MASTER OF SCIENCE (M.Sc.)

IN

PHYTOMEDICAL SCIENCE AND TECHNOLOGY

PROGRAM STRUCTURE AND SYLLABUS

2019-20 ADMISSIONS ONWARDS

(UNDER MAHATMA GANDHI UNIVERSITY PGCSS REGULATIONS 2019)

EXPERT COMMITTEE OF BIOSCIENCE (PG)

MAHATMA GANDHI UNIVERSITY

2019

EXPERT COMMITTEE OF BIOSCIENCE (PG)

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Dr. PriyaSenan V.

Assistant Professor and Head, Department of Biotechnology

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Assistant Professor and Head, School of Biosciences, MACFAST, Thiruvalla

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3. **Dr. P. K. Shaji (External expert)**

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Assistant Professor, Dept. of Botany, FMN College, Kollam

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9. **Dr. Thakur Das Saha (External expert)**

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Table of Contents

M.Sc. PHYTOMEDICAL SCIENCE AND TECHNOLOGY

(Mahatma Gandhi University Regulations PGCSS2019 from 2019-20 Academic Year)

1. Aim of the Program

M.Sc. Phytomedical Science and Technology programme aims to train students in the methods used to analyse and characterise medicinal natural products, to examine the safety and efficacy of currently used herbal medicines, analytical and bioassay methods, and the ethno pharmaceutical uses of plants from traditional systems of medicine.

2. Eligibility for Admissions

B Sc in Biotechnology, Pharmacology, Biophysics, Medicine, Veterinary Science, Biochemistry, Chemical Science and other biological sciences under Part III Core Group (Core + Complementary + Open Courses) with not less than CGPA of 2.00 out of 4. BAMS/BHMS/BSMS/B Pharm with not less than CGPA of 2.00 out of 4 are also eligible to apply.

3. Medium of Instruction and Assessment

Course of study will be over a period of two academic year under semester system

a. Scheme of examination

The examinations for the award of degree consist of theory and practical papers, dissertation and comprehensive viva-voce. There will be examinations at end of each semester for theory and practical courses. Each semester consists of three theory paper and one practical examination for the first three semesters. The fourth semester has project presentation and evaluation and comprehensive viva-voce in addition to one practical examination and three theory papers which are exclusively based on elective courses.

b. Dissertation

Each candidate should submit a dissertation in four copies of the research project undertaken by him/her at the end of fourth semester for evaluation.

c. Comprehensive viva-voce

A comprehensive viva-voce will be held at the end of the fourth semester covering all the courses of the programme taught in the entire four semesters.

4. Faculty under which the Degree is Awarded

M.Sc. Phytomediacal Science & Technology

5. Specializations offered, if any

NIL

6. Note on compliance with the UGC Minimum Standards for the conduct and award of Post Graduate Degrees

7. PROGRAMME STRUCTURE

Course Code	Title of the Course	Type of the Course	Hours per week	Credits	Total Credits
FIRST SEMESTER					
BS020101	Microbiology and Plant Molecular Biology	Core	5	5	19
BS020102	Plant Physiology, Biochemistry and Ecology	Core	5	5	
BS020103	Introduction to Traditional and Modern Systems of Medicine	Core	5	5	
BS020104	Laboratory course I	Core	10	4	
SECOND SEMESTER					
BS020201	Principles of Management	Core	5	5	19
BS020202	Medicinal and Aromatic plants: Conservation, Cultivation and Management	Core	5	5	
BS020203	Systematic Botany, Biodiversity and Economic botany	Core	5	5	
BS020204	Laboratory course-II	Core	10	4	
THIRD SEMESTER					
BS020301	Cell Biology and Biotechnology	Core	5	5	19
BS020302	Phytochemistry	Core	5	5	
BS020303	Pharmacognosy	Core	5	5	
BS020304	Laboratory course-III	Core	10	4	

Course Code	Title of the Course		Type of the Course	Hours per week	Credits	Total Credits
FOURTH SEMESTER						
BS830401	Electives Group A	Research Methodology and Science Communication	Elective	5	4	23
BS830402		Product Development, Quality Control and IPR	Elective	5	4	
BS830403		Basics of Plant Tissue Culture	Elective	5	4	
BS840401	Electives Group B	Pharmacology, Clinical Trial and Biostatistics	Elective	5	4	
BS840402		Business Plan and Entrepreneurship Development	Elective	5	4	
BS840403		Transgenic Techniques for Crop Improvement	Elective	5	4	
BS850401	Electives Group C	Introduction to Nanotechnology	Elective	5	4	
BS850402		Ecology and Ecoinformatics	Elective	5	4	
BS850403		Green House Management and Plant Protection	Elective	5	4	
BS020401	Laboratory course IV		Core	10	4	
BS020402	Research Project & dissertation		Core		5	
BS020403	Comprehensive Viva-Voce		Core		2	
			TOTAL		**80**	

8. SYLLABUS

8.1. FIRST SEMESTER COURSES

BS020101	Microbiology and Plant Molecular Biology
BS020102	Plant Physiology, Biochemistry and Ecology
BS020103	Introduction to Traditional and Modern Systems of Medicine
BS020104	Laboratory course I

BS020101 MICROBIOLOGY AND PLANT MOLECULAR BIOLOGY

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The course is designed to introduce the students to different groups of microorganisms, their structure, important chemical constituents, life cycle and significance of their interaction with environment, and various microbial culture methods. Finally the course aims to provide understanding in the basics of immunology, molecules involved, mechanisms and methods.

2. **Course Content**

Unit 1Introduction to microbiology:

History and scope of microbiology; Principles of microscopy: Bright field and electronic microscope; Micrometry: ocular and filar micrometers; cameralucida; Microscopic examination of microorganisms.

Microbial taxonomy and physiology: Five kingdom classification; Microbial types: Fungi, Bacteria, Protozoa and Viruses;their morphology and structural characteristics; microbial metabolism; factors determining microbial growth and multiplication (25hrs)

Unit 2Control of microorganisms:

Sterilization principles and techniques, methods of testing efficacy of antimicrobial substances, drug resistance in bacteria (10hrs)

Unit 3 Host-parasite interactions:

Infection, immunity, immune response, vaccines; Plant microbial interactions; symbiosis, antagonism and parasitism (10hrs)

Unit 4 Fermentation technology:

Microbial growth; fermentation process; fermentation products; industrial production of antibiotics, vitamins, amino acids; organic acids, enzymes; genetic improvement of fermentation products; Immunotechnology: Components of the immune system and immune response; cytokinesis, monoclonal antibodies and vaccines (20hrs)

Unit 5 Structural organization of DNA and RNA:

Organization of pro and eukaryotic genomes, nucleotypes (diversity in genome size), coding regions, non coding regions, introns and repetitive sequences; DNA and RNA polymerases, restriction enzymes, gene cloning and *in situ* hybridization of DNA **.DNA replication**: Mutation, DNA repair; Site directed mutagenesis; Polymerase chain reaction and its applications .**Gene expression**: Gene expression in prokaryotes and Ekaryotes, Transcription and Translation;

Reverse transcription; Regulation of gene expression; Transposable elements; Expression of foreign DNA in pro and Eukaryotes (25hrs)

3. Recommended Text books:

- Prescott, Harley and Klein: Microbiology-5th edition; Publisher: McGraw Hill science 2002
- BenchaminLewin. 2003. *Genes*. (8^{th}ed.). Prentice Hall Inc
- Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scot, Lawrence Zipursky and James Darnell. 2004. *Molecular Cell Biology*. (5^{th}ed.). Freeman and Co., New York

4. Recommended References:

- Gerard J. Tortora, Berdell, R. Funke, Christine L. Case: Microbiology: An Introduction. 8th edition Hardcover: 944 pages, Publisher: Benjamin Cummings. 2004.
- Jacquelyn G. Black: Microbiology-Principles and explorations 6^{th} edition: Publisher John Wiley & Sons 2004
- Robert W. Bauman: Microbiology Brief edition: Pearson Benjamin Cummings 2004.
- Pelczar, M.J. Jr., Chan, E.C.S., Krieg, N.R. 1993. *Microbiology*. (5^{th}ed.). Tata McGrew Hill Pub. Co. Ltd., New Delhi.

