DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Sci./C.B.C. & G.S./P.G. Syll./39/2015

It is hereby inform to all concerned that, the revised Curriculum under **Choice Based Credit and Grading System** submitted by the various Ad-hoc Boards which are run at college level only and recommended by the Dean, Faculty of Science, the Hon'ble Vice-Chancellor has accepted the same on behalf of the Academic Council under Section-14[7] of the Maharashtra Universities Act, 1994 as under :-

[1]	M.Sc. Forensic Science Ist Year, Semester-I & II Progressively
[2]	M.Sc. Electronics Ist & IInd Year, Semester-I to IV Progressively
[3]	M.Sc. Industrial Automation Ist & IInd Year, Semester-I to IV Progressively [Under Innovative Programme of U.G.C.]
[4]	M.Sc. Industrial Chemistry Ist & IInd Year, Semester-I to IV Progressively
[5]	M.Sc. Herbal Technology Ist & IInd Year, Semester-I to IV Progressively [Under Innovative Programme of U.G.C.]
[6]	M.Sc. Biophysics Ist & IInd Year, Semester-I to IV Progressively
[7]	M.Sc. Bioinformatics Ist & IInd Year, Semester-I to IV Progressively
[8]	M.Sc. Plant Breeding & Molecular Genetics Ist & IInd Year, Semester-I to IV Progressively
[9]	M.Sc. Plant Biotechnology Ist & IInd Year, Semester-I to IV Progressively
[10]	M.Sc. Geology Ist & IInd Year, Semester-I to IV Progressively.

This is effective from the Academic Year 2015-16 & onwards as appended herewith.

All concerned are requested to note the contents of the circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus, ★
Aurangabad-431 004. ★
REF.NO.SU/S.S./C.B.C. & G.S. / ★
P.G.Syll./2015/9893-10142 ★
Date:- 20-07-2015. ★
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Director,
Board of College and
University Development.

Copy forwarded with compliments to:-

1] The Principals, affiliated concerned colleges,
Dr. Babasaheb Ambedkar Marathwada University

Copy to :-

1] The Controller of Examinations,
2] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter, Dr. Babasaheb Ambedkar Marathwada University,
3] The Superintendent, [M.Sc. Unit],
4] The Programmer [Computer Unit-1] Examinations,
5] The Programmer [Computer Unit-2] Examinations,
6] The Record Keeper.

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DR. BABASAHEB AMBEDKAR

MARATHWADA UNIVERSITY,

AURANGADAD.

SYLLAUS OF

M.Sc. (HERBAL TECHNOLOGY)

CREDIT BASED GRADING SYSTEM

I to IV Semester

{ Semester – wise }

Under U. G. C. Innovating Programme

{ Effective from 2015-2016 }

Course Structure

100 Credits against 1200 Marks

Choice Based Credit System under Academic Flexibility

M.Sc. HERBAL TECHNOLOGY

Course Credit	Theory / Practical	Paper Title	Total Hours	Marks	Credits Allotted
01	02	03	04	05	06
Semester Ist					
HT-101	Theory	Introduction to herbs	45 Hrs	50	03
HT-102	Theory	Herbal Processing	45 Hrs	50	03
HT-103	Theory	Isolation and Separation Techniques	45 Hrs	50	03
HT-104	Theory	Phytochemistry	45 Hrs	50	03
HT-105	Practical	Based on theory Paper 101 & 102	90 Hrs	50	06
HT-106	Practical	Based on theory Paper 103 & 104	90 Hrs	50	06
Semester IInd					
HT-201	Theory	Herbal Products	45 Hrs	50	03
HT-202	Theory	Herbal Post Harvest Technology	45 Hrs	50	03
HT-203	Theory	Herbal Biotechnology	45 Hrs	50	03
HT-204	Theory	Analytical Techniques	45 Hrs	50	03
HT-205	Practical	Based on theory Paper – 201 & 202	90 Hrs	50	06
HT-206	Practical	Based on theory Paper – 203 & 204	90 Hrs	50	06
Semester IIIrd					
HT-301	Theory	Herbal Trade and IPR	45 Hrs	50	03
HT-302	Theory	Herbal Beverages	45 Hrs	50	03
HT-303	Theory	Herbal Business and Management	45 Hrs	50	03
HT-304	Theory	Pharmacognosy	45 Hrs	50	03
HT-305	Practical	Based on theory Paper – 301 & 302	90 Hrs	50	06
HT-306	Practical	Based on theory Paper – 303 & 304	90 Hrs	50	06
HT-307	Service Course	01) Tissue Culture			03
Semester IVth					
HT-401	Project Work	Project work and Seminar (200 Marks) a) Project work - 150 Marks. (Dissertation -100 Marks and Viva -50 Marks) b) Seminar - 50 Marks.		200	16
HT-402	In- plant Training	a) In- plant Training report – 50 Marks. b) In- plant Training presentation – 50 Marks		100	08

