,
New York.

5. Industrial MicrobiologyBy:A.H.Patel
6. Industrial MicrobiologyBy:L.E.Casida.
7. Prescott and Dunns Industrial microbiology.By;Gerald Reed.
8. Advances in Applied microbiology.By:D.Pearlman academic press.

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER – III
Practical –V

Time: 6 hours. Full Marks: 100
Q. 1 Onequestion from Sr. No A-1-7 of Core-9 15
Q. 2 Onequestion from Sr. No B-1-9 of Core-9 15
Q. 3 Onequestion from Sr. No 1-3 of Core-10 15
Q. 4 Onequestion from Sr. No 4-6 of Core-10 15
Q. 5 Spotting (2 spots from each core) 20
Q. 6 Viva-voce 10
Q. 7 Practical Record 10

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER- III
Practical –VI (Core Elective-1)

Time: 6 hours. Full Marks: 100
Q. 1 Onequestion from Sr. No 1-4 of Core elective-1 15
Q. 2 Onequestion from Sr. No 5-6 of Core elective-1 15
Q. 3 Onequestion from Sr. No 7-8 of Core elective-1 15
Q. 4 Onequestion from Sr. No 9-10 of Core elective-1 15
Q. 5 Spotting (4 spots from core elective -1) 20
Q. 6 Viva-voce 10
Q. 7 Practical Record 10

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-IV
(4T1): paper XIII: Herbal Drug Technology &Development (HDD)

Unit-I
General methods of extraction, isolation and purification of phytoconstituents
Isolation, identification tests and estimation methods for the following phytoconstituents with special emphasis on HPLC, HPTLC and other advanced techniques
Aloin from Aloes; Vasicine from *Adhatoda vasica*; Andrographolides from *Andrographis paniculata*
Unit-II
Phytochemical study
Definition, occurence, chemistry, isolation, estimation and biogenesis of alkaloids, glycosides,plant phenols, resins, terpenes and terpenoids, phospholipids and steroids
Screening procedures for herbal drugs with current innovations in following therapeutic classes- Antihypertensive; Antioxidant; Antipyretic & anti-inflamatory; Antidiabetic; Anticancer; Antihepatotoxic; Immunomodulatory

Unit-III

General Methods of Processing of Herbs:

Definition, sources, identification and authentification of herbs; Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions; Methods of drying – Natural and artificial drying methods with their merits and demerits.

Methods of Preparation of Extracts:

Principles of extraction and selection of suitable extraction method; Different methods of extraction including maceration, percolation, hot continuous extraction, pilot scale extraction and supercritical fluid extraction with their merits and demerits; Purification and Recovery of Solvents.

Unit-IV

Isolation and Estimation of Phytoconstituents:

Different methods (including industrial) for isolation and estimation of phytoconstituents from the following drugs (with special emphasis on HPLC andHPTLC).

1. Forskoline from Coleus forskoli; 2. Catechins from Green tea; 3.L-Dopa from Mucuna pruriens; 4.Alicin from Garlic; 5.Piperine from Piper nigrum / Piper longum.

Herbal Formulation Development:

Selection of herbal ingredients.

Different dosage forms of herbal drugs.

Evaluation of different dosage forms.

