CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)

Semester- I
Core 1. Indian System of Medicines (ISM)
Core 2. Systematics of Plants (SOP)
Core 3. Cell and Molecular Biology (CMB)
Core 4. Modern Analytical Techniques (MAT)
Practical Practical I & II (Question Paper)

Semester – II
Core 5. Fundamentals of Pharmacognosy (FOP)
Core 6. Plant Biochemistry (PBC)
Core 7. Plant Metabolism and Development (PMD)
Core 8. Medicinal Plant Biotechnology (MPB)
Practical Practical III & IV (Question Paper)

Semester – III
Core 9. Immunology and Microbiology (IMM)
Core 10. Herbal Cosmetics (HCT)
Core Elective 1. Natural Plant Products & Phytochemistry – I (NPP -I)
Or
Core Elective 1. Forensic and Industrial Botany - I
Foundation Course 1. Fermentation Technology (FMT)
OR
Core Subject Centric Cultivation and Utilization of Medicinal Plants
Practical Practical V & VI (Question Paper)

Semester – IV
Core 11. Herbal Drug Technology & Development (HDD)
Core 12. Drug Standardization and Regulations (DSR)
Core Elective 2. Natural Plant Products & Phytochemistry - II (NPP –II)
Or
Core Elective 2. Forensic and Industrial Botany -II
Foundation Course 2. Ethnobotany (ETH)
OR
Core Subject Centric Cultivation and Utilization of Aromatic Plants
Practical Practical VII (Question Paper)& Project

Theory Question Paper Pattern

Note: Scheme of Examination, pattern of question paper and pattern of practical examination along with project is adopted as per CBCS pattern of other M. Sc. Courses run by RTM Nagpur University, Nagpur.
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-operative Pharmacy and Stores Ltd, IMPCOPS.
5. Siddha Pharmacopoeia by Dr. S. Chidambarathanu Pillai, 1st edition.
6. Unani Pharmacopoeia.
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.
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).

Suggested Laboratory Readings.

1. Ayurvedic Pharmacopoeia.
2. Ayurvedic Formulary of India, the Indian Medical Practitioners Co-operative Pharmacy and Stores Ltd, IMPCOPS.
5. Siddha Pharmacopoeia by Dr. S. Chidambarathan pillai, 1st edition.
6. Unani Pharmacopoeia.
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.
CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-I
Core – 2
SYSTEMATICS OF PLANTS

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.


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 (Monocot): Liliaceae, Poaceae, Orchidaceae.

Note: Practicals based on above theory syllabus.
Suggested Readings

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.

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-I
Core –3
CELL AND MOLECULAR BIOLOGY

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; comparison with gap junction.
Cellular organelles: Ultra-structure and function of golgi complex, lysosomes, peroxisomes, endoplasmic reticulum, mitochondria, chloroplast and plant vacuoles.

UNIT-II
Cell shape and motility: The cytoskeleton; organization and role of microtubules and microfilaments; motor movements, implications in flagellar & other movements, cell division.
Protein sorting: Machinery involved, vesicles, coat proteins; protein targeting to plastids, 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 dependent kinases; 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:
SEMESTER-I
Core – 3 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 SDS PAGE
7. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis, visualization by ethidium bromide staining.
8. To study in vitro transcription.
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.
MODERN ANALYTICAL TECHNIQUES

Unit - I

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:

12. Modern Methods of Pharmaceutical Analysis, Vol 1,2,RE Schirmer,Franklin Book
14. Indian Pharmacopoeia
15. British Pharmacopoeia
16. U.S. Pharmacopoeia
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.
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.

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)

SEMESTER– I

Practical –I

Time: 6 hours.  
Full Marks: 100

Q. 1 One question from Sr. No 1-3 of Core-1  
Q. 2 One question from Sr. No 4-6 of Core-1  
Q. 3 One question from Sr. No 1-7 of Core-2  
Q. 4 One question from Sr. No 8-15 of Core-2  
Q. 5 Spotting (2 spots from each core)  
Q. 6 Viva-voce  
Q. 7 Practical Record

Q. 1 One question from Sr. No 1-3 of Core-3  
Q. 2 One question from Sr. No 8-13 of Core-3  
Q. 3 One question from Sr. No 1-5 of Core-4  
Q. 4 One question from Sr. No 6-11 of Core-4  
Q. 5 Spotting (2 spots from each core)  
Q. 6 Viva-voce  
Q. 7 Practical Record
CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
Core –5
FUNDAMENTALS OF PHARMACOGNOSY

