।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
ACADEMIC (1-BOARD OF STUDIES) SECTION
Phone: (02462) 229542
Fax : (02462) 229574
Website: www.srtmun.ac.in
E-mail: bos.srtmun@gmail.com

संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे **CBCS Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२०**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

1. M.Sc.-II Year-Botany
2. M.Sc.-II Year-Herbal Medicine
3. M.Sc.-II Year-Analytical Chemistry
4. M.Sc.-II Year-Biochemistry
5. M.Sc.-II Year-Organic Chemistry
6. M.Sc.-II Year-Physical Chemistry
7. M.Sc.-II Year-Computer Management
8. M.Sc.-II Year-Computer Science
9. M.Sc.-II Year-Information Technology
10. M.C.A. (Master of Computer Applications)-II Year
11. M.Sc.-II Year-Software Engineering
12. M.Sc.-II Year-System Administration & Networking
13. M.Sc.-II Year-Dairy Science
14. M.Sc.-II Year-Environmental Science
15. M.Sc.-II Year-Applied Mathematics
16. M.Sc.-II Year-Mathematics
17. M.Sc.-II Year-Microbiology
18. M.Sc.-II Year-Physics
19. M.Sc.-II Year-Zoology
20. M.Sc.-II Year-Biotechnology
21. M.Sc.-II Year-Bioinformatics

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/२०२०–२१/**३३५**

दिनांक : १६.०७.२०२०.

स्वाक्षरित/–
उपकुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR
SEMESTER III & IV
HERBAL MEDICINE
CURRICULUM

JUNE, 2020

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

INTRODUCTION

The SRTMUN is gearing up for several initiatives towards academic excellence, quality improvement and administrative reforms. In view of this priority and in-keeping with Vision and Mission; process was already initiated towards introduction of semester system, grading system and credit system. In the recent past, University had already implemented Credit based grading system to campus schools. Now University is implementing Choice Based Credit System (CBCS) for UG and PG in all the affiliated colleges. These regulations shall be called as Choice Based Course Credit System & Grading, 2014. In short it will be referred as SRTMUN CBCS REGULATION. Further, Revised Guidelines for implementation of CBCS in affiliated college w.e.f. 2019-20 were also issued.

Revision and updating of the curriculum is the continuous process to provide an updated education to the students at large. Presently there is wide diversity in the curriculum of different Indian Universities which inhibited mobility of students in other universities or states. To ensure and have uniform curriculum at UG and PG levels as per the SRTMUN CBCS REGULATION, curriculum of different Indian Universities, syllabus of NET/SET, MPSC, UPSC, forest services, pharmacy, Ayurveda, Homeopathy, Unani medicine and the UGC model curriculum are referred to serve as a base in updating the same.

The M.Sc. Herbal medicine (General) semester pattern course is running in different affiliated colleges of the SRTMUN. The course content has been designed on the basis of CBCS pattern. The course content of each theory paper is divided into units by giving appropriate titles and subtitles. For each unit, total number of periods required, weightage of maximum marks and credits are mentioned. A list of practical exercises for laboratory course work based on theory papers to be completed in the academic year is also given. A list of selected reading material and a common skeleton question paper for all the theory papers of semester-I&II are also provided at the end of the syllabus.

The addition of Discipline Specific Elective Courses which includes Skill Enhancement Courses aims to develop skills in plant sciences and practical experience in the

students.

At the end of the curriculum, the students should have increased: an aptitude towards science and nature and also undertake the fundamental and applied research in herbal Medicine in the benefit of the human and nature.

At last, comments or suggestions are welcome from all the teachers, students and other stakeholders for the upbringing the curriculum.

Salient Features:

The syllabus of M Sc Herbal Medicine has been framed to meet the requirement of Choice Based Credit System. The courses offered will train and orient the students in the specific fields of Herbal Medicine.

Apart from the Fundamental and applied Core Courses, the Discipline Specific Elective Courses deals with Herbal Cosmetics, Regulatory affairs and IPR, Drug Standardization and Validation and Herbal Drug Technology.

Open Elective Courses provides an option to learn courses of their own choice across the Discipline from the other colleges or any other Institute. It also provides the option to learn online Courses of their choice like MOOC-NPTEL-SWAYAM etc.

This would help students to lay a strong foundation in the field of Herbal Medicine.

The courses which deal with the environment, sustainability and ethics are Taxonomy and Anatomy of Medicinal Plants, Cultivation, Properties and Utilization of Medicinal Plants and Natural Plant Products. These courses create awareness about conservation of biodiversity and its relevance with the socio-economical and environmental aspects.

Overall after completion of this course, students will also acquire fundamental knowledge in Herbal Medicine and also understand that Medicinal Plants are an integral part of the human life and developments.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

Program Educational Objectives:

The Objectives of this program are:

PEO-1: To provide an updated education to the students at large in order to know the importance and scope of the discipline and to provide mobility to students from one university or state to other.

PEO-2: To update curriculum by introducing recent advances in the subject and enable the students to face NET, SET, UPSC and other competitive examinations successfully.

PEO-3: To impart knowledge of Herbal medicine as the basic objective of Education

PEO-4: To develop a scientific attitude to make students open minded, critical and curious

PEO-5: To develop an ability to work on their own and to make them fit for the society

PEO-6: To expose the students to contribute in different pharmaceutical industries and research institutes.

PEO-7: To develop skill in practical work, experiments, equipments and laboratory use along with collection and interpretation of herbal products and their utilization.

PEO-8: To make aware of natural resources and environment and the importance of conserving the same.

PEO-9: To develop ability for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient.

PEO-10: To appreciate and apply ethical principles to Herbal medicine research and studies.

Program Outcomes:

PSO-1: This program will train and orient the students for job opportunities in Herbal Medicine

PSO-2: This program will also generate human resource for Phytochemical laboratories, Pharmaceutical industries, Herbal industries and Research in Herbal Medicine.

PSO-3: This program will also generate human resources for medicinal plant sector, Herbal cosmetics.

PSO-4: This program will generate expertise in the field of Medicinal botany.

Prerequisite:

The optional courses are offered to the students registered for post-graduate programs. Such students should have the basic knowledge of Herbal Science and willing to gain additional knowledge in the field of Herbal Medicine.