Stability studies of herbal formulations

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. Manske-The Alkaloid- Chemistry and Physiology.
2. Sim - Medicinal Plant Glycosides.
3. Sim - Medicinal Plant Alkaloids.
4. IUPAC - Chemistry of Natural Products - International symposium.
5. Zechmeister - Progress in the Chemistry of Organic Natural Products.
6. Reinhold - Liwschitz - Progress in Phytochemistry.
7. Wagner - Wolf- New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutic Activity
8. Finar- Organic Chemistry.
9. Peach - Tracey - Modern Methods of Plant Analysis.
10. Geissman - Modem Methods of Plant Analysis.
11. Garatt -The Quantitative Analysis of Drugs.
12. Backett - Stenlake - Practical Pharmaceutical Chemistry,
13. Arthur-Symposium on Phytochemistry.
14. Pridham - Swain - Biosynthetic Pathways in Higher Plants.
15. Greenbury - Metabolic Pathways.
16. Margaret - Brain - Secondary Plant Metabolism.
17. Wagner - Horhammer - Pharmacognosy and Phytochemistry
18. Harborne - Comparative Biochemistry of Flavonoids.
19. Lehninger - Principles of Biochemistry,
20. Bonner - Plant Biochemistry.
21. Harborne - Phytochemical Methods.
22. Rosenthaler -The Chemical Investigation of Plants.
23. Cheronis - Organic Functional Group Analysis.
24. Nakanishi -Natural Products Chemistry, Vol. 1 & Vol. 2
25. Screening methods in pharmacology (vol I & II)–R.A. Turner
26. Drug Discovery and Evaluation in Pharmacology assay: Vogel
27. Design and analysis of animal studies in pharmaceutical development, Chow, Shein, Ching.
28. Evaluation of Drug Activity: Pharmacometrics D.R. Laurence
29. Animal and Clinical pharmacologic Techniques in Drug Evaluation-Nodine and Siegler

30. Pharmacology and Toxicology- Kale S.R.
31. Fundamentals of experimental Pharmacology- Ghosh M.N.
32. Handbook of Experimental Pharmacology- Goyal R.K.
33. Handbook of Experimental Pharmacology- Kulkarni S.K.

SEMESTER-IV
Practicals
HERBAL DRUG TECHNOLOGY AND DEVELOPMENT

Suggested Laboratory Exercise:

1. Preparation of Ayurvedic formulation like Asava, Arista, Bhasma, Ghrita and Gutika.
2. General methods of screening of natural products for the following Biological activities.
a. Anti-inflammatory Activity. d. Cardiac Activity.
b.Hypoglycemic. e. Antibacterial Activity.
c. Diuretic.
3. Acute toxicity Study. Determination of LD50 and ED50. General methods of screening of natural products for the following Biological activities.
a. Antifertility Activity.
b. Screening of In-vitro Antioxidant Activity.
c. Antiulcer Activity.
d. Hepatoprotective Activity.
4. Determination of ascorbic acid (vitamin C) by UV spectroscopic method in various herbal formulations.
5. Determination of natural herbal products by UV Spectroscopic method.
6. Preparation of some important extracts by using preliminary Scale Extraction Plant.
7. Isolation and estimation of phytoconstituents by HPTLC.
8. Volatile oil Analysis by Gas chromatography.

Note: One Pharmaceutical industry visits is compulsory for the observation of various processes in industry.

Suggested Laboratory Readings:

1. W.C. Evans, Trease and Evans Pharmacognosy, 15th edition, 2002, W.B. Sounders & Co., London.
2. V.K. Srivastava, K.Kishore, Introduction to chromatography theory & practicals, 1991, S.Chand & Co. Ltd.,
Delhi.
3. A.C.Mottal , Clerk's Isolation & Identification of drugs , 1967, Pharmaceutical Press, London.
4. J.B. Harbone , Phytochemical methods of chemical analysis, 1973, Chapman & Hall, London.
5. B.N.Dhavan& R.C.Srimal, The use of Pharmacological techniques for the evaluation of natural products. CDRI,
Lucknow.
6. C.K. Kokate ,Practical Pharmacognosy ,1988 ,Vallabh Prakashan, Delhi.
7. M.Williamson, David T.Okpako, J.Evans, Selection, Preparation and pharmacological evaluation of plantmaterial.
8. R.D.Chaudhury, Herbal Drug Industry, Eastern Publishers, New Delhi.
9. H. Gerhard Vogel, Drug Discovery & Evaluation, 2nd Edn.2002, Springer-Verlag Berlin Heidelberg New York.
10. Robert A.Turner, Screening Methods in Pharmacology, Elseveir's, London.
11 Herbal Drug Technology by S.S. Agrawal & M. Paridhavi
12 Modern Methods of Plant Analysis by Peach & Tracey
14 Quality control of herbal drugs: an approach to evaluation of botanicals by P. K. Mukherjee.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-IV
(4T2): paper XIV: Drug Standardization and Regulations (DSR)

Unit I

General Introduction:

Definition, source of herbal raw materials, identification, authentication, standardization of medicinal plants as per WHO guidelines & different herbal pharmacopoeias.