Unit I
Definition, history and scope of pharmacognosy including indigenous system of medicine.
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, chemical constituents
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 efficacy of 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) Antidyseptics – 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:

4. Indian Pharmacopoeia, 1996, Govt. of India, Ministry of Health and family welfare, 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.
13. CSIR - Cultivation and Utilization of Medicinal Plants.
15. CSIR - Wealth of India, Raw Materials.
19. WHO guide lines for the quality control of Herbal plant materials.
20. The Practical evaluation of phytopharmaceutical by brain & turner.
23. Indian Pharmacopoeia, Indian Herbal Pharmacopoea and other pharmacopoeia.
SEMESTER-II
Core – 5 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, Cinnamon 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.
10. Herbal Drug technology by SS Agrawal and M Paridhavi, Orient Longman
17. Neutraceuticals by Lisa Rapport and Brain Lockwood.
CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
Core – 6
PLANT BIOCHEMISTRY

Unit I
Biochemical organisation of the cell and transport processes across cell membrane. The concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance. Introduction to 3D structure of protein, stability and denaturation of protein, allosteric proteins.

Unit-II

Unit-III
Lipids Metabolism: Oxidation of fatty acids, α-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 in oxidation reduction & its control, The respiratory chain, its role in energy capture and its control, Energetic of oxidative phosphorylation, Inhibitors of respiratory chain and oxidative phosphorylation, Mechanism of oxidative phosphorylation.

Note: Practicals based on above theory syllabus.
Suggested Readings:

SEMESTER-II
Core – 6 Practicals
PLANT BIOCHEMISTRY

Suggested Laboratory Exercise:
1. pH measurements and preparation of buffers.
2. Determination of saponification number of lipids.
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 to inhibitors.
9. To determine the total carbohydrate content in the given sample.
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.

Suggested Laboratory Readings:
15. Sadasivam and Manikum: Biochemical Methos, New Age International (p) Limited Publishers 4835/24, Ansari Road, Daryaganj, New Delhi- 110002
17. Laboratory manual in biochemistry, Strove, B.L.A., Mzka vora, V.C., 1989. MIR Publisher, Moscow.
CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-II
Core –7
PLANT METABOLISM AND DEVELOPMENT

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:

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 Chopardani Road, Jodhpur -34
SEMESTER-II
Core – 7 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
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.
12. Study the effect of different factors on O₂ evolution 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:

MEDICINAL PLANT BIOTECHNOLOGY

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:

17. Watson, J., Tooze and Kurtz Recombinant DNA: A short course
Suggested Laboratory Exercise:
1. Tissue culture methods-
   a) 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.
10. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.

Suggested Laboratory Readings:
5. Molecular cloning - a lab manual, Mntes Vol I-III.
9. Molecular plant development from gene to plant, Pester Westhoff.
10. Molecular genetics of plant development, Howell, S. H.
CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)

SEMESTER – II

Practical –III

Time: 6 hours. Full Marks: 100

Q. 1 One question from Sr. No 1-6 of Core-5 15
Q. 2 One question from Sr. No 7-11 of Core-5 15
Q. 3 One question from Sr. No 1-8 of Core-6 15
Q. 4 One question 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 One question from Sr. No 1-8 of Core-7 15
Q. 2 One question from Sr. No 9-16 of Core-7 15
Q. 3 One question from Sr. No 1-5 of Core-8 15
Q. 4 One question 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  
Core –9  
IMMUNOLOGY & MICROBIOLOGY

UNIT-I: - Overview of the Immune system and CMI  
**Cells involved in Immune system:** Hematopoiesis, Lymphocytes, mononuclear phagocytes, Antigen-presenting 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 independent defense 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 the Immune 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, microbial resistance, interferon.  
Microbial assays of antibiotics, Vitamins (Vitamin B12 & Niacin), amino acids. Diseases and disease-producing microorganisms, like Staphylococcus aureus, Streptococcus pyrogenes, E. coli, Salmonella typhi, Vibrio cholera and Yersinia pestis; virulence factors.  