Admissions to this program are given as per the University rules.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND HERBAL MEDICINE CURRICULUM

Semester-III

An Outline:

Paper number & Title	Credits (Marks)			Periods
	External: ESE	Internal: CA	Total Credits (Marks)	
Theory Paper-XI: Natural Plant Products	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
Theory Paper-XII: Medicinal Plant Biotechnology	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
Theory Paper-XIII: Herbal Drug Technology	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
***Theory Paper-XIV:** Herbal Cosmetics **(Elective)**	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
Theory Paper-XV: Seminar/ MOOCs (SWAYAM/NPTEL)	-	Credit: 01 (Marks:25)	Credits: 01 (Marks:25)	-
Total	Credit: 12 (Marks: 300)	Credit: 05 (Marks:125)	Credits: 17 (Marks:425)	240

(**ESE:** End of semester examination, **CA:** Continuous assessment, ***:** Elective paper)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND HERBAL MEDICINE CURRICULUM

Semester-IV

An Outline:

Paper number & Title	Credits (Marks)			Periods
	External: ESE	Internal: CA	Total Credits (Marks)	
Theory Paper-XVI: Industrial Pharmacognosy	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
Theory Paper-XVII: Herbal Drug Development	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
Theory Paper-XVIII: Drug Standardization and Validation	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
***Theory Paper-XIX:** Regulatory affairs and IPR **(Elective)**	Credit: 03 (Marks:75)	Credit: 01 (Marks:25) (2 Tests: 20 marks, Assignment: 05marks)	Credits: 04 (Marks:100)	60
Theory Paper-XX: Seminar/ MOOCs (SWAYAM/NPTEL)	-	Credit: 01 (Marks:25)	Credits: 01 (Marks:25)	-
Total	Credit: 12 (Marks: 300)	Credit: 05 (Marks:125)	Credits: 17 (Marks:425)	240

(**ESE:** End of semester examination, **CA:** Continuous assessment, ***:** Elective papers)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR HERBAL MEDICINE

LABORATORY COURSE WORK

Annual Pattern

An Outline:

Paper number & Title	Credits (Marks)			Practicals
	External: ESE	Internal: CA	Total Credits (Marks)	
Laboratory Course Work-V: Based on theory paper-XI&XII	Credit: 03 (Marks:75)	Credit: 01 (Marks:25)	Credits: 04 (Marks:100)	15
Laboratory Course Work-VI: Based on theory paper-XIII&XIV	Credit: 03 (Marks:75)	Credit: 01 (Marks:25)	Credits: 04 (Marks:100)	15
Laboratory Course Work-VII: Based on theory paper-XVI XVII XVIII &XIX	Credit: 03 (Marks:75)	Credit: 01 (Marks:25)	Credits: 04 (Marks:100)	15
Laboratory Course Work-VIII: Project Work	Credit: 03 (Marks:75)	Credit: 01 (Marks:25)	Credits: 04 (Marks:100)	15
Total	Credit: 12 (Marks: 300)	Credit: 05 (Marks:125)	Credits: 16 (Marks:425)	60

(**ESE:** End of semester examination, **CA:** Continuous assessment, ***:** Elective paper)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR
SEMESTER – III
HERBAL MEDICINE

JUNE, 2020

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – III

HERBAL MEDICINE

THEORY PAPER-XI: NATURAL PLANT PRODUCTS

Periods: 60 Credits: 04

Learning Objective:

1. To know the various basic and applied aspects of natural plant products
2. To understand the various extraction methods of herbal drugs

Learning Outcome:

1. Learn the methods of isolation and preliminary screening of phytochemicals.
2. Understand the knowledge of various biological enzymes

UNIT I : DRUGS CONTAINING RESINS AND TANNINS (15 periods)

RESINS: Classification General Characteristics and Chemical Composition of Resins,.Biological Source, Geographical Source, Collection, Characteristics, Chemical Constituents, Uses and Marketed Products of Asafoetida, Cannabis, Capsicum, Ginger, Guggul, Turmeric, Jalap and Balsam Of Peru

TANNINS Classification Hydrolysable Tannins Nonhydrolysable or Condensed Tannins Characteristics Of Tannins Biosynthesis Of Tannins

Biological Sources Collection and Preparation Characteristic chemical constituents, Uses, Marketed Products of Myrobalan, Bahera, Arjuna, Amla, Black Catechu.

UNIT-II: DRUGS CONTAINING VOLATILE OILS (15 periods)

General methods of extraction of volatile oils from plants, Study of biological source, chemical constituents, chemical tests and uses of volatile oils of Mentha, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Nutmeg, Chenopodium, Valerian, Musk, Palmarosa, Gaultheria Detailed Pharmacognosy of Clove, Coriander, Fennel, Sandal wood, Cardamom, Cinnamon and Eucalyptus, Natural allergens and photosensitizing agents, Antioxidants from plant origin.

UNIT-III: DRUG GROUPS (15 periods)

General methods of isolation and preliminary phytochemical screening of glycosides. Study of biological source, cultivation, collection, chemical constituents, adulterants, uses, macroscopic, microscopic features and chemical tests of following drug groups : Drug containing Saponin: Liquorices, Ginseng, Dioscorea, Sarsaparilla and Senega, Drug containing Cardio active sterols: Digitalis, Squill and Strophanthus, Drug containing Anthraquinone cathartics: Aloes, Senna, Rhubarb and Cascara, Others: Psoralea, Gentian, Saffron, Chirata and Quassia

UNIT-IV: ENZYMES AND PROTEIN DRUGS (15 periods)

ENZYMES Biological sources, Preparation, Chemical Composition, identification tests and uses of the following Enzymes: Diastase, Papain, Pepsin, Trypsine, Pancreatin. Urokinase and Streptokinase.

PROTEINS: Biological Source, Preparation, Characteristics, Chemical Constituents and uses of Malt extract, Gelatin ,Casein and Collagen.

General techniques of biosynthetic studies and basic metabolic pathways. Biogenesis of aromatic amino acids.

LABORATORY COURSE WORK BASED ON PAPER-XI:

1. Identification of Resin containing crude drugs mentioned in theory (at least 5)

2. Study of pharmaceutical aids.

3. Micro chemical tests of Tannin containing crude drugs mentioned in theory .

4. Identification testsof Enzymes mentioned in theory. (Three practicals)

7. Specific identification tests for protein crude drugs listed in theory (Three practicals)

8. Phytochemical screening of glycosides

9. Identification of drug containing Saponin

10 Identification of drug containing Cardio active sterols

11 Identification of drug containing Drug containing Anthraquinone cathartics

12. Visit to Herbal drug industries,Research centres etc.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – III

HERBAL MEDICINE

THEORY PAPER- XII: MEDICINAL PLANT BIOTECHNOLOGY

Periods: 60 Credits: 04

Learning Objective:

1. To know the basics of genetics and molecular biology
2. To learn the basic gene transfer methods

Learning Outcome:

1. Learn the Crop quality improving methods.
2. Understand the knowledge of basic and applied aspects of tissue culture

3 Outcome: Students will gain the knowledge about various strategies of plant tissue culture and students will gain knowledge about various secondary metabolites produced by plant tissue culture.