Standardizations:

Determination of physical and chemical constants such as extractive values, moisture content, volatile oil content, ash values, bitterness value and foreign matters applicable to the various herbal drugs.

Unit II

Herbal Formulations:

Principle, methods, single herb formulation, poly-herbal formulation & their merits and demerits. Standardization of various herbal formulations Drug Research (Laboratory-based)- Basic knowledge of the following: Drug sources: plant, animal and mineral. Methods of drug identification.

Unit III

Quality control and standardization aspects: Basic knowledge of Pharmacopoeial standards and parameters as set by Ayurvedic Pharmacopoeia of India.

Safety aspects: Protocols for assessing acute, sub-acute and chronic toxicity studies. Familiarization with AYUSH guidelines (Rule 170), CDCSO and OECD guidelines.

Unit IV

Introduction to latest Trends in Drug Discovery and Drug Development

-Brief information on the traditional drug discovery process

-Brief information on the latest trends in the Drug Discovery process through employment of rational approach techniques; anti-sense approach, use of micro and macro-arrays, cell culture based assays, use of concepts of systems biology and network physiology

-Brief introduction to the process of Drug development

Note: Practicals based on above theory syllabus.

Suggested Readings:

1. W.C. Evans, Trease and Evans Pharmacognosy, 15th edition, 2002, W.B. Sounders & Co., London.
2. V.K. Srivastava, K.Kishore, Introduction to chromatography theory & practicals, 1991, S.Chand & Co. Ltd., Delhi.
3. A.C.Mottal , Clerk's Isolation & Identification of drugs , 1967, Pharmaceutical Press, London.
4. J.B. Harbone , Phytochemical methods of chemical analysis, 1973, Chapman & Hall, London.
5. B.N.Dhavan& R.C.Srimal, The use of Pharmacological techniques for the evaluation of natural products. CDRI, Lucknow.
6. C.K. Kokate ,Practical Pharmacognosy ,1988 ,Vallabh Prakashan, Delhi.
7. M.Williamson, David T.Okpako, J.Evans, Selection, Preparation and pharmacological evaluation of plant material.
8. R.D.Chaudhury, Herbal Drug Industry, Eastern Publishers, New Delhi.
9. H. Gerhard Vogel, Drug Discovery & Evaluation, 2nd Edn. 2002, Springer-Verlag Berlin Heidelberg New York.
10. Robert A.Turner, Screening Methods in Pharmacology, Elseveir's, London.
11. Dr.P.Mukherjee, Quality control herbal drugs, 2005,Business Horizons, New Delhi.
12. Forensic Pharmacy by B.S. Kuchekar, A. M. Khadatare and S. C. Jitkar, 6th Ed., Nirali Prakashan
13. Drugs and Cosmetics Laws by Krishnan Arora, Professional Book Publishers, New Delhi
14. Mittal B.M., A Textbook of Forensic Pharmacy, 9th Ed., Vallabh Prakashan
15. James Swarbrick, James C Boylon, Encyclopedia of Pharmaceutical Technology, 2nd Ed. Marcel Dekker Inc.
16. Deshpande S.W., Drugs and Cosmetic Act.1940
17. Bubuarm N.R, Whatever one should know about patent, 2nd Ed., Pharma Book Syndicate
18. Gnarino Richard A, New Drug Approval Process, 3rd Edition, Marcel Dekker Inc

19. Deshpande S.W, Drug and Magic Remedies Act 1954.
20. P. Warayan, Intellectual Property Laws, Eastern Law House.
21. Drug and Cosmetic Act 1940, Eastern Book company by Vijay Malic, 11th Ed. Patents for Medicine, by N. B. Zareri, Indian Drug Manufacturers Association (IDMA)
22. Pharmacy Law and Ethics by Dale and Appelbes, The Pharmaceutical Press, Joy Winfield.
23. Guidelines of various countries like MCA, TGA, ICH.
24. GLP regulation by Alen Hirsch Vol 38 Marcel Decker series.
25. GMP for pharmaceuticals forth edition by S. Willing, J. Stocker Marcel Decker series 1997.