BS020102PLANT PHYSIOLOGY, BIOCHEMISTRY AND ECOLOGY

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The course is designed to give a basic understanding of the chemical makeup of the cell and the different mechanisms in a cell which makes life possible.

2. Course Content

Unit 1-Nutrition and transport and storage:

Inorganic and organic nutrient requirement, mineral deficiency; Transport of water and solutes in plant body, role of membranes in transport, water balance, transpiration, accumulation and storage of organic compounds in plant tissues; Growth and development**:** chemical regulation**,** centers of growth, cell differentiation and morphogenesis; physiology of reproduction; Seed germination, seed viability, seed dormancy, seed vigour and longevity, factors affecting seed quality, seed testing and certification **Physiological improvement of plants**: Physiological efficiency of target characteristics for improvement (salt tolerance, draught and flood resistance, low and high temperature tolerance, pest and pathogens resistance, herbicide resistance, photoperiodism, nitrogen fixation, enhanced nutritional value, shelf life.

(25hrs)

Unit 2-Bioinorganic and organic compounds:

Distribution and role of elements and inorganic compounds in plants; General classification and basic molecular structure of phenolic compounds, terpenes and terpenoids; their biosynthesis, and degradation, function and distribution in plants Phyto-hormones: Chemical structure, synthesis, translocation; Mode of action and physiological effects of growth regulators and inhibitors: Auxins, cytokinins, giberellines, ethylene and abscissic acid**(23hrs)**

Unit 3-Chemistryof biological molecules:

Structure and classification of Carbohydrates (monosccharides, oligosaccharides and polysaccharides), Lipids (fatty acids, tri-glycerides, fats and oils), Nucleic acids, Amino acids and Proteins (classification of proteins, prmary, secondary, tertiary and quaternary structure of proteins); nature of peptides; Enzymes**:** catalytic activity protein enzymes and ribozymes, structure of enzymes, nomenclature and classification isozymes and allozymes, cofactors, enzymes kinetics, regulatory role of enzymes in metabolism; purification and characterization

(10hrs)

Unit 4- Photosynthesis:

Pigments: chlorophyll, carotenoids, xanthophylls; Photo-phosphorylation; CO_2 fixation, Calvin cycle, Hatch-slack pathway; Photo-respiration and C3 and C4 pathways; Spectra

of electromagnetic radiation and biologically significant wavelengths, electron transport, energy relation in photosynthesis, aerobic oxidation of sugars and secondary oxidative mechanisms (10hrs)

Unit 5- Introduction to Ecology:

Definition and scope of Ecology; Ecosystem: concept of ecosystem, significance of habitat, trophic levels, primary and secondary productivity; Population: population characteristics, population growth, biotic potential, factors affecting population growth, carrying capacity; Community ecology: classification of communities, qualitative, quantitative and synthetic characteristics **Phytogeography:** Principles governing plant distribution;Phyto-geographic regions of the world and India; Adaptation; Speciation and extinction; Native, naturalized and exotic taxa; Endemism: Concept of endemism, endemic flora; Rarity: Rare, endangered and threatened category (IUCN) species (22hrs)

3. Recommended Text books:

- Anderson, J.W. and Beardall, J. 1991. *Molecular Activities of Plant Cells*, Blackwell Scientific Publication, Oxford
- Clarke, G.L. 1954. *Elements of Ecology*. John Wiley Publ., London
- Copeland, L.O. and McDonald. M.B. 1995. *Principles of Seed Science and Technology* 3rded Chapman & Hall New York
- Dennis, D.T and Turpin D.H. (ed). 1990. *Plant physiology, Biochemistry and Molecular biology*, Longman Scientific and Technical Esses
- Price, N.C. and Stevens, L. 1989. *Fundamentals of enzymology*. Oxford University Press Oxford

4. Recommended References:

- Indian Institute of Ecology and Environment, New Delhi
- Walker J.M. and Gingold, E.B. 1993. *Molecular biology and Biotechnology* 3rded Royal Society of Chemistry, Cambridge
- Wilson, K. and Walker, J. 2004. *Practical Biochemistry*: Principles and Techniques. Cambridge University Press, Cambridge.

BS020103INTRODUCTION TO TRADITIONAL AND MODERN SYSTEMS OF MEDICINE

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The course aims to introduce the science of Ayurveda, naturopathy &Unani system of medicine to the students. It is also designed to familiarize the students with modern system of medicine

2. Course Content

Unit 1- Herbs and healing:

Historical perspectives:local, national and global level;Herbal cultures: origin and development of human civilizations; Ethnobotany and Ethnomedicine; Development of European, South and Central American, African, Indian, Chinese, and South East Asian Herbal Cultures (10hrs)

Unit 2- Classical health traditions:

Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (*Ayurveda, Siddha, Unani, Tibetan*) *Ayurveda*: Historical perspective, *Swasthavritta* (measures to be adopted for maintaining the health of healthy person in a positive way through prevention, promotion and correction), *Athuravritta* (disease management and treatment which involves eight specialties including Internal medicine and Surgery); Fundamental principles of *Ayurveda*: *Panchabhootha* theory, *Thridosha* theory, *Saptadhatu* theory and *Mala* theory; Ayurvedic Pharmacology, Ayurvedic Pharmacopoeia; *Mrigayurveda* and *Vrikshayurveda*

(20hrs)

Unit 3-Local health traditions:

Symbiotic relationship between Classical health tradition and Local health tradition; Contemporary relevance of Local health traditions/Oral health traditions, primary health care and local health traditions, homestead level of medicinal plant garden for conservation and utilization of medicinal plants; Scientific documentation of traditional/indigenous knowledge related to plants used for healthcare .Concept of health and disease: A comparative account of (a) concept of health and disease (b) principles of prevention and treatment of disease and (c) health care in Ayurveda, Sidha, Unani and Homoeopathy. (30hrs)

Unit 4- Cross cultural influences:

Mutual influences of Ayurveda, Tibetan Medicine; Chinese Medicine, South American herbal medicine, Homoeopathy and Biomedicine; benefits of integration of ideas and material

(20hrs)

Unit 5- Dietetics and supportive therapies:

Role of diet in health and disease; *pathya, apathya, anupana*; therapeutic and nutritive value of Indian foods; Fermentation techniques and development of self generated alcoholic drinks; role of Raw Juice Therapy, Aromatherapy, Bach's flower remedies, Naturopathy, Hydrotherapy and Yoga in health care Cultural, Social and economic issues in health and disease: Causes for the decline and the current revival of interest in indigenous systems of medicine; a comparative evaluation of accessibility, benefits and costs of different systems of medicine; the relevance of herbal medicine as health care package for the masses in the 21st Century. (10hrs)

3. Recommended Text books:

- Bannerman, R.H., Burton, J. and Wen Chen, C. (eds). 1983. *Traditional medicine and health care coverage*. WHO, Geneva.
- Chancellor, P.M. 1971. *Handbook of the Bach flower remedies*. Saffron Waldon, Essex.
- Martin, G.S. 1995. *Ethnobotany*. Chapman and Hall, London.

4. Recommended References:

- KameswaraRao, C. 2000. *Database of Medicinal Plants*. KSCST, Bangalore.
- Pushpangadan, P., Nyman, U. and George, V. 1995. *Glimpses of Indian Ethno-pharmacology*. *Tropical Botanic Garden and Research Institute*, Thiruvananthapuram, Kerala.

BS020104 LABORATORY COURSE-I

Total Credits: 4

Total Hours: 10 hours/ week

1. Objective of the Course

The objective of the course is to make the students able to do microbiological procedure, plant physiology and biochemistry related experiments.