UNIT I : PLANT TISSUE CULTURE - I (15 periods)

Concepts of Biotechnology, History of Biotechnology, Scope of Biotechnology: The Indian Advantage Laboratory Organization, Maintenance of asepsis in tissue culture, Totipotency, Nutritional requirements, Media preparation, Explant preparation, Establishment of Aseptic cultures. Biotechnological applications of Plant Tissue culture in pharmacy and allied fields. Types and techniques of plant tissue culture, Initiation and maintenance of callus and suspension culture, growth parameters, Organogenesis and embryogenesis.

UNIT II : PLANT TISSUE CULTURE - II (15 periods)

Micropropagation : Sterlization of Explant, Inoculation of Explant, Multiplication of Shoots or Somatic Embryo formation, Germination of Somatic Embryo and Rooting of regenerated shoot, Proliferation of Shoots in the Multiplication Medium, Acclimatization of Plant transferred to Soil, Browning of the Medium, Advantages of Micropropagation product development.

Protoplast: Isolation of Protoplast , Source of Plant Material, Techniques of Isolation of Protoplast Applications of Protoplast Culture. **synthetic seed**

Androgenic Haploid Production: Process of Androgenesis Factor Affecting Androgenesis, Application of Anther and Microspore Culture, Merits & Demerits , Limitations , Gynogenic Haploids , Factors Affecting Gynogenesis , Applications of Ovule culture

UNIT IV BIOTRANSFORMATION AND TRANGENESIS: (15 periods)

Biotransformation of Plant Cell Culture and its importance. Biotechnological Methods For Production of secondary metabolites in Medicinal Plants. In-Vitro Production of Phytomedicinal Secondary Metabolites, Factors Leading to elevated production of Secondary Metabolites in Medicinal Plant Cell Cultures , Large-Scale Production of Medicinal Secondary Metabolites in Bioreactor Systems..Production of Anthocyanins in Callus Cultures of *Solanum melongena*,Production of important secondary metabolites (Ajmalicine,

Shikonin, Artemicin, Cinnamic acids and Flavonoids and Anthraquinones)., Production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest. Transgenic technology- Hairy root multiple shoot cultures and their applications.

UNIT –IV CLONING AND GENE TRANSFER IN PLANTS (15 periods)

Cloning of plant cells : Different methods of cloning and its application. . Advantages and disadvantages of plant cell cloning . Transgenic plants, Application of transgenic plants with special reference to a) Resistant to Herbicide, insects, fungus and viruses. b) Resisitant to physiological stress. c) Production of Pytopharmaceuticals d) Edible vaccines

Gene Transfer in plants: Gene transfer methods,Vector mediated gene transfer,Agrobacterium mediated DNA transformation,Tumor inducing principle and Ti plasmid,T-DNA transfer,Virus mediated gene transfer.

LABORATORY COURSE WORK BASED ON PAPER-XII:

1 Study of design and organization or plant tissue culture laboratory

2 Preparation of Plant Tissue Culture media

3. Establishment of callus culture

4 Micro propagation of endangered medicinal plant

5. Fermentation technology in lab scale

6. Immobilization techniques

7 Establishment of callus culture for isolation of various secondary metabolites

8. Establishment of suspension culture

9. Isolation of Protoplast and fusion

10. Anther and Microspore Culture

11.Quantitative estimation of DNA

12. Gene transfer by rDNA technology

13. Screening methods for rDNA technology

14.Short and Long excursion to Visit Tissue Culture Lab.University department, Research lab.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – III

HERBAL MEDICINE

THEORY PAPER- XIII: HERBAL DRUG TECHNOLOGY

Periods: 60 Credits: 04

Learning Objective:

1. To learn the general methods of extraction and purification of phytoconstituents
2. To understand role of nutraceuticals in human health

Learning Outcome:

1. Learn the making and uses of herbal medicines for common ailments
2. Understand the knowledge of Quality Control and Quality Assurance of Herbal ingredient

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UNIT-I: PLANT DRUG PREPARATIONS AND ANALYSIS

Definition of Herbal drug, Importance of Herbal therapies, Herbal verses conventional drugs, Safety in herbal drugs. Toxicity in Herbal drugs and their interactions, General methods of extraction, isolation and purification of phyto-constituents.Determination of tannins, Ash value, Extractable matter and Pesticide residues.

Preparation of herbal infusions, decoctions, lotions, insect repellents, suppositories, tinctures, syrups, poultices, plasters, ointments,.,Successive solvent extraction,super critical Fluid extraction,Steam distillation.Isolation, identification tests and estimation methods for Aloin from Aloes ,Vasicine from *Adhatoda vasica* ,Andrographolides from *Andrographis paniculata* ,Curcumin from *Curcuma longa* ,Piperine from *Piper longum*

UNIT-II: APPLICATION OF HERBAL MEDICINES (15 periods)

Making and using herbal medicines for common ailments like cold, skin infections and Diarrhea; Analytical Profiles of selected herbs – Brahmi, Aradrographis paniculata Aegle marmelos and Gymnema sylvestre. Antimicrobial, anti-inflammatory and antibiotic drugs Screening methods for herbal drugs with current innovations in following therapeutic classes Antibacterial,Antifungal,Antihypertensive ,Antioxidant, Antipyretic & anti-inflamatory Antidiabetic Anticancer,Antihepatotoxic, Immunomodulatory, Anti-ulcer drugs,screening methods for diuretics, Antifertility agents,,Analgesic activity

UNIT-III: HERBAL PRODUCT DEVELOPMENT : (15 periods)

The sources and description of raw materials of herbal origin used like fixed oils, waxes, gums, hydrophilic colloids, colours , perfumes, protective agents, bleaching agents, preservatives ,antioxidants and other ancillary agents

Herbal product development Lipid orals, tablets, capsules, dermatologic and herbal cosmetics Methods involved in monoherbal and polyherbal formulations with their merits and demerits. Quality control of finished herbal medicinal products.

UNIT IV :NUTRACEUTICALS:

Herbal Neutraceuticals as new source of medicine. , concept of nutritional requirements at different age, sex and in different conditions like normal, diseases, pregnancy etc.

Current trends and future scope, Inorganic mineral supplements, Vitamin supplements, Digestive enzymes, Dietary fibres, Cereals and grains, Health drinks from natural origin, Antioxidants, Polyunsaturated fatty acids, Herbs as functional foods, Formulation and standardization of neutraceuticals, Regulatory aspects, FSSAI guidelines, Sources, name of marker compounds and their chemical nature, medicinal uses and health benefits of following i) Spirulina ii) Soya bean iii) Ginseng iv) Garlic v) Broccoli vi) Green and Herbal Tea vii) Flax seeds viii) Black cohosh ix) Turmeric.