M.Sc. HERBAL TECHNOLOGY

SEMESTER – I

PAPER No. H. T. 101

Credits - 03 **INTRODUCTION TO HERBS (THEORY)** **Marks – 50**

1	**A} Conservation of Herbs :** Ex-situ and in-situ conservation of medicinal plants. **Herbal Cultivation I :** Systematic method of cultivation and post harvest technology of medicinal plants, Cultivation of following plants in India. Lemon grass, Aswagandha, Senna, Ispaghula, Opium, Turmeric and Ginger.	**10 Hrs.**
2	**B} Herbal Cultivation II :** Exogenous and endogenous factors influencing the production of crude drugs, plant growth regulators (Auxins, Gibberelins, Cytokinins, Abscissic acid, Ethylene). Pest and weed control, Disease management of medicinal and aromatic plants. Dietary antioxidants in disease prevention.Neutraceuticals.	**10 Hrs.**
3	**A} Study of medicinal plant parts :** The cell- Definition, structure, morphology, function, cell inclusions. Plant tissue :- Classification, types – i) Meristmatic, ii)Permanent- a) Simple tissues (Epidermis,Parenchyma,Sclerenchyma,Collenchyma,cork) b) Complex tissues : (Xylem, Phloem, Secretory) **B} Crude drugs and its classification :** i) Alphabetic – classification ii) Taxonomic classification. iii) Morphological classification iv) Chemical classification. iv) Pharmacological classification vii) Chemotaxonomic classification.	**10 Hrs.**
4	**Classification and Nomenclature :** Bentham and Hooker's Classification system, Concept of Nomenclature, Plant identification methods Study of some plants from following families : 1) Papaveraceae 2) Brassicaceae 3) Meliaceae 4) Apocynaceae 5) Lamiaceae 6) Verbenaceae 7) Euphorbiaceae 8) Liliaceae.	**15 Hrs**

Reference Books:

1) Cultivation of medicinal plants by C. K. Atal and B.M. Kapoor.

2) Cultivation & Utilization of aromatic plants by C.K. Atal and B.M. Kapoor.

3) Herbal Drug Industry by R.D.Choudhary.1st edition,Eastern Publisher, NewDelhi,1996

4) Text book of pharmacognosy by C.K. Kokate, Purohit Gokhale, 4th edition, Nirali Prakashan, 1996

5) Marine Pharmacognosy ED. By Dean F. Martin & George Padilla.

6) Marine Natural Product – Vol. I to IV

7) Chemical plant Taxonomy by T. Swain.

8) Cultivation of Medicinal and Aromatic Crops by A. A. Farooqui & B.S. Sreeramu.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – I

PAPER No. H. T. 102

Credits - 03 **HERBAL PROCESSING (THEORY)** **Marks – 50**

1	**Particle size analysis :** Particle size measurement Screen analysis – Differential, Cumulative analysis, Screening – Definition, types of Screening equipments – Grizzlies Trommels, constriction and working, Vibrating Screen – Principles and operations, variables in Screening operations, material balances over Screen, effectiveness of Screen, capacity of Screens.	**10 Hrs.**
2	**Handling of solids :** Size reduction equipments- Crushers-Blake jaw crusher Dodge jaw crusher, Gyratary crusher (Principles constriction and working) Smooth Roll crusher,Grinders- Hammer Mill, Ball Mill (Principles constriction and working) comparision of crussing and Grinding operations.Ultra line grinder (Principles constriction and working), Classifing Hammer Mill .	**10 Hrs.**
3	**Equipment for solid handling :** Classification, Gravity settling tank, cone classifier, double cone classifier, mechanical classifier – Rake, spiral cyclone separator, liquid cyclone (hydrocyclone), Jigging-principles and operatons,Hydrolic Jig (Principles constriction and working) Electrostatic and magnetic separators – drum, pulleys,Tabling for shaking, Reffled tables (constriction and working).	**10 Hrs.**
4	**Fluid – solid systems :** Filtration – Definition, principles, types – constant pressure filtration and constant rate filtration, characterstics of filter medium, pressure filter vacuum filter (advantages and disadvantages) Plate and Frame press filter - constriction , working advantages and disadvantages, Rotary drum filter, Leaf filter, Moore filter, Rapid sand filter, pressure sand filter, (constriction , working advantages and disadvantages) centrifuge filtration, suspended batch centrifugal (constriction , working) Sedimentation - Definition, principles, laboratory batch sedimentation test, Thickener..	**15 Hrs.**

Reference Books:

1) Introduction to Chemical Engineering by Badger, Banchero.

2) Chemical Ecgineering by Richardson and Coulson.

3) A Hand Book of Unit Operation by Moketta.

4) Unit Operation in Chemical engineering by McCabe Smith.