SEMESTER-IV

Practicals

DRUG STANDARDIZATION AND REGULATION

Suggested Laboratory Exercise:

1. Qualitative and Quantitative Microscopic Examination: Microscopic evaluation of powder drugs and their mixtures with adulterants.
2. Exercises based on standardization and quality control of plant drugs.
3. Qualitative and Quantitative Estimation of Phytoconstituents:
4. Determination of phytoconstituents in crude drugs and commercial herbal formulations.
5. Pharmacopoeial evaluation of natural products.
6. Determination of ash values, extractive values, swelling index and foaming index of crude drugs as per WHO Guidelines.
7. Preparation of detailed monograph of at least one plant drug covering Pharmacognosy and Phytochemical investigation with its use in traditional system of medicine.
8. Experiment on raw material standardization, purification of extracts with chromatographic techniques.
9. Isolation of piperine from pepper.
10. Isolation of Hespiridine from orange peel.
11. Isolation & TLC of reserpine from Rauwolfia root.
12. Isolation & TLC of Menthol from mentha oil.
13. Preparation and Evaluation of Herbal formulations.

Suggested Laboratory Readings:

1. W.C. Evans, Trease and Evans Pharmacognosy, 15th edition, 2002, W.B. Sounders & Co., London.
2. V.K. Srivastava, K.Kishore, Introduction to chromatography theory & practicals, 1991, S.Chand & Co. Ltd.,
Delhi.
3. A.C.Mottal , Clerk's Isolation & Identification of drugs , 1967, Pharmaceutical Press, London.
4. J.B. Harbone , Phytochemical methods of chemical analysis, 1973, Chapman & Hall, London.
5. B.N.Dhavan& R.C.Srimal, The use of Pharmacological techniques for the evaluation of natural products.
CDRI, Lucknow.
6. C.K. Kokate ,Practical Pharmacognosy ,1988 ,Vallabh Prakashan, Delhi.
7. M.Williamson, David T.Okpako, J.Evans, Selection, Preparation and pharmacological evaluation of plant
material.
8. R.D.Chaudhury, Herbal Drug Industry, Eastern Publishers, New Delhi.
9. H. Gerhard Vogel, Drug Discovery & Evaluation, 2nd Edn. 2002, Springer-Verlag Berlin Heidelberg New
York.
10. Robert A.Turner, Screening Methods in Pharmacology, Elseveir's, London.
11. Dr.P.Mukherjee, Quality control herbal drugs, 2005,Business Horizons, New Delhi.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)

Semester-IV

(4T3): Elective paper XV: Natural Plant Products & Phytochemistry - II (NPP –II)

UNIT-I:

Natural Pigments: Introduction, Definition, Classification, Nomenclature, Sources (*Lycopersicum esculentum, Bixa orlenata, Indigofera tinctoria, Quercus)*,importance, Structure , chemistry , structural elucidation of Carotene, Lycopene, Bixin ,Chlorophyll, Quercetine and Indigotine.

Purines: Introduction, Definition, Classification, Nomenclature, Source, importance,Structure, chemistry, structural elucidation of Caffeine.

UNIT-II:

Amino acids :Introduction, Definition, Classification , Nomenclature, Source,importance, Preparation and Properties of amino acids.

Peptides: Introduction, Definition, Classification, Synthesis, determination of structureof Peptides.

Proteins: Introduction, Definition, Classification, properties, Sources (*Ananas comosus, Carica papaya, Hordeum disticho*) structure ofProtein, Chemistry of Oxytocin, Thyroxin, Insulin.

UNIT-III:

Alkaloids: Introduction, Definition, Classification, Nomenclature, Sources (*Claviceps purpurea, Rauwolfia serpentina, Vinca rosea, Papaver somniferum, Datura metle, Adhatoda vasica Withania somniferum, Atropa beladona*), importance,Structure, chemistry, structural elucidation of quinine, morphine and atropine.