LABORATORY COURSE WORK BASED ON PAPER-XIII:

1.Preparation of herbal infusions, decoctions, lotions,

2 Preparation of herbal insect repellents, suppositories, tinctures,

3 Preparation of herbal syrups, poultices, ointments

4. Detection/Estimations of Vasicine from *Adhatoda vasica*

5 Identifacation of Curcumin from *Curcuma longa* by HPTLC

6 Identifacation of Piperine from *Piper longum* by HPTLC

7 Antibacterial activity of selected drugs

8. Antifungal activity of selected drugs

9. Antioxidant activity of selected drugs

10.To perform preliminary phytochemical screening of crude drugs.

11 Analytical Profiles of selected herbs – Brahmi,and Aradrographis paniculata

12 Analytical Profiles of selected herbs Aegle marmelos and Gymnema sylvestre.

13 Study of active compounds and medicinal uses of Spirulina , Soya bean , Ginseng and Garlic

14 Study of active compounds and medicinal uses of Flax seeds , Green Tea and Turmeric.

15 Visit to Pharmaceutical industries,Department of Pharmacy in University,Research institutes.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – III

HERBAL MEDICINE

***THEORY PAPER- XIV: HERBAL COSMETICS (ELECTIVE)**

Periods: 60 Credits: 04

Learning Objective:

Learning Objective:

1. To know the fundamentals of cosmetic technology
2. To learns the quality control of different cosmetic products

Learning Outcome:

1. Students will design the hair and skin care products
2. Student will establish a small scale industry of herbal cosmetics

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UNIT-I: FUNDAMENTALS OF COSMETIC TECHNOLOGY (15 PERIODS)

classification of cosmetics, A brief study of raw materials used for Cosmetic preparations: preservatives, surfactants, humectants, oils, colours, and some functional herbs, cream bases, aerosol propellants, perfumes.preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation.

UNIT II DESIGN OF HERBAL COSMETICS: (15 PERIODS)

Physiology and chemistry of skin and pigmentation, hairs, scalp, oral and nail, Cleansing cream, Lotions, Vanishing and Foundation creams, Anti- sun burn preparations, Moisturizing cream , deodorants, Face powders, Face packs, Lipsticks, Bath products, soaps and baby product, Preparation and standardisation of the following : Shampoos, Conditioners, Tonic, Bleaches, Colorants, Depilatories and Hair oils, Dentifrices and Mouth washes & Tooth Pastes, Cosmetics for Nails.

UNIT III FORMULATION OF COSMETICS (15 PERIODS)

Building blocks for different product formulations of cosmetics. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndetbars. Perfumes; Classification of perfumes. Perfume ingredients listed as allergens in EU regulation. Controversial ingredients: Parabens, formaldehyde liberators, dioxane.

UNIT IV REGULATORY ASPECTS OF COSMETICS:

Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics. Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties. Review of guidelines for herbal cosmetics by private bodies like

cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics.

LABORATORY COURSE WORK BASED ON PAPER-XIV:

1. Preparation and evaluation of, Anti dandruff Shampoo.
3. Preparation of Mouth washes
4. Preparation and evaluation of Cold Creams, Vanishing Creams.
5. Preparation and evaluation of Gels like Shaving gels
6. Preparation and evaluation of Face powder and Dusting Powder
7. Preparation and evaluation of Eye liners and Lip sticks
8. Preparation of Hand and Body Lotions
9. Preparation and evaluation of Foundation Creams and Cleansing Creams
10. Preparation of Hair oils to prevent hair fall
11. Preparation and evaluation of Aloe vera Gel
12. Preparation of Antiseptic cream (Turmeric)
13. Preparation and evaluation of Perfumes
14. Preparation and evaluation of Herbal Henna
15. Collection of various packaging materials used for cosmetics and their description

(Each student shall collect at least 10 different types of containers.)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – IV

HERBAL MEDICINE

THEORY PAPER- XVI: INDUSTRIAL PHARMACOGNOSY

Periods: 60 Credits: 04

Learning Objective:

1. To understand the concept and applications of bioreactors
2. To Understand the various methods of bio seperations

Learning Outcome:

1. The student shall be able to Know the requirements for setting up the herbal/natural drug industry.
2. Student will understand the guidelines for quality of herbal/natural medicines and regulatory issues
3. Interest will develop to establish Herbal product industry

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UNIT- I HERBAL DRUG INDUSTRY DEVELOPMENTS

Legal requirements and Licenses for API and formulation industry, Plant location-Factors influencing. Plant layout: Factors influencing, Special provisions, Storage space requirements, sterile and aseptic area layout. Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Current challenges in upgrading and modernization of herbal formulations. Entrepreneurship Development, Project selection, project report, technical knowledge, Capital venture, plant design, layout and construction. Pilot plant scale –up techniques, case studies of herbal extracts. Formulation production management.

UNIT II. REGULATORY REQUIREMENTS FOR SETTING HERBAL DRUG INDUSTRY:

Global marketing management. Indian and international patent law as applicable herbal drugs and natural products.Export –import (EXIM) policy, TRIPS, IPR. Quality assurance in herbal/natural drug products. Concepts of TDM, GMP, GLP, ISO-9000.

Documentation in pharmaceutical industry: Three tier documentation, Policy, Procedures and Work instructions, and records (Formats), Basic principles- How to maintain, retention and retrieval etc. Standard operating procedures (How to write), Master Formula Record, Batch Formula Record, Quality audit plan and reports. Specification and test procedures, Protocols and reports. Distribution records. Electronic data.

UNIT III SCALE UP OF FERMENTATION PROCESS

Principles, theoretical considerations, techniques used, media for fermentation, HTST sterilization, advantage and disadvantage, liquid sterilization. Cultivation and immobilized culture system , Cultivation system - batch culture, continuous culture, synchronous cultures, fed batch culture. Graphical plot representing the above systems. Introduction to immobilization , Techniques, immobilization of whole cell, immobilized culture system to

prepare fine chemicals. Immobilization of enzymes and their applications in the industry. Reactors for immobilized systems and perspective of enzyme eengineering.

UNIT-IV MANUFACTURING PROCESS TECHNOLOGY: Process Automation in Pharmaceutical Industry with specific reference to manufacturing of tablets and coated products, Improved Tablet Production: Tablet production process, granulation and pelletization equipments, continuous and batch mixing, rapid mixing granulators, rota granulators, spheronizers and marumerisers, and other specialized granulation and drying equipments. Problems encountered. Coating technology: Process, equipments, particle coating, fluidized bed coating, application techniques. Problems encountered.