2. Course content

Unit 1- Microbiology:

Staining of bacteria: simple, Gram's staining, spore staining, etc.; Media preparation: Nutrient agar, blood agar, etc.; Cultivation of microbes, bacterial motility and colony characteristics; Biochemical tests for bacterial identification; Study of anti-bacterial effects of plant extracts; Sterility tests for *Ayurvedic* concepts. (45 h)

Unit 2-Plant physiology:

Determinationof leaf extract (cell sap) pH; Estimation of relative water content in leaves; Extraction of pigments; Separation and identification of pigments (chlorophylls, carotenoids and xanthophylls) by chromatography; Growth analysis: Net primary productivity (NPP), Relative growth rate (RGR), Net assimilation rate (NAR) and Leaf weight ratio (LWR).

Estimation of chlorophyll: Spectrophotometric assay of total chlorophyll, chlorophyll-a and chlorophyll-b. (55 h)

Unit 3- Biochemistry:

Estimation of total sugar, reducing sugars, lipids, phenolic compounds, terpenes, terpenoids, amino acids and proteins; Assay of enzymes: protease, amylase, invertase and succinic dehydrogenase; Electrophoresis: Protein (40 h)

Unit 4- Ecology:

Community analysis for quantitative characteristics through quadrat method: quadrat sampling, minimum size and number of quadrat, measurement of density, abundance, frequency, and dominance and importance value index (IVI). (40 h)

3. Recommended Text books:

- Chodhury, M.A. Practical Plant Physiology. NCBA, 2009.

- Jain, M. and Agarwal, J. and Venkatesh, V. Microbiology Practical Manual. Elsevier India, 2018
- Plummer, D. An Introduction to Practical Biochemistry 3e, McGraw Hill Education, 2017
- Sawhney, S.K. and Singh, R. (Eds). Introductory Practical Biochemistry. Narosa Publications. New Delhi, 1999.

4. **Recommended References:**

- Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 2010.
- Mackie and Mccartney. Practical Medical Microbiology, Elsevier, 1996.

8.2. SECOND SEMESTER COURSES

BS020201	Principles of Management
BS020202	Medicinal and Aromatic plants: Conservation,Cultivation and Management
BS020203	Systematic Botany, Biodiversity and Economic botany
BS020204	Laboratory course-II

BS020201 PRINCIPLES OF MANAGEMENT

Total Credits: 5

Total Hours: 90

1. Objective of the Course

To understand managerial operations of an industry and different types of industries

2. Course content

Unit 1- General Management:

Introduction, significance and definition of management, Administration vs management, Functions of management: planning, organizing, staffing, directing and controlling, Levels of management, Managerial skills, motivation, communication, decision making (10hrs)

Unit 2- Forms of business organization:

Sole ownership, Joint Stock Company, advantages and limitations and salient features of each, cooperatives, private and public companies, government companies'.**Organization**: Basic principles of organization: responsibility and authority, delegation and control, coordination, span of control. **Management structure**: line and staff and functional relationships, use of committees (20hrs)

Unit 3- Management Theories:

Henri Fayol's principles of management, Taylor's scientific management, Max Weber's theory of bureaucracy; human relations approach; Hawthorne studies, behavioral sciences and quantitative approaches (15hrs)

Unit 4 -Personnel Management:

Recruitment, sources, selection procedure, various stages, different types of employment tests, interviewing techniques, placement, transfers and promotions, exit interviews **.Marketing management**: Sales vs marketing, functions of marketing, market research, sales promotion, and advertising. Financial management: Objectives, financial planning, functions of finance managers, sources of industrial finance (35hrs)

Unit 5- Training and development:

Types of training, methods of training, management development, on &off the job training, performance appraisal (10hrs)

3. Recommended Text books

- Chhabra, T.N. 2002. *Principles and Practice of Management.*DhanpatRai and Co. Pvt. Ltd., Delhi

- Koontz, H. and Weihrich, H. 1998. *Essentials of management*. Tata McGraw Hill Pub. Co. Pvt. Ltd., New Delhi
- Massie Joseph, L. 2000. *Essentials of Management* (4th ed.). Prentice Hall of India Pvt. Ltd., New Delhi

4. Recommended References:

- Singh, B.P., Chhabra, T.N. and Taneja, P.L. 2001. *Personnel management and Industrial Relations*. DhanpatRai and Co. Pvt. Ltd., Delhi
- Terry, G.R. and Franklin, S.G. 2000. *Principles of Management*. (8th ed.). AITBS Publishers and Distributors, Delhi
- Weihrich, H. and Koontz, H. 2001. *Management: A Global Perspective*. Tata McGraw Hill Pub. Co. Pvt. Ltd., New Delhi

BS020202 MEDICINAL AND AROMATIC PLANTS: CONSERVATION, CULTIVATION AND MANAGEMENT

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The main purpose of this course is that students have an approach to economical importance, uses, botany and harvested processes of the most significant medicinal aromatic and seasoning specie plants. The course aims to introduce the students to the classification and identification of aromatic plant, seasonings and medicinal plant and to understand cultivation techniques and effective applicarion of current methodology for problem solving

2. Course content

Unit 1- Medicinal and Aromatic plants:

Important medicinal and aromatic plants of India; Non-angiosperm medicinal and aromatic plants (bacteria, fungi, algae, lichens, bryophytes and gymnosperms); Problems of overexploitation and deforestation; Rare and endangered species of medicinal and aromatic plants; Policies for their conservation, regeneration and sustainable use; Medicinal Plant Specialist Group of Species Survival Commission (IUCN) (10hrs)

Unit 2- Fundamentals of cultivation:

History and status of medicinal plant cultivation in India Agro climatic zones of India; Soil: components, types, physical and chemical properties, fertility and productivity, management and maintenance; Cultivation of medicinal plants: season and time, selection and preparation of land for cultivation, tillage (different types), planting density, planting patterns; Methods of propagation: sexual and asexual (vegetative, budding, grafting, layering) .References of Vrukshayurveda (27hrs)

Unit 3- Plant hybridization:

Conventional methods of hybridization: inbreeding and out breeding crops, hybrid vigour, role of human in the selection and production of new varieties of crops; Mutation breeding: spontaneous and induced mutations; physical and chemical mutagens; role of mutation breeding in the production of new varieties of crops (18hrs)

Unit 4- Principles of crop protection:

General management: Irrigation: requirement, methods and time, irrigation efficiency, drainage; Mineral nutrition of plants: organic manures and fertilizers, mode and time of fertilizer application, fertilizer dosage calculation; Growth regulators; Weeds: methods of weed control Diseases: cause of plant diseases (brief account of fungi, bacteria and viruses), classification of plant diseases and their symptoms; Plant disease management: principles and control measures

such as physical, cultural, biological and chemical methods; Pests: different types and important groups of insects and pests, their mode of attack and control measures (physical, mechanical, chemical, biological and cultural); Integrated disease and pest management (25hrs)

Unit 5- Harvesting:

Pre and post harvest treatments; Yield analysis; Cost-benefit analysis; authentic suppliers of seeds and planting materials (10hrs)

3. Recommended Text books

- Ambasta, S.P. (ed) 1988. *The useful plants of India.* CSIR, New Delhi
- Bhattacharjee, S.K. 2004. *Handbook of MedicinalPlants* (4thed.). Pointer Publishers, Jaipur
- Chadha, K.L. and Gupta, R. 1995. *Advance in Horticulture*: Vol. II: *Medicinal and Aromatic Plants*. Malhotra Pub. House, New Delhi
- Sharma J.R. 1994. *Principles and Practice of Plant Breeding*. Tata McGraw-Hill Publishing Co.Ltd, New Delhi

4. Recommended References:

- Pearce, D. and Moran, D. 1994. *The economic value of biodiversity*.Earthscan Pub., London
- Prajapati, N.S., Purohit, S.S., Sharma, A.K. and Kumar,T. 2003. *A Handbook of Medicinal Plants*. Agrobios-India.
- Pushpangadan, P. and Nair, K.N. 1997. Medicinal Plants. In: *The Natural Resources of Kerala*. K. BalachandranThampi*et al*. (Eds.), World Wide Fund for Nature-India, Kerala Chapter, Thiruvananthapuram.