Note: Practicals based on above theory syllabus.
Suggested Readings:

1. Pelczar, T.B.of Microbiology.
9. Vasil IK (1986), cell culture and somatic cell genetics of plants, vol 1,2,3.
    Universal Press
    Freeman and company.
16. Fahim Halim Khan, “The elements of Immunology”, Pearson Education.
    Publishing company
    publishing
19. Microbiology and Plant Pathology Dr. Arun K. Zingare 978-81-921419-4-7, Satyam , 2013
SEMESTER-III
Core – 9 Practicals
IMMUNOLOGY & MICROBIOLOGY

Suggested Laboratory Exercise:

A. Immunology Experiments

Precipitation reactions of antigen-antibody:
1. Immunelectrophoresis
2. Rocket immunelectrophoresis
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

B. Microbiology Experiments
1. Isolation, identification and characterization of actinomycetes, halophiles, cyanobacteria, molds and yeast.
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:

UNIT I
Cosmetics preparations: Incorporating the herbal extracts in various cosmetic formulations like Skin care preparations (Creams and Lotions), Sunscreens and Sunburn applications, Hair care preparations (Hair oils and Hair shampoos) and Beautifying preparations (Lipsticks, Face powders and Nail polish).

Skin care herbs:
- **Lipids**: Apricot, Ranolin, Beesay, Olive oil, Seasome oil (Cleansing & emollent)
- **Glycosides**: Almond Aloe, Ambiholds, Rhubers, (Emollent & Skin Pigmentation)
- **Alkaloids**: Black peper, Vinca, Cinchona, Withania, (Antipimples, Antiallulite)
- **Volatile oils**: Chandan Khus, Saffron, Cinnamon, (Fresshers, Pigmentations & perfumes)
- **Tannins**: Amla, Netmeg, Tannic acid, Ashoka, Hirda, (Astringents, Antibacterial)
- **Carbohydrades**: Accacia, Agar, Tragacanth, Pectin Sland (Bindes, Golmorner, Emulgents)

UNIT II
Standardization of herbs: Importance of standardization (as per WHO guidelines), assessment of Herbal extracts & formulations, methods employed for standardization of herbs with special reforms to industrial methods HPLC, HPTLC; Flash chromatography, GLC etc.

Aromatherapy: Various Oils used in Aromatherapy with their Significance & skin texture.

UNIT III
Nomenclature, characteristics & classification, chemical constitution, method of isolation & estimation of herbs used for haircare.

Hair grooming: - Apricot, Aloe

Hair growth promoter: Brahmi, Manjistha, Jatamansi,

Hair Tonics: Bawachi, Hibiscus, Amla, Almond oil, Coconut oil, Olive oil

Antidandruff: 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, Banana, Barli, Melon, Carrot, Cucumber, honey, lemon, peach, pudina, tomato, Yogurt, tea. Extraction & isolation of active principles of herbs & their incorporation in various cosmetics formulations like creams, lotions, powders & other cosmetics, formulations. Production trade & market for culinary herbs.


Note: Practicals based on above theory syllabus.
Suggested Readings:

2. Perfumes, Cosmetics and Soaps by Poucher.
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.
SEASON-III
Core – 10 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.
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.
CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-III
Core – Elective 1
NATURAL PLANT PRODUCTS& PHYTOCHEMISTRY – I

UNIT-I:

Extraction: Introduction, definition, factors influencing the choice of extraction, principles of extraction methods, types of extraction (Extraction of Plant drugs by Microwave 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 of some natural products: Starch, Citric acid, Pectin, Sennosides, Phyllanthin, Curcumin, Lemon grass oil, Sandal wood oil, Emiteine and Caffeine.

UNIT-II:

Carbohydrates: Introduction, Definition, Classification, Nomenclature, Sources (Acacia arabica, Anogeissus latifolia, Plantago ovata, 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.
7. Manske- The Alkaloid- Chemistry and Physiology
8. IUPAC - Chemistry of Natural Products - International symposium.
19. Natural products chemistry – Nakanishi Golo
20. Natural products – A Laboratory guide by Raphel Ikhan.
22. Chemistry of Natural Products by K.W. Bentley
23. Pharmacognosy by Trease and Evans, ELBS.
28. The review of Natural products – Ara Dermarderosia.
30. Encyclopedia of Medicinal Flora, Dr. Arun K. Zingare 978-81-921419-1-6, Satyam , 2012
31. Medicinal and Poisonous Plants Dr. Arun K. Zingare978-93-82664-09-3, Satyam , 2014
32. Handbook of Medicinal Plants Dr. Arun K. Zingare 978-93-82664-03-1, Satyam , 2014
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.