Description of industrial processes; Process flow sheeting; Sedimentation; Flocculation; Microfiltration; Sonication; Bead mills; Homogenizers; Chemical lysis; Enzymatic lysis Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis ; Diafiltration ; Pervaporation; Perstraction

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LABORATORY COURSE WORK BASED ON PAPER-XVI:

1 Case studies of herbal extracts

2 Preparation of project report for development of herbal drug industry

3 Preparation of media for fermentation

4 Centrifugation in batch and continuous centrifuge

5 Conventional filtration

6. Adsorption process in batch and continuous mode

7 Immobilization of enzymes

8 Tablet production process

9. Membrane based filtration-ultra filtration in cross flow modules and micro filtration

10 Membrane based purifications

11 Protein precipitation and its recovery

12 Visit to Pharmaceutical industries,Department of Pharmacy in University,Research institutes.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – IV

HERBAL MEDICINE

THEORY PAPER- XVII: HERBAL DRUG DEVELOPMENT

Periods: 60 Credits: 04

Learning Objective:

1. To know the general methods of processing of herbs.
2. To understand the various extraction methods of herbal drugs

Learning Outcome:

1. Student will know the techniques for processing of herbs
2. Student will understand the methods of isolation and estimation of phytochemicals.
3. Student will prepare herbal formulations..

UNIT-I: DRUG DISCOVERY AND PROCESSING OF HERBS (15 periods)

Drug discovery and development: History of herbs as source of drugs and drug discovery, the lead structure selection process, structure development, product discovery process and drug registration.

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.

UNIT II HERBAL PRODUCT DEVELOPMENT

Preparation of liquid orals, tablets, capsules ,ointments ,creams and cosmatics . Methods involved in monoherbal and polyherbal formulation with their merits and demerits. Excipeints used in herbal formulation . Compatibility studies . Stability studies . Bioavability & Pharmacokinetic aspects for herbal drugs with examples of well known documented, clinically used herbal drugs. Quality Control of finished herbal medicinals products.

UNIT-III: ISOLATION AND ESTIMATION OF PHYTOCONSTITUENTS (15 periods)

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

Hypericin / Hyperforin from Hypericum species., Forskoline from Coleus forskoli, Catechins from Green tea, L-Hydroxy citric acid from *Garcinia combogia*, L-Dopa from *Mucuna pruriens*,. Andrographolides from *Andrographis paniculata*, Alicin from Garlic, Piperine from *Piper nigram / Piper longum*, Bacosides from *Bacopa monnieri*, Berberine from *Berberis aristata.*

UNIT-IV: HERBAL FORMULATION DEVELOPMENT (15 periods)

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.Selection of herbal ingredients, Different dosage forms of herbal drugs, Evaluation of different dosage forms, Stability studies of herbal formulations.

LABORATORY COURSE WORK BASED ON PAPER-XVII:

1. Processing of herbs
2. Isolation and estimation of phytoconstituents by HPTLC listed in chapter III
3. Spectroscopic analysis of some isolated compounds
4. Estimation of phytoconstituents in mono and polyherbal formulations by HPTLC technique
5. Preparation of liquid orals and capsules
6. Preparation of ointments and creams
7. Estimation Of Andrographolides from *Andrographis paniculata*
8. Estimation Of Alicin from Garlic
9. Estimation Of Bacosides from *Bacopa monnieri*
10. Estimation Of L-Dopa from *Mucuna pruriens*,
11. Preparation of some important extracts by using Pilot Scale Extraction Plant
12. Evaluation of different dosage forms,
13. Visit to Pharmaceutical industries,Department of Pharmacy in University, Research institutes.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – IV

HERBAL MEDICINE

THEORY PAPER- XVIII: DRUG STANDARDIZATION AND VALIDATION

Periods: 60 Credits: 04

Learning Objective:

1. To know the basics concepts of drug standardization
2. To understand the methods of qualitative and quantitative estimation of herbal extracts

Learning Outcome:

1. Learn the good agricultural practices of herbal drug processing
2. Understand the knowledge of drug validation

UNIT-I: STANDARDIZATION OF HERBAL MATERIAL (15 PERIODS)

Standardization of herbal raw materials including Pharmacognostic, physical, chemical and biological methods with examples, Standardization of herbal extracts, physical, chemical and spectral analysis. Standaridization of herbal extracts as per WHO/CGMP Guidelines :Physical,chemical,spectral and toxicologicals standardization,qualitative and quantitative estimations exemplified by the methods of preparation of at least two standardized extracts. Stability studies for extracts. Predictable chemical and galenical changes.

UNIT-II: HERBAL DRUG PROCESSING PRACTICES (15 periods)

Good Agricultural Practices, Good practices in collection of plant materials, Primary processing of herbal products. Documentation required other guidelines for Quality Assurance of Herbal drugs.

Qualitative and Quantitative estimation of active principles from standardized extracts by HPTLC, Biological standardization -Pharmacological screening of herbal extracts and Microbiological evaluation of herbal extracts Toxicity studies of herbal extracts.

UNIT-III: DRUG VALIDATION (15 periods)

Introduction to validation: Definition of Calibration, Qualification and Validation, Scope, frequency and importance. Difference between calibration and validation.Calibration of weights and measures. Advantages of Validation, scope of Validation,Organization for Validation, Validation Master plan, Types of Validation, Streamlining of qualification & Validation process and Validation Master Plan. Qualification: User requirement specification, Design qualification, Factory Acceptance Test (FAT)/Site Acceptance Test (SAT), Installation qualification, Operational qualification,Performance qualification, ReQualification (Maintaining status-Calibration Preventive Maintenance, Change management).

UNIT IV : PROCESS VALIDATION

Qualification of analytical instruments: Electronic balance, pH meter, UV-Visible spectrophotometer, FTIR, GC, HPLC, HPTLC, Disintegration and Dissolution Qualification of Glassware: Volumetric flask, pipette, beakers and burette .

Validation of Utility systems - Pharmaceutical Water System & pure steam, HVAC system, Compressed air and nitrogen. Cleaning Validation: Cleaning Validation-Cleaning Method development, Validation and validation of analytical method used in cleaning. Cleaning of Equipment, Cleaning of Facilities. Cleaning in place (CIP). General principles, Validation of analytical method as per ICH guidelines .