BS020203SYSTEMATIC BOTANY, BIODIVERSITY AND ECONOMIC BOTANY

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The course is designed to develop an understanding among about the morphology, structure & function of various parts of plants. It is designed in a way that the students get acquainted with the basic concepts of ecology & environment. It finally aim at making the students able to appreciate the diversity of ecosystem

2. Course content

Unit 1- Taxonomy and systematics:

Concepts and taxonomic characters: taxa and taxonomic hierarchy; Systems of classification: artificial, natural and phylogenetic systems; Classification systems of Bentham and Hooker, Engler and Prantle, Hutchinson, and Bessey; Taxonomic evidence: morphology, anatomy, embryology, palynology, cytology and micromorphology; Chemotaxonomy; Variation and speciation; Phylogeny of angiosperms, phylogenetic reconstruction (35hrs)

Unit 2- Organizations for systematic studies and taxonomic literature:

Botanical specimen collection, herbarium preparation; Important herbaria and botanical gardens; Botanical Survey of India; Floras, monographs, revisions, keys, indices, and glossaries (10hrs)

Unit 3- Plant nomenclature:

Binomial system; Need for scientific names; Principles of ICBN; Type method; Publication of names: conservation, retention and rejection of names, Principle of Priority (10hrs)

Unit 4- Biodiversity:

Biodiversity concepts and definitions; Genetic diversity, species diversity and ecosystem diversity; Agro biodiversity and cultivated taxa; Loss of biodiversity, factors causing biodiversity loss; Red Data book and Red Lists; Conservation of biodiversity: *in situ* conservation, protected areas-biosphere reserves and national parks, homestead gardens and sacred groves; *ex situ* conservation, botanic gardens seed banks, field gene banks; *in vitro* conservation methods; Biodiversity legislation and conventions, international biodiversity laws, Convention on Biological Diversity, Agenda 21, national legislation, Biodiversity Act; Economic value of biodiversity; Trade restrictions; Economic, legal and ethical issues of biodiversity (20hrs)

Unit 5- Economic Botany:

Plant products and their importance to mankind; Origin and distribution of food plants; Cereals, legumes and nuts, vegetables, fruit plants; Spices and condiments; Fatty oils and waxes;

Essential oils; Forest products: timber, Non-wood forest products- gums, resins; honey, dyes and pigments, etc. (15hrs)

3. Recommended Text books

- Briggs, D. and Walters, S.M. 1997. *Plant Variation and Evolution*, 3rd ed., Cambridge University Press, Cambridge.
- Davis, P.H. and Heywood, V.H. 1963. *Principles of Angiosperm Taxonomy*. Oliver and Boyd, Edinburgh.
- Jones, P.G and Sutton, J.M. 1997. *Plant Molecular Biology: Essential techniques*. John Wiley & Sons, New York.
- Krishnamurthy, K.V. 2003. *An Advanced Text Book of Biodiversity: Principles and Practice*. Oxford IBH Pub. Pvt. Ltd., New Delhi
- Melchias, G. 2001. *Biodiversity and Conservation*. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi
- Rao, C.K., Geetha, B.L. and Geetha Suresh. 2003. *Red List of Threatened Vascular Plant Species in India*. ENVIS, Botanical Survey of India, Ministry of Environment and Forests, New Delhi
- Sivarajan, V.V. 1991. *Introduction to Principles of Plant Taxonomy* (2nded). Edward Arnolod, London.

4. Recommended References:

- Nayar, M.P. 1992. *Hot spots of Endemic Plants of India, Nepal and Bhutan*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram
- Pushpangadan, P. Ravi, K. and Santhosh, V. (Eds.). 1997. *Conservation and Economic Evaluation of Biodiversity*. Oxford IBH Pub. Pvt. Ltd., New Delhi
- Quickie, D.I.J. 1993. *Principles and Techniques of Contemporary Taxonomy*. Blackie Academic and Professional, London.
- Radford, A.E., Dickison, W.C. Massey J.R and Bell, C.R. 1974. *Vascular Plant Systematics*. Harper and Row Publishers, New York.
- Singh, R.S. 1984. *Introduction to Principles of Plant Pthology*. Oxford &IBH Pub. Co. Pvt. Ltd., New Delhi

BS020204LABORATORY COURSE II

Total Credits: 4

Total Hours: 10 hours/ week

1. Objective of the Course

The objective of the course is to familiarise the students with medicinal plants resources, plant morphology and families of flowering plants. The course also aims at the making the students do soil analysis and Field trial (agrotechnology) for important medicinal plants

2. Course Content

Unit 1- Medicinal plant resources:

Field exploration; Collection and preservation of plant specimens; Preparation of herbarium (50 sheets)

Unit 2-Plant morphology:

Morphological description of plants; ***Habit***: ephemeral/ annual/biennial herbs, herbaceous perennials, creepers, trailers, climbers, twiners, woody perennials, shrubs, lianas, trees; ***Root***: Taproot, adventitious roots, aerial roots, assimilatory roots, fibrous roots; tuberous roots; prop roots, stilt roots; ***Stem***: nodes, internodes and buds; phylloclades and cladodes; stem thorns and tendrils; rhizome, corm, tuber and bulb, bulbils and pseudobulbils; ***Leaf***: leaves, stipules; phyllodes; Phyllotaxy: alternate, opposite, whorled; Leaf forms: shape, margin, apex, surface, texture, venation; Types of leaves: simple leaves, pinnately compound leaves and palmately compound leaves; Leaf modifications: scale leaves, phyllode, leaf tendrils; ***Inflorescence***: Inflorescence types: racemose, cymose and specialized types; ***Flower***: unisexual and bisexual flowers; complete and incomplete flowers; actinomorphic and zygomorphic; bractiate and ebractiate; pedicellate and sessile; hypogynous, perigynous and epigynous; pentamerous, tetramerous, cyclic and spirocyclic; ***Calyx***: polysepalous and gamosepalous; caduceus, deciduous and persistent; ***Corolla***: polypetalous and gamopetalous; ***Aestivation***: valvate, twisted, imbricate, quincuncial and vexillary; ***Androecium***: polyandrous, monadelphous, diadelphous, syngenesious, epipetalous, synandrous; didynamous, tetradidynamous, diplostemonous, obdiplostemonous; basifixed, adnate, dorsifixed and versatile; ***Gynoecium***: monocarpellary, bicarpellary, tricarpellary, tetracarpellary, pentacarpellary and multicarpellary; unilocular, bilocular, trilocular, tetralocular, pentalocular and multilocular; apocarpous and syncarpous; ***Placentation***: marginal, parietal, axile, free central, basal, superficial; ***Ovule***: orthotropous, anatropous, campylotropous and amphitropous; ***Fruits***: follicle, legume or pod, siliqua, capsule; dry indehiscent fruit: drupe, berry, pepo and pome; aggregate fruit; multiple (composite) fruit: sorosis and synconium; ***Floral formula and floral diagram***

Unit 3- Selected families of flowering plants:

Acanthaceae, Amaranthaceae, Anacardiaceae, Apiaceae, Apocynaceae, Araceae, Aristolochiaceae, Asclepiadaceae, Asteraceae, Capparaceae, Clusiaceae, Combretaceae, Convolvulaceae, Cucurbitaceae, Cyperaceae, Dipterocrpaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Lauraceae, Liliaceae, Malvaceae, Meliaceae, Moraceae, Myrtaceae, Nyctaginaceae, Orchidaceae, Poaceae, Ranunculaceae, Rubiaceae, Rutaceae, Scrophulariaceae, Solanaceae, Verbenaceae, Zingiberaceae.

Unit 4 -Soil analysis:

Soil sampling; Determination of soil moisture, pH, water holding capacity, field capacity; Estimation of organic carbon, carbonate, bicarbonate, calcium, magnesium, chloride, nitrogen, phosphorus and potassium.

Unit 5

Field trial (agrotechnology) for important medicinal plants.