Lipids (Fixed oils, Fats & Waxes) Introduction, Definition, Classification, Nomenclature, Sources (*Arachis hypogea, Ricinus communis, Linum usitatissimum, Sesamum indicum, Carthamus tinctorius, Helianthus annus, Oryza sativa, Brassica campestris, Pongamia pinnata, Madhuca indica*)

Volatile Oils - Introduction, Definition, Classification, Nomenclature, Sources (*Cinnamonum camphora, Eucalypus globules, Cymbopogon citratus, Mentha piperata, Elettaria cardamom, Citus limon,Ocimum sanctum, Lavendula officinalis, Santalum album, Vetiveria zizanoides*)

UNIT- IV

Drugs containing Tannins-Introduction, Definition, Classification, Nomenclature, Sources (*Terminalia chebula, Terminalia bellerica, Terminalia arjuna,Acacia catechu*)

Drugs containing Resins Introduction, Definition, Classification, Nomenclature, Sources (*Zingiber officinale, Capsicum annum, Curcuma longa, Canabis sativa, Commifera mukul*)

Natural products as markers for new drug discovery:

The Role of natural products as potential new drug discovery.The Role of natural products chemistry in drug discovery.Selection and optimization of lead compounds for further development withsuitable examples.

Suggested Readings:

1. Nakanishi -Natural Products Chemistry, Vol. 1 & Vol. 2
2. Bonner - Plant Biochemistry.
3. Harborne - Comparative Biochemistry of Flavonoids.
4. Wagner - Wolf- New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutic
Activity
5. Sim - Medicinal Plant Glycosides.
6. Sim - Medicinal Plant Alkaloids.
7. Manske- The Alkaloid- Chemistry and Physiology
8. IUPAC - Chemistry of Natural Products - International symposium.
9. Zechmeister - Progress in the Chemistry of Organic Natural Products.
10. Chatwal G. Organic Chemistry ofNatural Products, Vol-I and II, 7th Reprint 1998, Himalaya Publishing
House, Mumbai
11. Indian Herbal Pharmacopoia, Volume I and II-1999, a Joint publication of IDMA and RRL Jannu Tawi.
12. Trease and Evants-Pharmacognosy, 14th Edition, 1997, W. B. Sounders Company, Singapore
13. Wallis, T. E. Textbook of Pharmacognosy, 5th Edition-1997, CBS Publisher
14. Tyler, Brady, Robberts-Pharmacognosy, 8th Edition-1981, K. M. Varghese Company, Mumbai
15. Sim. S. K. Medicinal Plant Alkaoids and Glycosides, 2nd Edition-1966 University of Toronto Press, Toronto.

16. Cultivation and Utilization of Medicinal Plants, Edited by Atal and Kapur, 1982, RRL Jammu Tawi
17. Cultivation and Utilization of Aromatic Plants, Edited by Atal and Kaur, 1982, RRL Jammu Tawi.
18. Harbone J. B. Phytochemical Methods, 3rd Edition-1998 Champan and Hall London
19. Natural products chemistry – Nakanishi Golo
20. Natural products – A Laboratory guide by Raphel Ikhan.
21. Organic Chemistry by I.L. Finar vol.ii
22. Chemistry of Natural Products by K.W. Bentley
23. Pharmacognosy by Trease and Evans, ELBS.
24. Practical Evaluation of Phytopharmaceuticals by K.r. Brain, T.D. Turner.
25. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer International Edn. 1994.
26. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRC Press, New York, 1998.
27. Natural products: A lab guide by Raphael Ikan , 2nd Edition, Academic Press1991.
28. The review of Natural products – Ara Dermarderosia.
29. Modern methods of plant analysis –High performance Liquid chromatography in plant science –H.F.Linskens and J.F.Jacksons
30. Encyclopedia of Medicinal Flora, Dr. Arun K. Zingare 978-81-921419-1-6, Satyam , 2012
31. Medicinal and Poisonous Plants Dr. Arun K. Zingare 978-93-82664-09-3, Satyam , 2014
32. Handbook of Medicinal Plants Dr. Arun K. Zingare 978-93-82664-03-1, Satyam , 2014