5) Unit Operation – I by K. A. Gavhane.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – I

PAPER No. H. T. 103

Credits - 03 ISOLATION AND SEPARATION TECHNIQUES Marks – 50

1	**General techniques of Isolation and Separation :** **A}-Solvent extraction:** Introduction, principle of solvent of extraction, mechanism of solvent extraction, techniques of extraction such as Batch extraction, Stripping or Back extraction, Continuous extraction, counter-current extraction, extraction of solids, applications of solvent extraction. **B}-Distillation :** Introduction, Principle of distillation process, types of distillation, experimental details of simple distillation, steam distillation, fractional distillation, distillation under reduced pressure and vacuum distillation and its applications.	**15 Hrs.**
2	**A}-Chromatography :** Introduction, types of chromatography, theoretical principle underlying chromatographic techniques, Classification of chromatography, theories of chromatography, (Plate theory and Rate theory). **B}-Column chromatography :** Introduction, Principles, Experimental details, theory of development, column efficiency, factors affecting column efficiency and its applications.	**10 Hrs.**
3	**A}-Gas chromatography:** Introduction, principle of gas chromatography, instrumentation, evaluation, retention volume, resolution, branches of gas chromatography, applications, introduction to head space gas chromatography **B}-Ion exchange chromatography:** Introduction, definition, principal, cation and anion exchangers, use of exchange columns, technique and applications	**10 Hrs.**
4	**High Performanance Liquid Chromatography (HPLC) :** Introduction, Principle, instrumentation, apparatus and materials, column packing procedure, chromatography solvent (mobile phase), pumping system, detector system, comparison of high performanance liquid chromatography and gas chromatography, applications.	**10 Hrs.**

Reference Books:

1) Fundamental of Analytical Chemistry by skoog and west.

2) Analytical Chemistry by Gary Chearisten.

3) Analytical Chemistry by Kennedy J. H.

4) Instrumental Methods of chemical analysis by Willara, Merritt, Tean and settle.

5) Analytical Chemistry by Khopkar.

6) Instrumental methods of chemical analysis by Chatwal Anand.

7) Principles and practical of Analytical chemistry by Fifield F. A. & D. Kealey.

8) Modern methods of plant analysis Vol I & II by Peach and M. V. Trecey.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – I

PAPER No. H. T. 104

Credits - 03 **PHYTOCHEMISTRY (THEORY)** **Marks – 50**

1	**Phytochemical study :** a) Introduction, Occurrence, Chemistry, Isolation and chemical tests of the following natural products– Alkaloids, Plant Resins and plant phenol, Terpenes and Terpenoids Steroids and bile acids, Fatty acids, Vitamins, Purines and Pyrimidines, Nucleic acids, Carotenoids, Anthocyanins, Flavones, Lipids and Phospholipids. b) Biogenesis of the natural products Alkaloids, Terpenes and Terpenoids, Steroids, Amino acids.	**15 Hrs.**
2	**Elucidation of Structure of the following phytoconstituents :** Terpenes – Citral, Camphor, Lorvone, a – pinene, Steroids – Cholesterol Alkaloids – nicotine, atropine, morphine, piperine zinziberene and papaverine, Caffine, flavones, vitamin- B_1, vitamin – B_2, vitamin-B_3, penicillin and Cephalosporin, Chlorophyll, α-carotene, β-carotene and amygdalin	**15 Hrs.**
3	**Phyto-pharmaceuticals of the following therapeutic classes :** 1) Anticancer----------*Catharanthus roseus* (Apocynaceae) 2) Hepatoprotective ---------- (Antihepatotoxins) *Zingiber officinale* Zingiberaceae 3) Cardio sascular system ---- *Digitalis purpuria* (Scrophulariceae)- Foxglove leaf 4) Immunomodulator --------- (Immunostimulants) *Echinacea pallida* (Asteraceae) 5) Neuropharmacological --- -*Passiflora incornela* (Passifloraceae) Passion flower or central nervos system----*Papaver sominiferum* (Papaveraceae) – Opium. 6) Antiviral ----------*Allum sativum* (Liliaceae) 7) Urinary disorders ----------*Arctostaphylos uva-ussi* (Ericaceae) - Bearberry 8) Antidiabetic ----------*Momordica charatia* (Cucurbitaceae) – Karela --*Gymnema sylvestris* (Asclepedaceae) 9) Anti-inflammatory ---------*Curcuma domestica* (Zingbiberceae) --*Aloe vera* (Liliaceae	**15 Hrs.**

Reference Books:

1) Phytochemistry – Vol – I to IV Miller Jan Nostrant Renhold.

2) Recent advances in phytochemistry – Vol – I to IV Scikel Runeckles.

3) Introduction to molecular phytochemistry – Paul J. Schewer 1973.

4) Pharmacognosy and phytochemistry of Medicinal plants – Jean Bruneton.

5) Techniques and documentation – Lacoiser, 1995.

6) Organic chemistry of natural products Vol - I & II – Gurdeep R. Chatwal.