3. Recommended Text books

- Ambasta, S.P. (ed) 1988. *The useful plants of India.* CSIR, New Delhi
- Bhattacharjee, S.K. 2004. *Handbook of MedicinalPlants* (4thed.). Pointer Publishers, Jaipur
- Chadha, K.L. and Gupta, R. 1995. *Advance in Horticulture*: Vol. II: *Medicinal and Aromatic Plants*. Malhotra Pub. House, New Delhi

4. Recommended References:

- Sharma J.R. 1994. *Principles and Practice of Plant Breeding*. Tata McGraw-Hill Publishing Co.Ltd, New Delhi

8.3. THIRD SEMESTER COURSES

BS020301	Cell Biology and Biotechnology
BS020302	Phytochemistry
BS020303	Pharmacognosy
BS020304	Laboratory course-III

BS020301 CELL BIOLOGY AND BIOTECHNOLOGY

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The course aims at making the students understand the structures and purpose of basic components of prokaryotic and eukaryotic cells. The course also aims at acquainting the students with various fields of biotechnology & their application

2. Course content

Unit 1- Ultra structure of plant cell:

Organization and functions of cell; Cell membrane and cell organelles: cytosol, membranes, cytoskeleton, endoplasmic reticulum, nucleus, nucleolus, chromosomes, golgi complex, lysosomes, peroxisomes, mitochondria and chloroplast; Nucleo-cytoplasmic transport (10hrs)

Unit 2- Cell cycles:

Phases of cell cycle, check point of cell cycle, extra cellular cell signals (hormones, cytokinines and growth factors), signal receptors, photoreception; Chromosomes and cell division: chromatin structure (histones, nucleosomes and fibers) and chromosome replication, mitosis (nuclear envelope, centromere, telomeres) meiosis (chromosome pairing, synapsis and movement, meiotic spindle), cytokinesis **(15hrs)**

Unit 3- Chromosomal (numerical and structural) variation:

Euploids, aneuploids and polyploids; β-chromosomes; structural aberrations; Experimental induction of numerical and structural changes in chromosomes, role of chromosomal variation in evolution and plant breeding (10hrs)

Unit 4- Recombinant DNA technology:

DNA sequence analysis: gene libraries, gene cloning, cutting and joining of DNA; Transformation, vectors, laboratory synthesis of genes, nucleic acid hybridization; Plant improvement: improvement of plants through manipulation of phenotypic traits; protoplast isolation and fusion; genetic engineering and transgenic plants. Economic, Social and ethical implications: Intellectual and material property rights; Technology transfer; International trade; Ethical and social concerns regarding the use of genetically engineered organisms or their products in agriculture and medicine (20hrs)

Unit 5-Applications of biotechnology:

Plant tissue culture: Totipotency of cells; concept and general composition of culture media; cell, tissue and organ culture; Somatic embryos, somaclonal variation; control of

differentiation, growth and flowering; Haploid production, embryo rescue; Micropropagation Applications in: Pharmaceuticals (production of therapeutic proteins, drugs and nutritional supplements), Medicine (molecular diagnosis of disease, monoclonal antibodies, gene therapy, biotransformation, vaccine production), Forensic science (blood typing and DNA finger printing), Industry (enzyme engineering, biocatalysts, biopolymers, biosensors), Environment management (bioremediation), Genetic conservation (storage of DNA, cells, pollen, tissues and organs by *in vitro* methods), and Food (enhanced keeping quality, nutritional superiority, fermentation products (35hrs)

3. Recommended Text books

- Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. 1997. *Biotechnology and Plant GeneticResources Conservation and Use*. CAB International Oxon
- Chirikjian, J.G. (ed). 1995. *Biotechnology: Theory and Techniques* (Vol. 1&2). Jones &Barlett Pub., Boston
- Clark, M.S. and Wall, W.J. 1996. *Chromosomes the Complex Code*. Chapman and Hall, London
- Walker, J.M. and Gingold, E.B. 1993. *Molecular Biology and Biotechnology* (3rd ed.). Royal Society of Chemistry, Cambridge

4. Recommended References

- Murray, R.M. (ed). 1991. *Advanced Methods in Plant Breeding and Biotechnology*. CAB International Oxon
- Ravishankar, G.A. and Venkatesh, L.V. 1997. *Recent Advances in Biotechnological Applications of Plant Tissue and Cell culture*. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi
- Stebbins, G.L. 1971. *Chromosomal evolution in higher plants*. Edward Arnold, London

BS020302 PHYTOCHEMISTRY

Total Credits: 5

Total Hours: 90

1. Objective of the Course

The course aims to provide students with the necessary skills for separation of the active constituents obtained from natural sources (alkaloids – glycosides and anticancer drugs) in addition to the different methods of separation (chromatography).

2. Course content

Unit 1-Phytochemical techniques:

Cold and hot extraction methods, liquid-liquid extraction techniques, liquid-carbon dioxide extraction, concentration and evaporation techniques, lyophilisation; TLC, preparative TLC, PC, column chromatography, gel-chromatography, affinity chromatography, ion-exchange chromatography, gas-liquid chromatography, high performance liquid chromatography, high performance thin layer chromatography and colorimetric analysis of extracts; finger printing of extracts and estimation of bioactive molecules (15hrs)

Unit 2- Bioactive secondary metabolites:

Steroids: Occurrence and distribution in plants, saponins, sapogenins and steroids; Isolation, structure elucidation and synthesis of bioactive steroids such as cholesterol, diosgenin, estrone, estrodiol, etc.; ***Terpenoids***: Occurrence and distribution in plants, essential oils, aroma chemicals, mono and sesquiterpenoids, their use in flavour and perfumery industry, diterpenes, triterpenes, isolation and characterization of terpenes, their synthesis; ***Alkaloids***: occurrence and distribution in plants, bioactive alkaloids-isolation and structure elucidation of alkaloids such as atropine, quinine, papaverine, thebaine, vincristine, etc.; ***Anthocyanidin***: occurrence and distribution in plants, isolation and characterization of anthocyanins, chalcones, flavones, isoflavones, chromones, coumarins; structure elucidation of quercetin, kaempferol, etc. (20hrs)

Unit 3-Spectroscopy:

UV/Visible, IR, 1H and 13 C NMR, 2D NMR and MS; application of spectroscopic techniques in structural elucidation of secondary metabolites (20hrs)

Unit 4- Instrumentation:

Analytical Methods: Light and election microscopy, tissue printing cytochemical localization, immunological methods (production of monoclonal and polyclonal antibodes, agglutination and precipitation tests, immuno diffusion assays, immuno electrophoresis, radio immunological assay), radioactive isotopes and autoradiography, photometry and radiometry, atomic spectroscopy, GC-MS, LC-MS, centrifugation, electrophoresis, IEF and 2D electrophoresis, joint selective electrodes, enzymes, medicinal analysis (25hrs)

Unit 5- Applications:

Applications of biomolecular chemistry in plant systematics, plant physiology, medicine and pharmaceuticals, forensic science, environmental science, biotechnology, herbal and modern drug industries, food flavour and cosmetic industries (10hrs)

3. Recommended Text books

- Agarwal, P.K., Thakur, R.S. and Bansal, C.M. 1989. *Carbon-13 NMR of Flavonoids*. Elsevier Science Publishers, Amsterdam
- Athkins, P. and Jones, I. 1999. *Chemical Principles the Quest for Insight*. W.H Freeman and Co. New York.
- Dennis, D.T and Turpin, D.H. (Eds.). 1990. *Plant physiology, Biochemistry and Molecular biology*, Longman Scientific and Technical Essex

4. Recommended References:

- Schwedt, G. 1997. *The Essential Guide to Analytical Chemistry*. John Wiley & Sons, New York
- Silverstein, R.M., Bassler, G.C. and Morrill, T.C. 1981. *Spectroscopic Identification of Organic Compounds* (4^{th} ed.). John Wiley, New York
- Smith, P.M. 1976. *The Chemotaxonomy of Plants*. Edward Arnold, London
- Solomon, P.H. and Nakanishsi, K. 1998. Infrared Absorption Spectroscopy (2^{nd}ed.). Adams E (Pr) Inc.