LABORATORY COURSE WORK BASED ON PAPER-XVIII:

1. Formulation and standardization of some important herbal cosmetics.
2. Demonstration of various dosage forms available in each system.
3. Simple preparations used in Ayurvedic System and their Standardization (with special emphasis on HPTLC).
4. Simple preparations used in Siddha system and their Standardization (with special emphasis on HPTLC).
5. Simple preparations used in Unani system and their Standardization (with special emphasis on HPTLC).
6. Simple preparations used in Homeopathy system and their Standardization (with special emphasis on HPTLC).
7. Imupurity profiling of drugs
8. Calibration of glasswares
9. Calibration of pH meter
10. Calibration of UV-Visible spectrophotometer
11. Calibration of FTIR spectrophotometer
12. Calibration of GC instrument
13. Calibration of HPLC instrument
14. Cleaning validation of one equipment
15. Visit to Pharma industries ,Research institutes etc.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science

Post Graduate (PG) Programmes

HERBAL MEDICINE - CURRICULUM

w. e. f. Academic Year 2020-2021

M. Sc. SECOND YEAR

SEMESTER – IV

HERBAL MEDICINE

***THEORY PAPER- XIX: REGULATORY AFFAIRS AND IPR (ELECTIVE)**

Periods: 60 Credits: 04

Learning Objective:

1. To know the basics concepts of various types of Intellectual Property Rights.
2. To understand the Patent filing procedure in India,

Learning Outcome:

1. Learn the clear information about the patent laws, intellectual property rights
2. Understand the knowledge of drug regulation in India and abroad.

UNIT- I REGULATORY AFFAIRS :

Indian context – Requirements and guidelines of GMP, understanding of Drugs and Cosmetic Act 1940 and rules 1945 with reference to schedule M, U and Y.

Drugs Prices Control Order, 1995. 5. New Drug Policy, 1994. 6. ISO 9000 and 9002 documentation: Introduction and Support package: Guidance on the terminology used in ISO 9001:2000 and ISO 9004:2000.

GATT and WTO : GATT – Historical perspective, objectives, fundamental principles, impact on developing countries. WTO – objectives, scope, functions, structure, status, membership & withdrawal, dispute settlement, impact on globalization, India – tasks & challenges.

UNIT-II REGULATORY REQUIREMENT FOR PRODUCT APPROVAL

Documentation: Types related to pharmaceuticals industry, protocols, Harmonizing formulation development for global filings, NDA, ANDA, CTD, dealing with post-approval changes – SUPAC, handling and maintenance including electronic documentation

W.H.O. certification scheme on the quality of pharmaceutical products. Quality management in the drug industry: philosophy and essential elements. Guidelines on the inspection of pharmaceutical manufacture and drug distribution channels.

UNIT-I: GENERAL PRINCIPLES OF INTELLECTUAL PROPERTY

Introduction, Types of Intellectual Property Rights (Patents, Trademarks, Copyrights, Geographical Indications Industrial Designs and Trade secrets), Patentable Subject Matter (Novelty, Non Obviousness, Utility, enablement and Best mode). History of Indian Patent Protection, Rationale behind Patent System, Objectives and Advantages of Patent System, and future challenges. Indian Patents Act 1970, Definitions and Key Terminology, Types of Patent applications, Inventions not patentable (section 3 &4).

Salient features of Indian Patents (Amendments) Act 1999, 2002 and 2005. US and European Patent System. Salient Features and Impact of International Treaties / Conventions like, World Intellectual Property Organization (WIPO),Trade Related Aspects of Intellectual Property Rights (TRIPS).

UNIT-IV : PATENTS AND INTELLECTUAL PROPERTY RIGHTS (IPR) :

Definition, scope, objectives, sources of patent information, patent processing & application, Patents, copyrights, trademarks, salient features, trade related aspects (TRIPS), international & regional agreements.

Patent filing procedure in India (Patent Prosecution), Specifications (Provisional and Complete), Claims- types of claims and legal importance of claims, Grant of patent, Rights of Patentee and co-owners.

Opposition- pre-grant opposition and post-grant opposition, Anticipation, Infringement, Compulsory Licensing, revocation of patents, and power of Controller.Patent filing procedure under PCT, advantages, patent search and literature

Patent validation process in India, US and Europe. IPR related to copyright, trade mark, trade secret and geographical indication. Patent application writing. Claim construction and claims.

LABORATORY COURSE WORK BASED ON PAPER-XIX:

1. Protocol preparation for documentation of various types of records for filing Indian Patents.
2. Preparation of clinical trial protocols for submission to regulatory authority.
3. Preparation and documentation of Indian Patents.
4. Preparation and documentation of US Patents.
5. Preparation and documentation of European Patents.
6. Case studies of some popular Indian Patents
7. Case studies of some popular International patents

RECOMMENDED BOOKS:

THEORY PAPER-XI: NATURAL PLANT PRODUCTS

1. Textbook of Pharmacognosy by C.K.Kokate and D.P.Purohit (Nirali Prakashan, Pune)
2. Trease G.E. and Evans w.e., Pharmacognosy (Baillere Tindall, Eastbourne)
3. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)
4. Pharmacognosy by T.E. Wallis (CBS Publisher, New Delhi)
5. Staba E.J., Plant Tissue Culture as a source of Bio-medicinals
8. Medicinal plants: Alkaloids and Glycosides By Toronto
9. CSIR- Cultivation and Utilization of Medicinal Plants
10. CSIR - Wealth of India, Raw Materials
11. Paul J. Schewer Chemistry of Marine Natural Products.
12. Dean F. Martin & George Padilla Marine Pharmacognosy.
13. Marine Natural Products-Vol.I to IV.
14. T. Swain Comparative Phytochemistry.
15. T. Swain Chemical Plant Taxonomy
16. C.K. Atal & B.M. Kapoor Cultivation of Medicinal Plants.
17. C.K. Atal & B.M.Kapoor Cultivation and Utilization of Aromatic Plants
18. Cultivation of medicinal and aromatic crops, Ist edn, by A.A.Farooqui and B.S.shreeramu, University press., 2001
19. Medicinal plants of India, Ist edn, by S.N.Yoganarasimhan, Interline publication Pvt.Ltd., 2000
20. Medicinal natural products (a biosynthetic approach), Ist edn, by Paul M.Dewick, John Wiley and sons Ltd., England 1998
21. Natural Products from plants, Ist edn, by Peter B. Kaufman, CRC press, Newyork, 1998
22. Glimpses of Indian Ethanopharmacology by P. Pushpangadam,UIF Nyman, V.George, Tropical botanic Gardon and research institute., 1995
23. Natural Products:A lab guide by Raphael Ikan, IInd edn, academic press, 1991
24. Organic chemistry of natural products, volume 1 and 2. by Gurdeep R.Chatawal
25. Organic Chemistry by I.L.Finar –Vol. I and II
26. Text book of Pharmacognosy, by G.E.Treese nad W.C.Evans, 15th edn, W.B. Saunders Edenburg, NewYork.,
27. Text book of Pharmacognosy by Tyler, Brady and Robers
28. Modern methods of Plant analysis by Peach and M.V.Tracey, Volume I and II
29. Chemistry of marine natural products by Paul J.Schewer, 1973.
30. Marine Pharmacognosy Ed by Dean F. Martin and George Pedilla
31. Marine natural products Volume I to IV
32. Cultivation of medicinal plants by C.K.Atal and B.M. Kapoor
33. Cultivation and utilization of aromatic plants,by C.K.Atal and B.M. Kapoor