7) Organic chemistry Vol. I & II by I. L. Finar.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – I

Practical Syllabus

Paper – H.T. 105

Credits - 06 **Introduction to Herbs** **Marks – 50**

1} Study of herbarium

2} Study of morphological characters of some flowering plants

3} Study of following families

1) Papaveraceae- *Argemone Mexicana*

2) Malavaceae- *Hibiscus rosa – sinensis*

3) Meliaceae- *Azadiracta indica*

4) Cruciferae - *Brassica compestris*

5) Cyperaceae- *Cyperus flabelliformis*

6) Verbenaceae - *Lantana indica*

7) Acanthaceae- *Adhatoda vasica*

8) Labiateae- *Ocimum basilicum*

9) Apocynaceae- *Catharanthus roseus*

10) Asclepiadaceae- *Calotropis procera*

11) Poaceae- *Triticum aestivum*

4} Identification and mounting of pollen grains (Acetolysis method)

5} Identification of plants up to species by using flora (Flora of Bombay, Flora of Marathawada)

6) Students should undertake excursion to ecologically different areas for plant study and Submission of at least 10 wild plants herbarium at the time of examination

7) Study of histo-chemical tests:-

1) Protein 2) Carbohydrates

3) Lipids 4) Starch

5) Cellulose 6) Hemi cellulose

7) Lignin 8) Tannin

8) Study of marine Biomedicals:-

1) Agar 2) Spirulina

3) Shark liver oil 4) Cod liver oil

9) Study of some dry drug materials

1) Clove 2) Ginger

3) Coriander 4) Vasaka

5) Black peper 6) Datura

10) Study of some Dietary Nutrients:-

1) Egg 2) Milk

3) Dietary fibres 4) Soyabean

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M.Sc. HERBAL TECHNOLOGY

SEMESTER – I

Practical Syllabus

Paper H.T. 106

Credits - 06 **Phytochemistry** **Marks – 50**

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1. Separation and Identification of simple phenols by TLC.
2. Detection of phenolic acids and lignins in plant tissue.
3. Detection of scopolin in blight infected potato tuber.
4. Detection of essential oils of umbellifer seeds.
5. Examination of flavonoid aglycones in hydrolysed plant extracts.
6. Isolation and determination of Solanine in potato tissue.
7. Isolation and determination of Berberine from berberis.
8. Separation and identification of the Nicotine from given plant material.
9. Detection of plant pro anthocyanidins.
10. Detection of toxins in walnut and Arctostaphylos.
11. Determination of composition of peanut triglycerides.
12. Extraction and detection of Nucleic acids from cauliflower florets.
13. Determination of triterpenoid in the given seeds.
14. Detection of sugar from given plant material.

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M.Sc. HERBAL TECHNOLOGY

SEMESTER – II

PAPER No. H. T. 201

Credits - 03 **HERBAL PRODUCTS (THEORY)** **Marks – 50**

1	**Internal applicants: -** **A-Churn**- Definition, precautions, advantages, disadvantages, and classification based on size particles, procedure and components of a) Hingwashtaka b) Lavana Bhaskar c) Sitopaladi **B-Kwath**- Definition, classification, based on pharmacotherapeutic effect, procedure and components of a) Rasonadi kwath b) Punarnavashtaka kwath.	**10 Hrs.**
2	**Internal applicants : -** **A-Vati** - a) Sanjivani vati b) Lavangadi vati c) Rasonadi vati. **B- Ksheera Paka**- Procedure and components of a) Arjuna Ksheera Paka b) Rasana Ksheera Paka **C-Tablets** - Definition, classification, Tablet binders, manufacturing methods. a) Wet granulation b) Dry granulation c) Direct compression and d) coating of tablets	**10 Hrs.**
3	**A- Indian systems of medicine**:- a) Agurveda b) Homeopathy c) Yoga d) Unani e) Siddha f) Naturopathy **B- Scope and history of-** a) Pharmacy b) pharmacopoeia c) Pharmacognosy d) Pharmacodynamics	**10 Hrs.**
4	**A-Pharmaceutical instruments:-** a) Grinder b) Granulator c) Mixer- types, classification i) Liquid mixers ii) Solid mixers, iii) semi solid mixers d) Pulvarizer e) Micropulvarizer **B- Internal and external applicants:-** Internal - i) Kalp, Pakk, Asav, Arista, , Arka, Bhasms, Avaleha. External - i) Glycerol, Ointment, Linment, Lotions, Cerates, Poultice	**15 Hrs.**

Reference Books:

1) Pharmaceutics – I by P. V. Kasture, S. R. Parakh.

2) Pharmaceutics – II by G. K. Jani.

3) Dispensing pharmacy by R. M. Mehta.

4) Forensic pharmacy by Dr. B. Suresh.

5) Pharmacognosy by Kokate, Porohit, Gokhale.