BS020303 PHARMACOGNOSY

Total Credits: 5

Total Hours: 90

1. Objective of the Course

This course aims for gaining knowledge about raw drugs and maily its cultivation , storage and uses

2. Course content

Unit 1 - Pharmacognosy:

Definition, scope and applications in herbal medicine Classification and identification of drugs: Need for classification of drugs; classical (taxonomic, morphological, organoleptic, therapeutic); microscopy and modern (biogenetic) criteria for classification of powdered drug, methods for documentation of raw drugs (25hrs)

Unit 2- Processing of plant drugs:

Methods of collection, process and storage of medicinal and aromatic plants; purification of raw drugs; factors causing drug contamination, methods of storage of drugs (20hrs)

Unit 3- Drug administration in Indian systems of medicine:

The holistic concept of drug administration; description of Saptapadarthas in Dravyaguna; (20hrs)

Unit 4- Single plant drugs

Formulations in Ayurveda, Siddha and Unani; classical and modern means of drug administration (20hrs)

Unit 5- Pharmacognosy of crude drugs:

Based on market survey including adulterants and substitutes (5hrs)

3. Recommended Text books:

- Jackson, B.P. and Snowdon, D.W. 1992. *Atlas of Microscopy of Medicinal Plants, Culinary herbs and Spices*. CBS Pub., New Delhi

4. Recommended References

- Trease, G.E. and Evans, W.C. 1983. *Pharmacognosy* (12thed.). BailliereTindall, London

BS020304 LABORATORY COURSE-III

Total Credits: 4

Total Hours: 10 hours/ week

1. Objective of the Course

The course is designed to introduce experiments on estimation of fixed oil and alkaloids, study and physical evaluation of crude drugs and collection and submission of raw drug samples.

2. Course content

Unit 1- Phytochemistry:

Estimation of fixed oil from fruit kernel (e.g. Percentage yield of coconut oil in copra); Determination of saponification value, Iodine value and acid value of fixed oil; Estimation of nitrogen in plant parts using Kjeldahl's method; Estimation of the alkaloid piperine from Pepper, vasicine from *Adhatoda*leaves and carbohydrates in plant samples using Duboi's method; Thin Layer Chromatography of the Petroleum ether extract of Cinnamon bark/Clove/Nutmeg kernel/Turmeric/Cardomom seeds; Paper Chromatography of 70% aqueous alcoholic extract of Hibiscus leaves/Curry leaves/ Muringa leaves for amino acids (spray reagent: Ninhydrin); Isolation of Starch from Potato; Isolation and estimation of caffeine from tea leaves; Paper Chromatography of monosaccharides from fruits such as Mango/ Jack fruit /Orange; Estimation of ascorbic acid from gooseberry. (55 h)

Unit 2- Pharmacognosy:

Study of physical evaluation of crude drugs: determination of optical rotation and refractive index of drug samples (Castor oil); determination of Rf-value by Thin Layer Chromatography; determination of total ash value, acid soluble ash value and water soluble ash value of crude drug samples; morphological/taxonomic description (including morphological description of useful plant parts) and identification of important medicinal and aromatic plants of Kerala; histochemical/chemical tests for identifying various plant components such as suberin, cutin, mucilage, pectin, starch, protein, oils, alkaloids, tannin, calcium oxalate and calcium carbonate, in various crude drug samples; organoleptic evaluation of 25 crude drug samples: colour, odour, taste and other features; tests for detection of organic acids in: fruits of tamarind and lemon, leaves of *Oxalis corniculata*, etc.; **Anatomical studies**: killing and fixing of tissues, tissue dehydration, paraffin infiltration, mounting, microtomy, staining and mounting; anatomical study of selected plants: *Cinnamomumverum*, *Mimusopselengi*, *Azadirachtaindica* and *Saracaasoca*; Micrometry: determination of cell size and area using micrometers and cameralucida; determination of stomatal index and frequency. (100 h)

Unit 3- Raw drug resources:

Collection and submission of raw drug samples (25 samples) (25 h)

3. Recommended Text books:

- Kokate, C.K., Gokhale, S.B. Practical pharmacognosy, NiraliPrakashan, 2009.
- Khandelwal, K.R. Practical Pharmacognosy: Techniques and Experiments, NiraliPrakashan, 2008.

4. Recommended References

- Trease, G.E. and Evans, W.C. 1983. *Pharmacognosy* (12thed.). BaillièreTindall, London

8.3. FOUTH SEMESTER COURSES

BS830401	Electives Group A	Research Methodology and Science Communication
BS830402		Product Development, Quality Control and IPR
BS830403		Basics of Plant Tissue Culture
BS840401	Electives Group B	Pharmacology, Clinical Trial and Biostatistics
BS840402		Business Plan and Entrepreneurship Development
BS840403		Transgenic Techniques for Crop Improvement
BS850401	Electives Group C	Introduction to Nanotechnology
BS850402		Ecology and Ecoinformatics
BS850403		Green House Management and Plant Protection
BS020401	Laboratory course IV	
BS020402	Research Project & dissertation	
BS020403	Comprehensive Viva-Voce	

ELECTIVES
Group A

BS830401 RESEARCH METHODOLOGY AND SCIENCE COMMUNICATION

Total Credits: 4

Total Hours: 90

1. Objective of the Course

Post graduate courses in general are designed to encourage the students to further their knowledge through research activities. The course aims to introduce the student to the philosophy in research and accepted methodologies followed in due course and importance and methods of communicating science effectively. Also a basic understanding regarding biostatistics is also included.

2. Course content

Unit 1: Creativity, thinking skills and outlooks on research

Various views on creativity.Critical thinking.Problem solving strategies.Logical thinking – common logical fallacies; Types of research – pure and applied, incremental and innovative, qualitative and quantitative. Philosophy of science: the scientific method, Research process. The raw data- experimental designs, measurement and recording.Collection, analysis and interpretation of data.Ethics in scientific research and academics. (14 h)

Unit 2: Research papers

Format of a science research paper.Reference citing styles.Literature collection and report writing.Proof reading and editing.Publication process. Peer review – single/ double blind and open. Plagiarism. Open Access Publications; Google scholar and Scopus. Bibliometrics and Webometrics – impact factors, h-, h b-, g- indices, Drawbacks in interpreting impact. Reference management tools. Current awareness: RSS feed, TOC alerts, DB alerts. (18 h)

Unit 3: Biostatistics

The mean, the range, the standard deviation, standard error, student t-test, student t-distribution, chi-square test, correlation.Basic statistics-averages statistics of dispersion, coefficient of variation and analysis of variance. R software for statistical computing and graphics: (20 h)

Unit 4: Science Communication

Fundamentals of Science communication.History of Science communication, Science communication in India.Entrepreneurship in Science communication.Science communication in the information age. (20 h)

Unit 5: Practicing Science Communication

Effective science communication. – speaking and writing skills. Communication skills for scientists.Different modes of science communication and popularisation. Visualizing science

for communication..Making effective multi-media and poster presentations. Science diplomacy and public understanding of science (18 h)

3. Recommended Text books:

- Antonisamy, B. et al. Principles and Practice of Biostatistics. Elsevier India, 2017.
- BijuDharmapalan. Scientific Research Methodology. Alpha Science Int. Ltd., 2012.
- Holliman, R. et al. Practising Science Communication in the Information Age: Theorizing Professional Practice, Oxford University Press, 2009
- Kothari C. R. and Gaurav G. Research Methodology: Methods and Techniques. New Age Publishers, 2019.
- Wilson, A. (Ed). Handbook of Science Communication. Routledge, 1998.

4. Recommended References:

- Bagla, P. and Binoy, V. V. (Eds.) Bridging the Communication Gap in Science and Technology Lessons from India, Springer, 2017.
- Bassham, G., Irwin, W., Nardone, H. and Wallace, J.: Critical Thinking: A Students Introduction, Tata McGraw Hill, 2008
- Bennett, D.J. et al. Successful Science Communication. Cambridge University Press, 2012.
- Charles Pavitt. The Philosophy of Science and Communication. Nova Science Publications, 2001.
- Davies, S. R., Maja, H. Science Communication Culture, Identity and Citizenship. Palgrave Macmillan, 2016
- Day, R.A. How to Write and Publish a Scientific Paper. Greenwood Press, 2011
- Holliman, R., et al. Investigating Science Communication in the Information Age: Implications for Public Engagement and Popular Media. Oxford, 2009.
- Martin W. Bauer Journalism, Science and Society: Science Communication Between News and Public Relations. Routlledge, 2007
- Olson, R. Don't Be Such a Scientist: Talking Substance in an Age of Style. Island Press, 2010
- Pagano, M. andGauvreau, K.Principles of Biostatistics. Chapman and Hall, 2018.
- Patairiya, M. Science Journalism in India. Pantaneto Press, UK. http://pantaneto.co.uk/science-journalism-in-india-manoj-patairiya/
- Rowena Murray. How to Write a Thesis, Tata McGraw Hill, 2010.