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THEORY PAPER-XII: MEDICINAL PLANT BIOTECHNOLOGY

1. Introduction to plant tissue culture by M.K. Razadam
2. Molecular biology & Biotechnology by J.M. Walker & E.D. Gingo
3. Advanced methods in plant breeding & biotiechnology by David R Mirray
4. Experiments in plant tissue culture by John, H.D. & Lorin W.R.
5. Plant cell & tissue culture by Jafferey. W. Pollard & John. M. Walker
6. Breeding field crops by John M.P. & David. A.S.
7. Pharmaceuticals Biotiechnology S.P. Vyas & V.K. Dixit
8. Biotechnology theory & technique vol I by Jack. G. C.
9. Pharmacognosy by G.E. Trease & W.C.Evans ELBS.
10. Biotechnology by purohit & Matherr
11. Comprehensive biotechnology by Mooyoung
12. Biotechnology application to tissue culture by Shargool.
13. Plant tissue culture by Dixon
14. Plant tissue culture by Street
15. Elements of Biotechnology by P.K. Gupta.
16. Elements in plant Biotechnology by P.K.Gupta
17. Molecular biology and biotechnology by J.M.Walker and E.D. Gingold
18. An introduction to plant tissue culture by M.K. Razdan
19. Plant cell and tissue culture by Jeffrey W. Pollard and J.M.Walker
20. Plant tissue culture by Dixon
21. Plant tissue culture by Street
22. Biotechnological application for tissue culture by Shargool
23. Plant cell culture and technology by M.M. Yeoman
24. Plant tissue culture – Theory and practice by S.S. Bhajwani and M.K. Razdan
25. Secondary plant metabolism by Margaret L. Vikery and Brain Vikery
26. Plant tissue culture by W.E Gorge
27. Plant chromosome Analysis, Menupulatia and Engineering by Arun and Archana
28. Sharma., Ist Edn., Academic publishers, 1999
29. Transgenic plants by R. Ranjan, Agrobotanica, 1999

THEORY PAPER-XIII: HERBAL DRUG TECHNOLOGY

1. Trease and Evan's Pharmacognosy 15th edition
2. Indian Herbal Pharmacopeia Vol-I and II
3. Quality Control methods for medicinal plant material by W.H.O., Geneva.
4. Quality Control of Herbal drugs by Dr. Pulak K. Mukherjee
5. Botanical safety hand book by Michael Meguffin, Christopher Hobbs published by
6. American Herbal Product Association.

7. Herbal drugs by P.Mukherjee
8. Herbal Drugs Industry by R.D. Chowdary
9. Quality control of Herbal Drugs by Pulok. K. Mukarjee
10. Pharmacognosy, Phytochemistry, Medicinal Plants by Jean Bruneton
11. Natural Products a laboratory guide by Raphael Ikan.
12. Foye's Principles of Medicinal Chemistry by Thomas L.Lemke David A. Williams et.al.
13. Pharmacognosy by C.K. Kokate
14. Pharmacognosy by Trease & Evans
15. Pharmacognosy & Phytochemistry by Vinod Rangari
16. Pharmacognosy by Brady Taylor et. al.
17. Natual Excipients by R.S. Guad, Surana et. al.
18. Spectrometric identification of Organic compounds by Silverstein
19. Organic chemistry by Morrison & Byod
20. Cultivation of Medicinal and aromatic crops by A..A.Farooqui and B.S. Sreeramu.
21. Pharmacognosy & Pharmacobiotechnology by Ashutosh kar
22. Advances in Harticulture Volume.II Medicinal and Aromatic Plants by K.L. Chada & Rajendra Gupta.
23. Herbal Medicine expanded commission E Monographs. Blumenthal/ Goldberg/Brinckmam.
24. A handbook of Cosmetics by B.M. Mithal & RN Saha
25. The Complete Technology Book on Herbal Perfumes&Cosmetics by Panda 19. Plant Drug Analysis by Wagner H. and Bladt S.
26. "The Wealth of India" Raw materials, (I-XI) and Industrial Products – Volumes (I-VIII) (A to Z) by CSIR, New Delhi.
27. "Indian Medicinal Plants" Volumes by Kirtikar K.R. and Basu B.D.
28. Medicinal Plant Biotechnology by Ciddi Veeresham
29. Plant Tissue Culture by Bhojwani
30. Plant Tissue culture by M.K. Razdan.
31. Wilson and Gisvold's Text Book of Organic medicinal and Pharmaceutical Chemistry.
32. Burger's Medicinal Chemistry and Drug Discovery.
33. PHARMACOLOGY by H.P. Rang, M.M. Dale et. al.
34. Goodman and Gilman's Pharmacological Basis of Therapeutics.
35. Journals Publishing Phytochemical and Pharmacological investigations on plants.
36. Websites on Herbal Medicines/Products.
37. Pharmacognosy and Pharmacobiotechnology by Robert Sipero et. al.
38. Medicinal Natural Products by Paul M. Deweek.

THEORY PAPER-XIV: HERBAL COSMETICS (ELECTIVE)

1. Cosmetics: Formulation, manufacturing, and Quality control by P.P.Sharma
2. A Handbook of Cosmetics by B.M. Mithal, R.N. Saha