Suggested Laboratory Readings:

8. G Brahmacahi et Al. (2010), Natural Products in Drug Discovery: Impacts and Opportunities—An Assessment.,
SEMESTER-III
Core – Elective 1

Forensic and Industrial Botany-I (Elective-I)

CREDIT: I – DEVELOPMENTAL GROWTH OF FORENSIC SCIENCE: Introduction to Forensic science – nature, need and function Laws and Principles, basics of Forensic Science Historical development and scope of Forensic Science in India

Forensic Botany: Introduction, types, location, collection evaluation and forensic significance of fungi and plants in forensic science, wood and pollen grains,


Methods of identification and comparison of various types of planktons and diatoms and their forensic importance; Limnology, Diatoms types and morphology, methods of isolation from different tissues. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc.; Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material.

Study of Various types of Poisonous Plants. Identification of wood-physical properties, colour, fluorescence, hardness, weight, odour, lustre, texture, anatomical features, pore/vessel distribution, size and arrangement, pore numbers, pore arrangements, inclusions, colored deposits, etc.

CREDIT: III: Other Biological Evidences: Identification of Food stuffs & their stains: Plants used as food, animals used as food. Examination of plant foods (starch, herbs, spices & flavorings, fruits, vegetables).


CREDIT: IV: Study of Analysis of Beverages: Introduction, Definition of alcohol and illicit liquor, Alcoholic and nonalcoholic beverages and their composition, Proof spirit, absorption, de-toxication and excretions of alcohol, problems in alcohol cases and difficulties in diagnosis, Alcohol and prohibition, Consequences of drunken driving, Analytical techniques in the analysis of alcohol and other articles. Case study.
References

1. A vision for the twenty first century Select Publisher, New Delhi.
2. Compute Crime and Computer Forensic by Dr. R.K. Tiwari
3. Crime Scene Management with Special Emphasis on National level Crime Cases by Dr. Rukmani Krishnamurthy under publishing
4. Crime Scene Processing and Laboratory Work Book by Patric Jones
8. Forensic Biology by Shrikant H. Lade
11. Forensic Science: An Introduction to Scientific and Investigative Techniques 3rd ed. by Stuart H. James
14. Handbook of Forensic Psychology by Dr. Veerraghavan
15. Henry Lee’s Crime Scene Handbook by Henry C Lee
17. Introduction to Forensic Science in Crime Investigation By Dr.(Mrs.) Rukmani Krishnamurthy
19. Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology by Parikh C.K.
20. The Identification of Firearms and Forensic ballistics by Barrard and Gerald
UNIT-I: General Principles of Fermentation
Bioreactors: Bioreactor types, immobilized bioreactors, types of fermentation.
Process optimization: factors of optimization, rheology of fermentation fluid, oxygenation, and oxygen 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 up
Productivity, power requirements Basic control theory.

UNIT-III: Industrial Fermentation Products
Biofuels: Ethanol, Hydrogen, Methane
Antibiotics: ß-lactum antibiotics (Synthetic penicillin), Streptomycin, Cephalosporin.

UNIT-IV: Food and Healthcare products
SCP, various types and processes. Carotenoides
Aminoacids: Lysine, Glutamic acid.

Note: Practicals based on above theory syllabus.

Suggested Readings:
5. Industrial MicrobiologyBy:A.H.Patel
7. Prescott and Dunns Industrial microbiology.By;Gerald Reed.
Semester-III
Foundation Course 1- Core Subject Centric
Cultivation and Utilization of Medicinal Plants

Credit I. Introduction to medicinal plants: Introduction to Medicinally important Plant parts: Fruits, Leaves, Stem and its modifications (underground and aerial), Roots, Study of some medicinally important families with reference to systematic position. Diagnostic features and medicinal uses only: Meliaceae, Myrtaceae, Apiaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Euphorbiaceae, Zingiberaceae, Musaceae and Poaceae.