SEMESTER-IV

Elective Practical

NATURAL PLANT PRODUCTS& PHYTOCHEMISTRY – II

Suggested Laboratory Exercise

1. Chemical tests for
a) Volatile Oils.
b) Enzymes and proteins.
c) Alkaloids.
d) Resins
e) Tannins
f) Lipids (Oils) Fats & Waxes.
2. Study of Medicinal Plants mentioned in theory syllabus, at least TWO from Lipids, Fats, Waxes, Volatile Oils, Enzymes, Proteins, Alkaloids, Resins and Tannins.
3. Methods of Cultivation, with respect to the Medicinal Plants mentioned in theory syllabus - Sexual method (Seed propagation) &Asexual method (Vegetative Propagation)
4. Study of Soil- Physical & Chemical characteristics, with respect to the Medicinal Plants mentioned in theory syllabus
5. Study of Pests & Pests control, with respect to the Medicinal Plants mentioned in theory syllabus.
6. Isolation and characterization of Natural plant products.
7. Phytochemical screening of Natural plant products.

Suggested Laboratory Readings:

1. Miechel Verral (2011) Downstream processing of Natural Products. A Practical Handbook
2. Cutler, Stephen J.; Cutler, Horace G. (2000). *Biologically active natural products: pharmaceuticals*. CRC Press.
3. Praveen Kumar (2009) Natural Products: Practical Manual eds. Pharma Books Syndicate.
4. Newman DJ, Cragg GM (2007)Natural products as sources of new drugs over the last 25 years. Journal of Natural Products 70, 461-477.
5. Siddiqqui A. A. And Seemi siddiqui (2012) Natural Products Chemistry for Sci and Pharmacy Course. Eds. CBS Publisher.
6. Dossey, Aaron (2010). "Insects and their chemical weaponry: New potential for drug discovery". *Natural Product Reports***27**: 1737–1757.

7. Dan Bensky, Steven Clavey, Erich Stoger, and Andrew Gamble (2004) *Chinese Herbal Medicine: Materia*
Medica, Third Edition
8. Hernan Garcia, Antonio Sierra, Hilberto Balam, and Jeff Connant (1999) *Wind in the Blood: Mayan Healing &*
Chinese Medicine.
9. "The American Society of Pharmacognosy – Story of Taxol".
10. El-Shemy HA, Aboul-Enein AM, Aboul-Enein KM, Fujita K (2007) *Willow Leaves' Extracts Contain Anti-Tumor*
Agents Effective against Three Cell Types.: PLoS ONE.;2:e178
11. G Brahmachari et Al. (2010), Natural Products in Drug Discovery: Impacts and Opportunities—An Assessment.,
12. AJ Giannini, AE Slaby. (1989) Drugs of Abuse. Oradell, NJ, Medical Economics Books,.
13. Dewick, P. M. (2009). Medicinal Natural Products: A Biosynthetic Approach. United Kingdom: John Wiley &
Sons. 335-336.
14. Barbier P, Schneider F (1987). "Syntheses of tetrahydrolipstatin and absolute configuration of tetrahydrolipstatin
and lipstatin". *Helvetica Chimica Acta***70** (1): 196–202.
15. Goodman, Jordan; Walsh, Vivien (2001). *The Story of Taxol: Nature and Politics in the Pursuit of an Anti-Cancer*
Drug. Cambridge University Press. p. 51.
16. Kinghorn, A. D., Chin, Y.-W., & Swanson, S. M. (2009). " *Discovery of Natural Product Anticancer Agents from*
Biodiverse". Curr Opin Drug Discov Devel*: 189–196.*

CBCS Syllabus for M. Sc. (Medicinal Plants)
Semester-IV
(4T4): paper XVI: Foundation Course 2. Ethnobotany (ETH)