3. The Theory and Practice of Industrial Pharmacy by Lachman L., Liberman, H.A.
4. Modern Cosmetics by Thomson, E.G.
5. Paucher's Perfumes, cosmetics & soaps by W.A.Paucher.
6. Hary's cosmeticology by J.B.Wilkimsson.
7. Herbal Cosmetics - H.Pande, Asia Pacific Business press, New Delhi.
8. H.Pande, "The complete technology book on herbal perfumes and cosmetics", National Institute of Industrial Research, Delhi.
9. Panda H. 2007. Herbal Cosmetics (Hand book), Edition I, Asia Pacific Business Press Inc, New Delhi.
10. Thomson EG. 2006. Modern Cosmetics, Edition I, Universal Publishing Corporation, Mumbai.
11. P.P.Sharma. 2008. Cosmetics- Formulation, Manufacturing & Quality Control, Edition 4, Vandana Publications, New Delhi.
12. Supriya K B. 2005. Handbook of Aromatic Plants, Edition II(Revised and Enlarged), Pointer Publishers, Jaipur.
13. Skaria P. 2007. Aromatic Plants (Horticulture Science Series Vol. 1) , Edition I, New India Publishing Agency, New Delhi.
14. Kathi Keville and Mindy Green.1995. Aromatheraphy (A Complete Guide to the Healing Art), Edition I, Sri Satguru Publications, New Delhi.
15. Chattopadhyay PK. 2000. Herbal Cosmetics & Ayurvedic Medicines (EOU), Edition I, National Institute of Industrial Research, Delhi.
16. Balsam MS & Edward Sagarin. 2008. Cosmetics Science and Technology, Edition II (Vol-II), Wiley Interscience, New York.
17. Harry's Cosmeticology. 8th edition
18. Poucher's perfume cosmetics and Soaps, 10th edition
19. Cosmetics - Formulation, manufacture and quality control PP.Sharma, 4th edition
20. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I.Maibach. 3rdedition
21. S.P.Vyas and Roop K.Khar Controlled Drug Delivery system, Concepts and Advances
22. Cosmetic and Toiletries recent suppliers catalogue.
23. CTFA directory.

THEORY PAPER-XVI: INDUSTRIAL PHARMACOGNOSY

1. Industrial Biotechnology: L E Casida
2. Industrial Biotechnology: B M Miller and W Litsky
3. Microbial Technology Vols j & II: H Peppler
4. Industrial Biotechnology: Vedpal S Malik and Padma Sridhar
5. Biochemistry of Industrial Microorganisms: C Rainbow and A H Rose
6. Animal Cell Culture: Ian Freshney

7. Microbial Genetics: David Freifelder
8. Biochemical Engineering Fundaments: Bailey and Ollis
9. Biotechnology of Antibiotics and Other Bioactive Microbial Metabolites: Giancarlo Lancini and Roland Lorenzetii
10. Bioreactor Design and Product Yield: Butterworth and Heinemann
11. Enzyme Assays - A Practical Approach: Robert Eisenthal and Michael J Danson
12. Fermentation and Biochemical Engineering Handbook: Henry C Vogel
13. E L V Harris and S. Angal, Protein Purification Methods, Ed. IRL Press at Oxford University Press, 1989.
14. P.A. Belter, E.L. Cussler and Wei-Shou Hu., Bioseparations-Downstream Processing for Biotechnology, Wiley- Interscience Publication, 1988.
1. 15. J. E. Bailey and D. F. Ollis, Biochemical Engineering Fundamentals, 2nd Edition, Mc- Graw Hill, Inc., 1986.
15. R. K. Scopes, Berlin, Protein Purification: Principles and Practice, Springer, 1982.
16. Bernard Rosner, Fundamentals of Biostatistics, 5th Edition, Thomson Brooks/Cole, 2000.
17. Richard A. Johnson, Probability and Statistics for Engineers, 6th Edition, Prentice Hall, 2000.
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w. e. f. Academic Year 2020-2021

SKELETON OF THEORY QUESTION PAPER

M. Sc. SECOND YEAR

HERBAL MEDICINE

Maximum Marks: 75

Credits: 03

Time: 03 Hours

Note: **(i) Attempt all questions**
(ii) All questions carry equal marks
(iii) Draw neat and well labelled diagrams wherever necessary

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Q1.	**Long answer question based on unit- I**	**15**
	OR	
	Long answer question based on unit- I	
Q2.	**Long answer question based on unit- II**	**15**
	OR	
	Long answer question based on unit- II	
Q3.	**Long answer question based on unit- III**	**15**
	OR	
	Long answer question based on unit- III	
Q4.	**Long answer question based on unit- IV**	**15**
	OR	
	Long answer question based on unit- IV	
Q5.	**Write short notes on (Any three)**	**15**
	a). Unit - I	
	b). Unit -II	
	c). Unit- III	
	d). Unit -IV	

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M. Sc. SECOND YEAR, SEMESTER –III

HERBAL MEDICINE

LABORATORY COURSE WORK- V

BASED ON THEORY PAPER – XI&XII

Maximum Marks: 75

Credits: 03

Time: 06 Hours

Note: (i) Attempt all questions
(ii) Draw neat and well labelled diagrams wherever necessary

Q1.	**Major Experiment (Paper XI)**	**15**
Q2.	**Minor Experiment (Paper XI)**	**10**
Q3.	**Major Experiment (Paper XII)**	**15**
Q4.	**Minor Experiment (Paper XII)**	**10**
Q5.	**i) Record book**	**10**
	ii) Viva voce	**10**
	iii)Submission	**05**

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M. Sc. SECOND YEAR, SEMESTER –III

HERBAL MEDICINE

LABORATORY COURSE WORK- VI

BASED ON THEORY PAPER – XIII&XIV

Maximum Marks: 75

Credits: 03

Time: 06 Hours

Note: (i) Attempt all questions
(ii) Draw neat and well labelled diagrams wherever necessary

Q1.	**Major Experiment (Paper XIII)**	**15**
Q2.	**Minor Experiment (Paper XIII)**	**10**
Q3.	**Major Experiment (Paper XIV)**	**15**
Q4.	**Minor Experiment (Paper XIV)**	**10**
Q5.	**i) Record book**	**10**
	ii) Viva voce	**10**
	iii)Submission	**05**

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SKELETON OF PRACTICAL QUESTION PAPER

M. Sc. SECOND YEAR, SEMESTER –IV

HERBAL MEDICINE

LABORATORY COURSE WORK- VII

BASED ON THEORY PAPER – XVI, XVII, XVIII and XIX

Maximum Marks: 75

Credits: 03

Time: 06 Hours

Note: (i) Attempt all questions
(ii) Draw neat and well labelled diagrams wherever necessary

Q1.	**Major Experiment (Paper XVI)**	**15**
Q2.	**Major Experiment (Paper XVII)**	**15**
Q3.	**Major Experiment (Paper XVIII)**	**15**
Q4.	**Major Experiment (Paper XIX)**	**15**
Q5.	**i) Record book**	**10**
	ii) Viva voce	**05**

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SKELETON OF PRACTICAL QUESTION PAPER

M. Sc. SECOND YEAR, SEMESTER –IV

HERBAL MEDICINE

LABORATORY COURSE WORK- VIII

Project Work

Maximum Marks: 75

Credits: 03

ASSESSMENT OF PROJECT REPORT

S. No.	Content	Max. Marks	Marks Obtained
1	Introduction	10	
2	Review Of Literature	10	
3	Material And Methods	10	
4	Observations & Results	15	
5	Discussion	10	
6	Conclusion	10	
7	Viva-Voce/Presentation	10	
	Total	75	

Signature of Internal Examiner----------

Signature of External Examiner----------

----------20062020----------