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

Credit II. Medicinal plant cultivation


Credit III. Medicinal plants and Resource Management:

a) Concept, Medicinal resources, biological resources, plants as natural resources

b) Management practices - need and methods

c) Utilization –uses of medicinal plants (Aloe vera,Ashwagandha, Daruhaldi,. Isapgol, Brahmi, Kalmegh. Shankhpushpi Tulsi. and turmeric)

Credit IV. Quality control for medicinal plants: QUALITY ASSUARANCE:- Concept of quality control, quality assurance & total quality controls. Sources of variation, Quality control of raw materials & pharmaceutical process & finished products. Documentation concepts of statistical quality control. Validation of pharmaceutical process (at least one case study of a process & analytical method.)

Contribution of national research laboratories (CDRI, CIMAP,RRC,AND NBRI) in medicinal plants research
Reference:

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)

SEMESTER – III

Practical – V

Time: 6 hours. Full Marks: 100

<table>
<thead>
<tr>
<th>Q.</th>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1</td>
<td>One question from Sr. No A-1-7 of Core-9</td>
<td>15</td>
</tr>
<tr>
<td>Q. 2</td>
<td>One question from Sr. No B-1-9 of Core-9</td>
<td>15</td>
</tr>
<tr>
<td>Q. 3</td>
<td>One question from Sr. No 1-3 of Core-10</td>
<td>15</td>
</tr>
<tr>
<td>Q. 4</td>
<td>One question from Sr. No 4-6 of Core-10</td>
<td>15</td>
</tr>
<tr>
<td>Q. 5</td>
<td>Spotting (2 spots from each core)</td>
<td>20</td>
</tr>
<tr>
<td>Q. 6</td>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>Q. 7</td>
<td>Practical Record</td>
<td>10</td>
</tr>
</tbody>
</table>

CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)

SEMESTER- III

Practical – VI (Core Elective-1)

Time: 6 hours. Full Marks: 100

<table>
<thead>
<tr>
<th>Q.</th>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. 1</td>
<td>One question from Sr. No 1-4 of Core elective-1</td>
<td>15</td>
</tr>
<tr>
<td>Q. 2</td>
<td>One question from Sr. No 5-6 of Core elective-1</td>
<td>15</td>
</tr>
<tr>
<td>Q. 3</td>
<td>One question from Sr. No 7-8 of Core elective-1</td>
<td>15</td>
</tr>
<tr>
<td>Q. 4</td>
<td>One question from Sr. No 9-10 of Core elective-1</td>
<td>15</td>
</tr>
<tr>
<td>Q. 5</td>
<td>Spotting (4 spots from core elective -1)</td>
<td>20</td>
</tr>
<tr>
<td>Q. 6</td>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>Q. 7</td>
<td>Practical Record</td>
<td>10</td>
</tr>
</tbody>
</table>
CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-IV
Core –11
HERBAL DRUG TECHNOLOGY & DEVELOPMENT

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, occurrence, 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-inflammatory; Antidiabetic; Anticancer; Antihepatotoxic; Immunomodulatory

Unit-III
General Methods of Processing of Herbs:
Definition, sources, identification and authentication 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 and HPTLC).
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:

2. Sim - *Medicinal Plant Glycosides.*
4. IUPAC - *Chemistry of Natural Products - International symposium.*
5. Zechmeister - *Progress in the Chemistry of Organic Natural Products.*
7. Wagner - Wolf - *New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutic Activity*
12. Backett - Stenlake - *Practical Pharmaceutical Chemistry,*
16. Margaret - Brain - *Secondary Plant Metabolism.*
17. Wagner - Horhammer - *Pharmacognosy and Phytochemistry*
19. Lehninger - *Principles of Biochemistry,*
25. Screening methods in pharmacology (vol I & II) – R.A. Turner
27. Design and analysis of animal studies in pharmaceutical development, Chow, Shein, Ching.
29. Animal and Clinical pharmacologic Techniques in Drug Evaluation-Nodine and Siegler
30. Pharmacology and Toxicology- Kale S.R.
32. Handbook of Experimental Pharmacology- Goyal R.K.
33. Handbook of Experimental Pharmacology- Kulkarni S.K.
SEMESTER-IV
Core – 11 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.  
   b. Hypoglycemic.  
   c. Diuretic.  
   d. Cardiac Activity.
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:

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  
Core –12  
DRUG STANDARDIZATION AND REGULATIONS

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.  

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:

16. Deshpande S.W., Drugs and Cosmetic Act 1940
17. Bubuarm N.R, Whatever one should know about patent, 2nd Ed., Pharma Book Syndicate
23. Guidelines of various countries like MCA, TGA, ICH.
24. GLP regulation by Alen Hirsch Vol 38 Marcel Decker series.
SEMESTER-IV
Core – 12 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 Hesperidin from orange peel.
11. Isolation & TLC of reserpine from Rauwolfia root.
12. Isolation & TLC of Menthol from mentha oil.