UNIT I
Ethnobotany, its scope, interdisciplinary approaches.
Ethnic groups of India : major and minor tribes, life styles of ethnic tribes, conservation practices of biodiversity, taboos and totems.
World centers of Ethnobotany with special reference to India.
UNIT II
Role of Ethnobotany in national priorities, health care and development of cottage industries in India.
History and principles of ayurveda, Homeopathy, Allopathy, Unani and Siddha system of medicines.
A general idea of active principles of plants and plant parts their extraction and preparation of medicines in different systems.
UNIT III
Scope and uses of essential oil from plants as perfumes, cosmetics and as flavoring agents.
Preparation of perfumes from aromatic plants with special reference to the following Lemon grass, Palm-rosa, Mint, Lavender, Rose, Eucalyptus and Vetiver.
UNIT IV
Plants used in medicine with special reference to following.
Adhatoda vasica, Asparagus racemosus, Argemone mexicana, Boerhaavia diffusa, Hollarhina antidysenterica, Tinospora cordifolia Terminalia arjuna, Terminalia bellerica, Terminalia chebula, Pterocarpus marsupium, Eclipta prostrata, Withania sominifera, Rauwolfia serpentina,
Plants used in scarcity, emergency and as supplementary foods by tribals of India.
Suggested Readings:
1. A-Z in Ethnobotany : Dictionary of Words and Whos Who in Indian Ethnobotany : S.K. Jain and Ashok K.

Jain, Deep Publications, 2013, 178 p, col. photographs, ISBN : 9789380702049,
2. Advances in Horticulture : Volume 11: Medicinal & Aromatic Plants : Edited by K.L. Chadha, Malhotra
Publishing House, 2006, Reprint, xl, 935 p, ISBN : 8185048290,
3. An Introduction to Ethnobotany : Definitions Methods New Concepts and Approaches : edited by S.K. Jain and
Ashok K. Jain, Deep Publications, 2013, viii, 250 p, ISBN : 9789380702056,
4. An Introduction to Herbal Medicine in Ethnobotany : Rahat Ali, Vista International Pub House, 2012, 293
p, tables,, ISBN : 9789380239828,
5. Ethnic Plants of India : Used in Cancer Cure -- A Compendium : S.K. Sood, Shipra Parmar and T.N. Lakhanpal, Bishen Singh Mahendra Pal Singh, 2005, vii, 314 p, ISBN : 8121104726,
6. Ethnic Tribes and Medicinal Plants : Edited by Pravin Chandra Trivedi, Pointer Pub, 2010, xii, 264 p, ISBN :
9788171326235,
7. Ethno Medicinal Plants of Manipur North-East India : Thoubal District : Mohd. Habibullah Khan and P.S.
Yadava, Bishen Singh Mahendra Pal Singh, 2014, iii, 295 p, ISBN : 9788121108577,
8. Ethno Medico Botany of Arunachal Pradesh Nishi and Apatani Tribes : M.S. Rawat and S. Chowdhury, BSMPS, 1998, 206 p, col. photographs, maps, ISBN : 8121101530,
9. Ethno-Medicinal Plants of Mizoram : H. Lalramnghinglova, Bishen Singh Mahendra Pal Singh, 2003, xix, 333
p, tables, figs, photographs, boxes, ISBN : 8121102111,
10. Ethno-Medicine in India Vol. II: A Selective Bibliography : Kamal Kant Misra, Mohammad Rehan and Ravindra
K. Gupta, Gyan Publishing House, 2013, 359 p, ISBN : 9788121211895,
11. Ethnobotanical Studies in India : Sanjeev Kumar, Deep Publications, 2014, vi, 353 p, figs, tables, col. & b/w
plates, ISBN : 9789380702063,
12. Ethnobotanical Studies on Trees, Shrubs and Climbers of Himalaya : S.K. Sood, Sanjay K. Sharma, Neelam
Kumar and Harish Kumar, Satish Serial Pub, 2009, xii, 546 p, figs, ISBN : 8189304674,
13. Ethnobotanical Study of a Kumauni Festival "Harela" : Jagdish Chandra, Sudhir Chandra, Kiran Bargali and Y.P.S.
Pangtey, Bishen Singh Mahendra Pal Singh, 2005, iv, 68 p, tables, ISBN : 8121104769,
14. Ethnobotanical Wisdom and Microbial Studies on Medicinal Plants : Edited by D.R. Khanna, Ashutosh Gautam,
R. Bhutiani and Gagan Matta, Daya Publishing, 2011, xii, 390 p, ISBN : 9788170357100,
15. Ethnobotanical Wisdom of Khasis (Hynniew Treps) of Meghalaya : Ayesha Ashraf Ahmed and S.K. Borthakur, Bishen Singh Mahendra Pal Singh, 2005, l, 306 p, photos, ISBN : 8121104343,
16. Ethnobotanical Wisdom of the Tribals in the Palni Hills : S M John Kennedy S J, Daya, 2008, xviii, 254 p, plates,
figs, tables, ISBN : 8170355540,
17. Ethnobotany : Himalayan Region : S.K. Sood, Anjna Kharwal, T.N. Lakhanpal and A.K. Bhatnagar , I.K.
International, 2014 , 640 p, ISBN : 9789382332374,
18. Ethnobotany and Conservation of Plant Diversity in Nepal : Status, Bibliography and Agenda for Sustainable
Management : Ananda Raj Joshi and Kunjani Joshi, Rub Rick, 2005, pbk, viii, 159 p, figs, ISBN : 999463478X,
19. Ethnobotany and Medicinal Plants of India and Nepal (2 Vols-Set) : V. Singh and A.P.
Jain, Scientific, 2003, Reprint, 1006 p, 2 Vols, colour and BW figs, tables, ISBN : 8172333471,
20. Ethnobotany and Medicinal Plants of India and Nepal, Vol. III : Edited by V. Singh, Scientific Pub, 2009, viii, 338