6) Pharmacology & Toxicology by Dr. A. V. Yadav.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – II

PAPER No. H. T. 202

Credits - 03 HERBAL POST HARVEST TECHNOLOGY (THEORY) Marks – 50

1	**Post Harvest Technology :** Introduction, definition, principal, history, priorities and strategy, steps, components, potential of income and employment, qualitative and quantitative losses, problems occurring in harvesting, threshing, transport etc	**10 Hrs.**
2	**Herbal Drying :** Principal, importance of drying, Types of drying i) Conduction drying ii) Convection drying iii) Radiation drying a) Sun drying b) Infra-red drying c) Radiation convection drying iv) Mechanical drying v) Chemical drying vi) Vacuum drying vii) Freeze drying. Comparison of conventional and freeze dehydration, effects of parameters on drying – Temperature, Air velocity, Relative humidity, Moisture contents etc. Characterization of drying – High temperature and low temperature.	**10 Hrs.**
3	**Herbal Dryers :** Introduction, Types of dryers - i) Batch dyer ii) Continuous flow-columnar dryer iii) Recirculatory batch dryer – construction, operation, advantages and disadvantages iv) Baffle dryer – constriction, operation, advantages and disadvantages. v) Horizontal rotary dryer – construction, operation, advantages and disadvantages. vi) Spray dryer – Types, operation, advantages and disadvantages vii) Tray dryer, viii) Tray freeze dryer, ix) Accelerated freeze dryer, x) Vacuum dryer xi) Infra-red dryer xii) solar dryer and solar energy utilization. xiii) Solar cabinate dryer, xiv) Sack dryer	**10 Hrs.**
4	**Herbal Packaging and Handling :** Packaging requirement, packaging systems, packaging materials, moisture resistant materials (polyvinyl films, aluminium foil, polythene films), porous packaging materials, moisture proof materials, packaging machines, bagging scales, bag sewing machines, value-pack bags, Handing bags during packaging, Use of scale for weighing, platform scales, bagging scales, and Bagger-weigher (manual, automatic, semi-automatic), Filling of packages and process of packaging. Package labeling and recording, system of identifying lot numbers.	**15 Hrs.**

Reference Books

1) Post Harvest technology by A. Chakraverty.

2) Principles of Agri. Engineering by A. M. Michel, T. P. Ojha.

3) Unit operations of Agri. Processing by K. M. Sahay & K.K. sing.

4) Principle and Practices of Post Harvest Technology by P. H. Pandey.

5) Post Harvest Management of Horticultural Crops by S. Saraswathy.

6) Post harvest Technology and farm Mechanization by Panda S. C.

7) Principles of Post Harvest Seed Physiology and Technology by R. K. Malti.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – II

PAPER No. H. T. 203

Credits - 03 **HERBAL BIOTECHNOLOGY (THEORY)** **Marks – 50**

1	**Genetics and Molecular Biology :** **A}** Nucleic acid- DNA: structure, Chemical composition, replication of DNA, Recombinant DNA technology- principles, tools, applications & advantages. **B}** Nucleic acid- RNA- structure and functions of tRNA, mRNA, rRNA Genetic code- nature, properties and genetic code dictionary.	**10 Hrs.**
2	**Quality improvement of Herbal crops :** **A) Plant Breeding :-** Introduction, definition, history, nature, objectives, activities, types of selection i) Natural ii) Artificial (mass, pure line, clonal) **B) Hybridization :-** Definition, objectives, techniques, and steps i) Selection of parents ii) Isolation iii) Emasculation iv) Bagging v) Collection and storage of pollen vi) Crossing vii) Labeling viii) Releasing	**10 Hrs.**
3	**A) Mutation breeding in crop improvement:-** Definition, classification, types – Spontaneous and induced mutations, causes & practical applications, breeding procedure, effects on survival, limitations and applications **B) Tissue Culture in crop improvement:- a)** Types- cell culture, embryo culture, meristem culture, anther culture. Techniques and applications of callus, suspension, haploid embryo, and organ culture.	**10 Hrs.**
4	**A) Germplasm conservation :-** Introduction, Germplasm material types, Gene pool concept, genetic erosion, gremplasm regeneration, activities of germplasm conservation-1) Collection 2) Conservation (in- situ and Ex- situ) 3) Evaluation 4) Cataloguing 5) Multiplication and distribution 6) Utilization 7) Future activities. **B)** Organogenesis, Embryogenesis, Somaclonal variation, Micro propagation. Protoplast isolation, fusion, selection and culture, Biotransformation, Somatic hybridization	**15 Hrs.**

Reference Books

1) Pharmaceutical Biotechnology by S. D. Vyas and V. K. Dixit.

2) Advanced methods in plant breeding & Biotechnology by David R. Murray.

3) Role of Biotechnology in medicinal plants(Vol –I& II)by Irfan A.Khan, Atiyakhanum.

4) Biotechnology in plant science by N. C. Kumar.

5) Plant Breeding – by B. D. Sing.

6) Plant Tissue Culture by Kalyan kumar Dey.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – II