Suggested Laboratory Readings:

CBCS Pattern Syllabus for M. Sc. (Medicinal Plants)
Semester-IV
Core Elective 2
NATURAL PLANT PRODUCTS & PHYTOCHEMISTRY - 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.
Proteins: Introduction, Definition, Classification, properties, Sources (Ananas comosus, Carica papaya, Hordeum disticho) structure of Protein, 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 (Cinnamomum camphora, Eucalyps globules, Cymbopogon citratus, Mentha piperata, Elettaria cardamom, Citrus 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 with suitable 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.
7. Manske - The Alkaloid - Chemistry and Physiology
8. IUPAC - Chemistry of Natural Products - International symposium.
19. Natural products chemistry – Nakanishi Golo
20. Natural products – A Laboratory guide by Raphael Ikhan.
22. Chemistry of Natural Products by K.W. Bentley
23. Pharmacognosy by Trease and Evans, ELBS.
28. The review of Natural products – Ara Dermarderosia.
30. Encyclopedia of Medicinal Flora, Dr. Arun K. Zingare 978-81-921419-1-6, Satyam, 2012
31. Medicinal and Poisonous Plants Dr. Arun K. Zingare978-93-82664-09-3, Satyam, 2014
32. Handbook of Medicinal Plants Dr. Arun K. Zingare 978-93-82664-03-1, Satyam, 2014
SEMESTER-IV
CoreElective 2 - Practicals
NATURAL PLANT PRODUCTS & PHYTOCHEMISTRY – II

Suggested Laboratory Exercise

1. Chemical tests for
   a) Volatile Oils.                  d) Resins
   b) Enzymes and proteins.         e) Tannins
   c) Alkaloids.
   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:

11. G Brahmachari et Al. (2010), Natural Products in Drug Discovery: Impacts and Opportunities—An Assessment.,
SEMESTER-IV
Core Elective 2 -
Forensic and Industrial Botany-II

Credit 1- Entrepreneurship and Management

A. Entrepreneurship

1. Entrepreneur: Concept, characteristics of entrepreneur, types and functions of entrepreneur, difference between entrepreneur and a manager.

2. Entrepreneurship Development Programmes (EDPs) - Need, objectives, course contents and curriculum, phases and evaluation of EDPs, Project Identification and Selection (PIS) - Meaning of project and report, project identification, project selection, contents of project reports, preparation of project report.

3. Institutional Finance to Entrepreneurs- Commercial banks, other financial institutions- IDBI, IFSI, SIDBI, and EXIM Bank Institutional Support to Entrepreneurs - Need of institutional support, institutional support to small entrepreneurs- NSIC, SIDCO, SSIDC, Industrial Estates, NABARD

B. Management

1. The Business – Its Nature and Scope Meaning, characteristics, objectives and scope of business, difference between business and profession, interrelationship between industry, commerce and trade

2. Fundamentals of Management : Meaning, characteristics, difference between management and administration, management process, working capital management, inventory management, human resource management, production and operation management, marketing management. Accounting- need, meaning, objectives, journal, ledger, trial balance, final accounts- profits and loss accounts,

Credit:II- Herbal Technology

1. Introduction, concepts and prospects. 2. Phyto-technology- value addition to biodiversity through chemo prospection. 3. Medicinal mushrooms for healthy life. 4. Natural dyes for cotton and silk industry – Tecomella leaves, Katha and Ravenchi wood, Seeds of Bixa, Babul flowers. 5. Medicinal herbs for dying hair and in cosmetics.

Credit III - Plant Tissue culture

1. Laboratory design, maintenance of plant tissue culture laboratory, sterilization practices in plant tissue culture laboratory.