BS830402 PRODUCT DEVELOPMENT, QUALITY CONTROL AND IPR

Total Credits: 4

Total Hours: 90

1. Objective of the Course

The course is designed to familiarize the students with standard ayurvedic formulations, pharmacopeia of India and quality control. The course also aims at making the students understand the rights that exist to protect the intellectual holders.

2. Course content

Unit 1- Quality control from traditional medicine perspective:

Ayurvedic Formulary of India and pharmacopoeial standards for Ayurvedic formulations; Ayurvedic Pharmacopoeia of India; Indian herbal pharmacopoeia; British pharmacopoeia; Japanese standards for herbal medicine; Pharmacopoeia of the Peoples Republic of China. (25 hrs)

Unit 2- Quality control of raw drugs and Product development:

WHO guidelines for assessment of herbal drugs; authentication and standardization of herbal raw materials; quality control of processed herbal drugs: general protocols, chemical assay, bioassay, stability and safety assessments; Good manufacturing practices; regulatory bottlenecks with herbal drugs. **Drug testing, marketing network and feasibility studies** (20 hrs)

Unit 3- Production technology: Methods of preparation and quality assessment of *Arishtas, Asavas, Gulikas, Ghrithas, Satva, Tailas, Churnas, Lepas* and *Lehyas*; preparation of Siddha and Unani formulations; industrial practices of manufacture of herbal drugs (15Hrs)

Unit 4- Intellectual Property Rights:

Patent Amendment Act 2002; Patent Rules 2003; Biodiversity Act 2002; Biodiversity Rules 2004 of the Government of India; Protection of Plant Varieties and Farmer's Act 2001; *sui generis* system; benefit sharing model (15 hrs)

Unit 5- Rights relating to medicinal and aromatic plants:

Natural resource rights of countries and geographical areas; rights of governments, organizations, communities and individuals; geographical indication; intellectual property rights and traditional knowledge; new varieties and species and new uses and processes (15 hrs)

3. Recommended Text books:

- Bisset, N.G. (Ed.). 1994. Herbal Drugs Phytopharmaceuticals. Medpharm, Stuttgart
- GOI. 2002. *Biodiversity Act*. Govt. of India, New Delhi

- GOI. 2001. *The Protection of Plant Varieties and Farmer's Act*. Govt. of India, New Delhi.
- Handa, S.S., Deepak, M. and Mangal, A.K. 1998. *Indian Herbal Pharmacopoeia* Vol. 1. IDMA and RRL-Jammu

4. Recommended References:

- Wagner, H. and Baldt, S.Z. 1996. Plant Drug Analysis: A Thin Layer Chromatography Atlas. Springer Verlag, Berlin
- WHO. 1992. Quality Control Methods for Medicinal Plant Material. WHO/PHARM/ 92.559
- WHO. 1998. Quality Control Methods for Medicinal Plant Material. WHO, Geneva
- Yeshwanth, Shenoy. 2005. Biodiversity: Law and Practice. Law Books Centre, Banergee Road, Eranakulam

BS830403BASICS OF PLANT TISSUE CULTURE

Total Credits: 4

Total Hours: 90

1. Objective of the Course

The course is designed to give the student an overview of plant tissue culture which will make her/him appreciate the different techniques involved in the process and finally the applications of plant tissue culture for the greater goal of crop improvement.

2. Course Content

Unit 1: History of Tissue Culture technique

Requirements for a Cell Tissue Culture lab like Laminar Air Flow device, sterilisation scheme for culture chamber. Totipotency of plant cells- dedifferentiation and dedifferentiation. (18 h)

Unit 2 Nutrient media

Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents, vitamins, amino acids etc.Sterilisation of the media and appliances by autoclaving. (18 h)

Unit 3: Culture of plant materials

Explants selection and technique of culturing the same.Growth conditions.Methods of sub culturing and transfer of regenerated plants to the field. (18 h)

Unit 4: Micro propagation

Proliferation of axillary buds, induction of adventitious buds and bulbs, callus regeneration, somatic embryogenesis, continuous culture, immobilized cultures, estimation of growth and artificial seeds. (18 h)

Unit 5: Cloning

Isolation of single cells, culturing of single cell- different methods, culture cell viability test. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. (18 h)

3. Recommended Text books

- Razdan, M. K. Introduction to Plant Tissue Culture. Oxford & IBH, 2005.
- Gamborg, O. and Gregory, P. (Eds.) Plant Cell, Tissue and Organ Culture: Fundamental Methods, Springer, 1995.

4. Recommended References:

- Guptha, P.K. Elements of Biotechnology. Rastogi Publications, 2016
- Slater, A., Scott, N. and Fowler, M. Plant Biotechnology: The Genetic Manipulation of Plants, Oxford, 2008.

- Kung, De S., and Wu, R. Transgenic Plants: Engineering and Utilization, Academic Press, 2012
- Jogdand, S.N. Advances in Biotechnology. Himalaya Publishing House, 2007.

ELECTIVES
GROUP B

BS840401 PHARMACOLOGY, CLINICAL TRIAL AND BIOSTATISTICS

Total Credits: 4

Total Hours: 90

1. Objective of the Course

The course is designed to enable the students to learn the purpose of clinical trials and how Biostatistics is applied to the development, analysis and completion of the clinical trial process

2. Course content

Unit 1 - Pharmacology and Ethnopharmacology:

Definition, scope and applications in herbal medicines; Ethnopharmacology: Pharmacological evaluation of drugs from ethnomedicine (*Strychnosnux-vomica*, *Rauvolfiaserpentina*and *Digitalis species*); Importance of ethnopharmacological studies. **Criteria for pharmacological evaluation of drugs**: Absorption, distribution, elimination, pharmacokinetics and drug reception; Drug abuse and iatrogenic diseases **.Pharmacological activity of plant drugs**: Examples of plant drugs with effects on the autonomous and central nervous systems, cardiovascular system and the gastrointestinal system; Plant drugs with antimicrobial activity; Plant chemicals in modern pharmacology: Biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, Vinca alkaloids; synthetic substitutes for therapeutically active plant constituents; drug improvement by structure modification and biotransformation **.**

Clinical pharmacology, Drug therapy and clinical pharmacology; therapeutic situation; benefits and risks of use of drugs; qualitative and quantitative aspects of drug action; mechanisms of drug action; therapeutic efficacy; therapeutic index; tolerance; dosage forms and routes of drug action; factors affecting drug action; drug dosage and dosing schedules; biological variations in drug action; Adverse drug reactions and Drug Poisoning: Definition, detection, classification, and causes of ADR; principal clinical manifestations and treatment of ADR, general principles of management of drug poisoning; antidotes; Classification of drugs (35hrs)

Unit 2- Recent developments in ethnopharmacological validation of traditional medicine:

Bioassays related to active principles from plants: anti-bacterial, anti-fungal and anti-viral agents; anti-malarials; immuno-modulators; mediators of inflammation; anti-hepatotoxic agents; platelet aggregating factors; cardio-vascular agents; anti-inflammatory agents; diuretic agents; anti-allergic principles; fertility regulating agents; aphrodisiacs; hypo lipidaemic and hypo glycaemic agents; acute toxicity testing; Computerized database creation of ethnopharmacologically proven Indian medicinal plants (13hrs)

Unit 3- Culture of animal cells for ethnopharmacological research

Use of isolated tissues for determination of pharmacological activity .Care, breeding and management of laboratory animal's .Discovery and Development of Drugs: Pharmacology in drug development; principal approach to drug discovery; process of new drug development, pre-clinical trials .Evaluation of drug in man: Therapeutic evaluation; therapeutic trial design; size of therapeutic trial; clinical trials (19 hrs)