PAPER No. H. T. 204

Credits - 03 **ANALYTICAL TECHNIQUES (THEORY)** **Marks – 50**

1	**Spectroscopy : UV visible spectroscopy:** Introduction, Principle, mode of electronic transition, terms used in UV spectroscopy, double beam UV – spectrophotometer and its components, types of detectors, woodward-fischer rule, effect of conjugation, solvent effect and their choice, effect of pH, applications of UV and problems.	**10 Hrs.**
2	**Spectroscopy : IR Spectroscopy :** Introduction, theory, Instrumentation, types of molecular vibrations, interpretation of IR spectra, functional group and finger print regions, fundamental vibrations and over tones, selection rule, effect of solvent on frequency group shifts, characteristic absorptions frequencies of various functional groups in organic molecules interpretation of IR spectra of some representative compounds, FTIR spectroscopy.	**10 Hrs.**
3	**NMR Spectroscopy :** **A) Proton magnetic resonance (PMR) Spectroscopy :** .Introduction, Principle, instrumentation chemical shifts, internal standards, shielding and deshielding, an isotropic effect, equivalence and non equivalence protons, spin- spin splitting, multiplicity coupling constant, integration application, interpretation of PMR spectra of some representative compounds, COSY and NOE spectra. **B) 13- Carbon magnetic resonance (CMR) Spectroscopy :** Introduction, Natural abundance, ^{13}C-NMR spectra – a general study, operating frequency, multiplicity, decoupled spectra, complete removal of 13-C-H coupling, off resonance decoupling, chemical shift, Chemical shift equivalence, and DEPT ^{13}C spectra.	**15 Hrs.**
4	**Spectroscopy :** Mass Spectroscopy : Introduction, theory, instrumentation, fragmentation, types of ions and peaks, McLafferty rearrangement, interpretation of mass spectrum, initial examination and confirmation of structures. Some problems pertaining NMR, IR,UV and Mass spectroscopy	**10 Hrs.**

Reference Books

1) Introduction to high performance liquid chromatography by R. J. Hamilton.

2) Pharmaceutical analysis (part – A & B) by J. W. Munsen.

3) Qualitative analysis of drug in Pharmaceutical formulations by P. D. Shethi.

4) Introduction of spectroscopy, IIIrd Edition by Pavia Lampmen kriz.

5) Application of Absorption spectroscopy of organic compounds by J. R. Dyer.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – II

Practical Syllabus

Paper H.T. 205

Credits - 06 **Herbal Products** **Marks – 50**

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1) Preparation of internal applicants from the provided material
   1) Kwath
   2) Syrup
   3) Churn
   4) Watti
   5) Squash
2) Preparation of external applicants from the provided materials
   1) Lotion
   2) Cerates
   3) Poultices
   4) Liniment
   5) Ointments for wounds
   6) Burns
3) To study the standardization techniques
   a) Morphologivcal- Leaf, Flower
   b) Microscopic- Palisade ratio, Stomata, Tricheme
   c) Physical- Ash value, Mositure contents
4) Study of the some crude drugs
   1) Ajowan
   2) Turmeric
   3) Harda
   4) Behra

5) Study of the some laboratory instruments

1) Oven

2) Microscope

3) Auto clove

4) pH meter

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M.Sc. HERBAL TECHNOLOGY

SEMESTER – II

Practical Syllabus

Paper H.T. 206

Credits - 06 **Analytical Techniques** **Marks – 50**

A} UV- Spectrophotometer

1) To study the effect of acid on basic compounds by change in λ-max using UV – Spectrophotometer

2) To study the effect of base on acidic compounds by change in λ-max using UV - Spectrophotometer.

3) To find out the λ-max and absorbance / transmittance of known / unknown Phytochemicals.

4) To determine the strength of strong/ weak acid by using known alkali solution. pH- metrically.

5) To determine the pH of various unknown Phytochemicals.

6) To determine the optical index of optically active Phytochemicals.

B} HPLC- technique

Determine the % purity of various Phytochemicals using HPLC technique.

1) Caffeine

2) Nicotine

3) Camphor

4) Nicotinic acid

5) Terpine

6) and least five unknown phytochemicals.

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M.Sc. HERBAL TECHNOLOGY

SEMESTER – III

PAPER No. H. T. 301

Credits - 03 **HERBAL TRADE AND IPR (THEORY)** **Marks – 50**

1	**Collection and stabilization :** Cultivation practices, Collection, Harvesting, Drying, Dressing (Garbling), Packing, Preservation and forwarding of crude drugs, Detection of adulterants with reference to anatomical features, quality assurance.	**10 Hrs.**
2	**Entrepreneurship development :** Definition, Characteristic and quality of Entrepreneur, concept and types of Entrepreneur, Factors promoting to Entrepreneur, role and functions of Entrepreneur, Social responsibilities of Entrepreneur, Concept of Entrepreneurship, meaning and importance, Characteristics, barriers, origin and development of entrepreneurship in India, sources of finance technical assistance of Entrepreneurship.	**15 Hrs.**
3	**Marketing and advertising :** Legal formalities and provisions, export and import policies with reference to Herbal products and Herbal drugs. **Entrepreneurship development programme (EDP):**-Introduction, needs, objectives EDP, role of Government in EDP	**10 Hrs.**
4	**IPR and Patenting :** **Intellectual Property Right:** Introduction, history, protection, choice of IPR protection, management, benefits and problems from IPR,IPR in developing countries, Indian response to the IPR. **Patent-** Introduction, requirements, limits, procedure. Registration of new products and drugs, Indian patent Acts, US patent Acts and European patent Acts, Regulation, Requirement for filling patent, patent protection and patent servicing, Issues in registering Herbal products / Drugs.	**10 Hrs.**

Reference Books

1) Dynamics of Entrepreneurial Development and Management by Vasant Desai.