3. Transporting of ex-agar plantlet, rooting of ex-agar plantlet

4. Economics of micropropagation of banana, sugarcane, Lilium, orchids and Gerbera
Credit IV - Post-Harvest Technology of Fruits

1. General account of tropical and subtropical fruits. a) Introduction. b) World fruit production and contribution to gross domestic product (GDP). c) Global consumption of tropical and subtropical fruits d) International trade in tropical and subtropical fruit

2. Postharvest biology of tropical and subtropical fruits. a) Introduction. b) Diversity in fruit characteristics. c) Maturation and ripening. d) Quality attributes. e) Environmental factors affecting deterioration. f) Biological factors affecting deterioration. g) Pathological disorders and insect infestation. h) Biotechnological approaches for improving quality and postharvest life

3. Preservation and processing of fruits a) Principles of conventional methods of preservation b) Fruit preparation for preservation purposes c) Refrigeration and freezing d) Drying e) Manufacturing and canning of fruit beverages and purees f) Manufacturing of jams and jellies

Reference Books

2. Floriculture in India, Randhawa and Mukhopaddhay
3. Forest and Forestry, K P. Sagreiya, National Book Trust
4. Forest Management in India, Vasant Desai, Himalaya Publications
5. Gardening in India, Bose and Mukherjee, Oxford
6. Handbook of horticulture, ICAR, New Delhi
8. Introductory ornamental horticulture, Arora, Kalyani publishers
10. Post-harvest handling of tropical fruit, B R Champ, E Highley & G I Johnson (eds), Australian Centre for International Agricultural Research Page 62
CBCS Syllabus for M. Sc. (Medicinal Plants)
Semester-IV
Foundation Course - 2
Ethnobotany

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, Hollarthina 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:

7. Ethnobotanical Wisdom of Khasis (Hynniew Treps) of Meghalaya
8. Ethnobotanical Wisdom of the Tribals in the Palni Hills
9. Ethnobotanical Wisdom of the Himalayan Region
14. Ethnobotany of Dadra, Nagar Haveli and Da
15. Ethnobotany of a Kumauni Festival "Harela"
16. Ethnobotanical Studies in India
17. Ethnobotanical Studies on Trees, Shrubs and Climbers of Himalaya
20. Ethnobotany of Rewalsar Himalaya
Semester-IV
Foundation Course - 2Core subjects centric
CULTIVATION AND UTILIZATION OF AROMATIC PLANTS

Credit I: a. Aromatic plants: Introduction to aromatic plants with biological source,
   b. Aromatic plants as important sources of essence
   c. Utilization Status of Aromatic Plants: National and international level
   d. Patenting and IPR

Credit II: Cultivation of Aromatic Plants: Cultivation aromatic plants under Agroforestry systems, Soil and Climate, Field preparation, Propagation: (a) Raising of Nursery (b) Planting, Irrigation, Fertilizer Application, Intercultural, Harvesting and Yield

Studies on botanical features and Cultivation methods of important species of

Mentha, Coriander, Ocimum, Geranium oil, Lemon grass, Citronella, Cumin

Credit III: Chemical constituents of Mentha, Coriander, Clove, Ocimum, Geranium oil, Lemon Grass, Citronella, Cumin, Eucalyptus, Cardamom.

Credit IV: Uses of aromatic plants in

1. Perfume industries
2. Cosmetic industries
3. Folk medicine
4. Ayurvedic Properties
5. Food
References


CBCS PATTERN SYLLABUS
M. Sc. (MEDICINAL PLANTS)

SEMESTER – IV

Practical – VII

Time: 6 hours. Full Marks: 100

Q. 1 One question from Sr. No 1-3 of Core-11 10
Q. 2 One question from Sr. No 4-8 of Core-11 10
Q. 3 One question from Sr. No 1-6 of Core-12 10
Q. 4 One question 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
CBCS PATTERN SYLLABUS
M. Sc. (Medicinal Plants)
THEORY QUESTION PAPER PATTERN

TIME : 03 hrs
MARKS : 80

Note
1. All the Questions are compulsory and carry equal marks.
2. Draw neat and well labelled diagrams wherever necessary.

Que. 1. Long Answer Question. (Unit-I) 16

OR
Write notes on
A) Unit-I 08
B) Unit-I 08

Que. 2. Long Answer Question. (Unit-II) 16

OR
Write notes on
A) Unit-II 08
B) Unit-II 08

Que. 3. Long Answer Question. (Unit-III) 16

OR
Write notes on
A) Unit-III 08
B) Unit-III 08

Que. 4. Long Answer Question. (Unit-IV) 16

OR
Write notes on
A) Unit-IV 08
B) Unit-IV 08

Que. 5. Write short notes on
A) Unit-I 04
B) Unit-II 04
C) Unit-III 04
D) Unit-IV 04