p, figs, tables, 12 plates, maps, ISBN : 8172336035, Ethnobotany of Dadra, Nagar Haveli and Daman (Union
Territories) : P P Sharma & N P Singh, Botanical Survey of India, 2001, vi, 322 p, tables, figs., maps, colour
plates,
21. Ethnobotany of Jalgaon District, Maharashtra : Shubhangi Pawar and D A Patil, Daya, 2008, xii, 568 p, ISBN :
8170355151,
22. Ethnobotany of Mysore and Coorg, Karnataka State : Rajendra D Kshirsagar and N P Singh, Bishen Singh
Mahendra Pal Singh Pub, 2007, xxxii, 300 p, tables, photos, ISBN : 8121105781,
23. Ethnobotany of Nasik District, Maharashtra : M V Patil and D A Patil, Daya, 2006, x, 420 p, plates, ISBN :
8170354382,
24. Ethnobotany of Nepal : Keshab R. Rajbhandari, EthnoBotanical Sciences/anical Soc of Nepal, 2001, xiv, 189
p, ISBN : 9993334804,
25. Ethnobotany of Religious Practices in Kumaun (Havan) : Balwant Kumar; Sudhir Chandra; Kiran Bargali and Y P
S Pangtey, Bishen Singh Mahendra Pal Singh, 2007, vi, 138 p, figs, ISBN : 8121105811,
26. Ethnobotany of Rewalsar Himalaya : S.K. Sood and Smriti Thakur, Deep and Deep, 2004, vi, 388 p, ills, ISBN :
8185622108,
27. Ethnobotany of Rice Weeds in South Asia : Edited by R.A. Raju, Today Tomorrow's, 1999, Aspect of Plant
Science Vol. 16, 235 p, figs, ISBN : 8170194326,

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)
SEMESTER – IV
Practical –VII

Time: 6 hours. Full Marks: 100

Q. 1 Onequestion from Sr. No 1-3 of Core-11 10
Q. 2 Onequestion from Sr. No 4-8 of Core-11 10
Q. 3 Onequestion from Sr. No 1-6 of Core-12 10
Q. 4 Onequestion from Sr. No 7-13 of Core-12 10
Q. 5 One question from Sr. No 1-3 of Corel elective-2 10
Q. 6 One question from Sr. No 4-7 of Corel elective-2 10
Q. 7 Spotting (1 spots from each core) 15
Q. 8 Viva-voce 15
Q. 9 Practical Record 10

CBCS PATTERN SYLLABUS :M. Sc. (MEDICINAL PLANTS)
SEMESTER- IV
PROJECT

Full Marks: 100