2) Towards Entrepreneurship – by Kurup M. R.

3) Entrepreneurship and Small industries – by Boparikar Neeta.

4) Entrepreneurship and Small industries – by Sharma S. K.

5) Agricultural marketing in India – by Acharya Agrawal.

6) Herbal Industries -by Choudhari.

7) Fundamentals of Entrepreneurship – by Sudhir Sevekar.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – III

PAPER No. H. T. 302

Credits - 03 **HERBAL BEVERAGES (THEORY)** **Marks – 50**

1	**Beverages:** Introduction, Scope, types and importance in human diets.	**05 Hrs.**
2	**Non alcoholic beverages :** Derived from tea, coffee and cocoa. Botanical characters, Climate, soil, cultivation, pruning, plucking, withering, rolling, fermentation, Drying, Grading, Sorting, marketing and production of above beverage plants. **Fruit Juices:** Orange, Grape, Mango, Apple, Lemon, Santra, Pine apple, Tomato etc.	**10 Hrs.**
3	**Fermentation :** Introduction, History, component parts and process, large scale techniques and its improvement, process of fermentation. **1) Fermentation by Glycolysis** – role of microorganisms, growth of industrial fermentation, computer application in fermentation technology, approaches for fermentation. **2) Fermentation by Antibiotics: a) Penicillin**: Introduction, chemical nature, Biosynthesis, process, recovery and purification. **b) Streptomycin :** Introduction, medium, process, recovery and purification	**10Hrs.**
4	**Alcoholic beverages I:** **Fermented beverages:** Alcoholic fermentation – Industrial fermentation for alcohol production, enzymes used in fermentation, preparation of ethanol from molasses, barely grains, starch, grapes, mechanism of ethyl alcohol fermentation. **Brewing:** Introduction and process. Wines: classification, chemical composition, types – grape wine, red wine, citrus wine, fruit wine etc.	**10 Hrs.**
5	**Alcoholic beverages II :** **Distilled beverages:** Introduction, effects of alcohol on human body. **1) Rum:** Introduction, composition, production. **2) Glycerol:** Introduction, uses of glycerol. **Processes** – a) Sulphite process b) Cokking lily process.	**10 Hrs.**

Reference Books

1) Fermentation technology – by Tanuja sing, S. S. Porohit.

2) Principles of fermentation technology by P. F. Stanburry, A.Whitekar, S.J.Hall.

3) Industrial Microbiology - by A. H. Rose.

4) Industrial Microbiology – by L. E. Casida.

5) Industrial Microbiology – by Prescott S. C. Dunn C. G.

6) Economic Botany – by S. K. Singh, Seema Srivastava.

7) Economic Botany – by B. P. Pandey.

8) Economic Botany – by V. Verma.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – III

PAPER No. H. T. 303

Credits - 03 HERBAL BUSINESS MANAGEMENT (THEORY) Marks – 50

1	**Farm Management :** **a) Field & Farm Management:** Introduction, Definition, need of the farm management, success of manager, scope of farm management, importance of farm management in India, Contract and Integrated farming. **b) Farm Financial Management:** Introduction, need of financial management, importance and financial management, role of credit in production and marketing, Repayment plan.	**10 Hrs.**
2	**Herbal Business Communication and Management :** Introduction, types, purpose, skills and classification of communication, organization of management, organizational status, principles of organization, functional organization, commandments of organization, strategy and business organization goals, nature, culture, characteristics and categories of organization development, communication networks in organization.	**10 Hrs.**
3	**Herbal Marketing :** Introduction, definition, concept, meaning, scope, components of market, classification and growth of market, factors affecting rate of market growth concept, products and services of business marketing, marketing practices, marketing challenges in 21st century, nature and skills of marketing, marketing planning, advertising and its effects in marketing.	**10 Hrs.**
4	**Policy and Prospects of exports and imports :** Introduction, export – import policy – 1997, Negative list of exports and imports, main feature of export – imports policy – 2002 to 2007, current export – import policy, International trade agreements. Business environment in 21st century, business community industrialization, population growth, Economy, knowledge of customer, political, social, cultural, technical and International environment.	**15 Hrs.**

Reference Books

1) Fundamentals of farm business management – by S. S. Joshi, T. R. Kapoor.

2) Agriculture business management – by Gangadhar Bhatia.

3) Agriculture marketing in India – by S. S. Acharya, N. L. Agrawal.

4) Rural Agriculture and marketing – by S. B. Verma, S. K. Jiloka.

5) Business communication and management – by S. R. Doshi.

6) Marketing and sales management – by S. P. Sharma, D. B. Joshi.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – III

PAPER No. H. T. 304

Credits - 03 **PHARMACOGNOSY (THEORY)** **Marks – 50**

1	Introduction, History of Medicinal and Aromatic Plants (MAPs) and their importance Demand and supply of MAPs in India and world.	**02 Hrs.**
2	Synonyms. Biological source Geographical Source, Cultivation practices, Macroscopic characters, microscopic characters, chemical constituents and uses in respect to following medicinal plants.	
3	**a) Drug containing carbohydrates** 1) Isapgol (*Plantago ovate*) Plantaginaceae. 2) Bael (*Aegle marmelos*) Rutaceae. 3) Acacia (*Acacia Arabica*) Mimosaceae. **b) Drugs containing glycosides** 1) Aloe (*Aloe barbadensis*) Liliaceae. 2) Liquorice (*Glycyrrhiza glabra*) Leguminosae. 3) Shatavari (*Asparagus racemosus*) Liliaceae.	**10 Hrs.**
4	**a) Drugs containing Tannins** 1) Myrobalan (*Terminalia chebula*) Combreatceae. 2) Behda (*Terminalia belerica*) Combretaceae. 3) Arjuna (*Terminalia arjuna*) Combreataceae. **b) Drugs Containing lipids** 1) Castor Oil (*Ricinus communis*) Euphorbiaceae. 2) Linseed Oil (*Linum usitatissimum*) Linaceae. 3) Sesame oil (*Sesamum indicum*) Pedaliaceae.	**10 Hrs.**
5	**Drugs Containing Volatile Oil** 1) Eucalyptus Oil (*Eucalyptus globules*) Myrtaceae. 2) Lemon grass oil (*Cymbopogan martini*) Graminae. 3) Peppermint oil (*Mentha piperita*) Lamiaceae. 4) Coriander (*Coriandrum sativum*) Apiaceae. 5) Cinnamon (*Cinnamomum zeylanicum*) Lauraceae. 6) Tulsi (*Ocimum sanctum*) Lamiaceae. 7) Clove (*Eugenia caryophyllus*) Myrtaceae.	**13 Hrs.**
6	**a) Resins & Resin Combinations** 1) Asafetida (*Ferula Foetida*) Apiaceae. 2) Cannabis (*Cannabis sativa*) Cannbinaceae. 3)Guggal (*Commiphora weightii*) Burseraceae **b) Drugs Containing Alkaloid** 1) Vinca (*Catharanthus roseus*) Apocynaceae. 2) Ashwagandha (*Withania somnifera*) Solanceae. 3) Adulsa (*Adhatoda vasica*) Acanthaceae.	**10 Hrs**

Reference Books

1) Pharmacognosy by Kokate, Purohit, Gokhale.*

2) Pharmacognosy (Vol. I & II) by Mohammad Ali

3) Cultivation of Medicinal Plants by C. K. Atal and B. M. Kapoor.

4) Medicinal Plants of India by S. L. Yoganarasimhan.

5) Cultivation and utilization of Aromatic plants by C. K. Atal and B. M. Kapoor.

6) Pharmacognosy by G. E. Tease and W. C. Evans.

7) Pharmacognosy by Tyler, Brady, Robber.

8) Herbal Drug Technology by S. S. Agrawal and M. Paridhavi.

M.Sc. HERBAL TECHNOLOGY

SEMESTER – III

Practical Syllabus

Paper H.T. 305

Credits - 06 **Herbal Beverages** **Marks – 50**

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1) Preparation of alcoholic beverages from the following materials

   1) Molasses
   2) Barely grains
   3) Starch
   4) Grapes
   5) Sugarcane juice

2) Preparation of non – alcoholic beverages from the following materials

   1) Orange
   2) Grape
   3) Mango
   4) Apple
   5) Tomato
   6) Citrus

3) Identification of adulteration of food /beverages /powders by chemical tests.

   1) Tea
   2) Coffee
   3) Turmeric

4) Study of some antibiotics

   1) Streptomycin
   2) Penicillin

5) Study of some juicy fruits

1) Banana

2) Lemon

3) Santra

4) Mosambi

5) Mango

6) Apple

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M.Sc. HERBAL TECHNOLOGY

SEMESTER – III

Practical Syllabus

Paper H.T. 306

Credits - 06 **Pharmacognosy** **Marks – 50**

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1) Study microscopic and macroscopic characters of the following medicinal drugs.

   1) Root - Vinca, Shatavari.
   2) Leaf - Eucalyptus, Adulsa
   3) Flower - Clove
   4) Fruits - Cardamom, Coriander
   5) Bark - Cinnamon, Cinchona
   6) Rhizome - Ginger, Turmeric

2) Study of stomatal index and palisade ratio of locally available some plants.

   1) Datura
   2) Adulsa
   3) Vinca
   4) Hebiscus
   5) Withania
   6) Ocimum

3) Study of chemical tests of the following plant drugs.

   1) Aloe
   2) Clove
   3) Cinnamon
   4) Datura

4) Study of chemical constituents (drugs) of the following plants.

1) Carbohydrates	- Acacia, Bel
2) Lipids	- Castor, Sesame
3) Glycosides	- Aloe, Shatavari
4) Volatile oils	- Eucalyptus, Clove, Coriander
5) Alkoloids	- Adulsa, Vinca, Ashwagandha

5) Students should undertake excursion to study the different medicinal plants and submit at least 10 medicinal drug containing plants at the time of Examination.

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