Unit 4 -Pharmacoepidemology

Observation cohort study; case control study; record linkage by computer (5 hrs)

Unit 5- Principles

Experimental design and research concepts: sampling, probability, levels of significance, degrees of freedom and normal distribution; measure of central tendency; arithmetic mean, median and mode **.Measure of dispersion**: Standard deviation, standard error, coefficient of variation, correlation and regression; Tests of significance: t-test, normal curve test, F-test and modified F-test and chi-square test (18 hrs)

3. Recommended Text books:

- Barar, F.S.K. 2004. *Essentials of Pharmacotherapeutics*. S.Chand and Company, New Delhi.
- Beal, J.L. and Reinhard, E. (Eds.) 1981. *Natural Products as Medicinal Agents*. Suppl. to PlantaMedicaHippokratesVerlag. Stuttgart
- Brown, D. and Rothery, P. 1993. *Models in Biology, Mathematics, Statistics and Computing*. John Wiley & Sons, New York
- Derasari, H.R., Gandhi, T.P. Goyal, R.K. and Mehta, A.N. 1993. *Elements of Pharmacology* (6^{th}ed). SB Shah Prakashan, Ahemadabad

4. Recommended References

- Oliver-Bever, B.E.P. 1986. *Medicinal Plants of Tropical West Africa*. Cambridge University Press, Cambridge
- Pluchik, R. 1968. *Foundations of Experimental Research*. Harper and Row Pub., New York
- Pushpangadan, P., Nyman, U. and George, V. 1995. Glimpses of Indian Ethnopharmacology. TBGRI, Thiruvananthapuram

BS840402 BUSINESS PLAN AND ENTREPRENEURSHIP DEVELOPMENT

Total Credits: 4

Total Hours: 90

1. Objective of the Course

This course aims to promote a culture of entrepreneurship among the students

2. Course content

Unit 1- Entrepreneur and intrapreneur:

Generation of project ideas; portfolio models of planning; screening of project ideas (14hrs)

Unit 2- Technical Feasibility:

Technology development; acquisition-decisions on appropriate technology; environmental appraisal for projects (18 hrs)

Unit 3- Financial feasibility:

estimation of cost of project; requirement of long term funds; estimation of working capital requirements; projected cash flow statement and budgeting; project appraisal techniques; social cost benefit analysis; concept and approaches (20hrs)

Unit 4- Marketing feasibility:

Market opportunity analysis; systematic market appraisal; demand forecasting methods; quantitative and qualitative; Economic evaluation and marketing: Market demand and supply potential; import and export policies, criteria to determine economic value, value of land for cultivation, cultivation costs, value of raw and processed drugs, royalties and costs of marketing (22 hrs)

Unit 5- Preparing Business Plan, Pre-feasibility report and its clearance:

Estimates and Techno Economic Feasibility Report (TEFR); role of inter-related projects (multi-projects); Preparation of Detail Project Reports (DPR) (16 hrs)

3. Recommended Text books:

- Chandra Prasanna. *Financial Management*. Tata McGraw Hill Pub. Co.Ltd., New Delhi
- Chandra Prasanna. *Projects: Planning, Analysis, Selection, Implementation and Review.* Tata McGraw Hill Pub. Co.Ltd., New Delhi
- Kotler, P. 2002. Marketing Management. (10thed.). Prentice Hall of India Pvt. Ltd., Delhi
- Levin, R.I. and Rubin, D.S. 2002. *Statistics for Management* (7thed.). Pearson Education Asia, Delhi.

4. Recommended References

- Patel, B.M. 2005. *Project Planning, Analysis and Management*. Vikas Publishing House, New Delhi

BS840403 TRANSGENIC TECHNIQUES FOR CROP IMPROVEMENT

Total Credits: 4

Total Hours: 90

1. Objective of the Course The course aims to impart in the students an understanding of various molecular approaches followed in crop improvement programmes. The students will be introduced largely to the various marker technologies and their applications like in mapping and selection apart from genetic engineering involving nuclear and other organellar genomes, and different traits that are being introduced/ augmented in the process which helps in crop improvement

2. Course Content

Unit 1 Genetic engineering through *Agrobacterium tumefaciense*

Ti plasmids, Structure of TDNA. Suitability of Ti plasmid as cloning vector.T-DNA integration into chromosomal DNA.Genetic engineering through disarmed Ti plasmids.Regeneration of plantlets. (16 h)

Unit 2 Chloroplast and mitochondrial engineering

Engineering of chloroplast genome in Chlamidomonas, Transformation of chloroplast genome in higher plants. (14 h)

Unit 3 Molecular maps of plant genomes

RFLP Genetic maps in plants, Linkage of major genes and QTLs to RFLPs, Uses of RFLPs maps, Cytogenetic RFLP maps using aneuploids, RAPDs and SSRs. Crop improvement and gene tagging, physical maps using in- situ hybridisation (ISH), Resolution gap. Molecular maps in Yeast and other fungi (22 h)

Unit 4: Transgenic plants and Crop improvement

Herbicide resistant, Virus resistant, Insect resistant, Fungi and Bacterial resistant, plants, Transgenic plants with improved storage proteins, Stress- cold –drought tolerant plants, Fertility restoration and transgenic plants as bioreactors (20 h)

Unit 5: Gene banks and biosafety

Importance of gene banks, Establishment of gene banks using plasmids and phages. Risk factors involved in the release of Genetically Engineered Organism: Possible dangers of GEO's, biohazards of rDNA technology, risk evaluation and release of GEO's. GRAS.Bio safety handling of hazardous chemicals and radioisotopes.Biological containment –EL-1, EK-2 and EK-3.Physical laboratory containments- P1, P2, P3 and P4. (18 h)

3. Recommended Text books:

- Acquaah, G. Principles of Plant Genetics and Breeding. Wiley-Blackwell, 2012.
- Chawla, H.S. Introduction to Plant Biotechnology. CRC Press, 2009.
- Trevan M. D, Boffey S, Goulding K. H, Stanbury P. Biotechnology- The Biological Principles. Tata McGRaw Hill, 1995.

4. Recommended References:

- Abdin, M.Z. et al. Plant Biotechnology: Principles and Applications. Springer, 2017.
- Krebs, J.E.; Goldstein, E.S. and Kilpatrick, S.T. Lewin's Genes XII. Jones & Bartlett Learning, Burlington, MA, 2018
- Old, R.W. and Primrose, S.B. Principles of Gene Manipulation. Blackwell Publishing, MA, 2001.
- Sleper, D.A. and Poehlman, J.M. Breeding Field Crops. Wiley-Blackwell, 2006
- Tzfira, T. and Citovsky, V. (Eds). *Agrobacterium*: From Biology to Biotechnology. Springer, 2008.
- Watson et al. Molecular Biology of the Gene. Pearson, 2014.
- Xu, Y. Molecular Plant Breeding. CABI, 2010

ELECTIVES
GROUP C

BS850401 INTRODUCTION TO NANOTECHNOLOGY

Total Credits: 4

Total Hours: 90

1. Objective of the Course

The course aims to introduce the field of nanotechnology

Unit -1: Basics of Nanotechnology

Definitions and Scales, Origins of Nanotechnology Beyond Moore's Law, Current State of Nanotechnology, Future of Nanotechnology, Nanotechnology in Nature and Applications Tools of trade - Seeing the nano Scale, Nature of Light, Electron Microscope, Scanning Probe Microscope, Basic governing Theories – Quantum Mechanics, Chemical Bonds, Crystal Structure Negative Differential Resistance (NDR). (18 h)

Unit -2: Nanomaterials

Molecular building blocks for nanostructure systems, Nanomaterials - Formation of Materials, Carbon Nanomaterials, Buckyball, Carbon Nano Tubes, Inorganic Nano Materials, Zero Dimensional Nano-Structures, One Dimensional Structures, Two Dimensional Structures.

(16 h)

Unit -3: Electrical Resistance - an Atomistic View

Energy Band Diagram: Energy level diagram, Fermi function, n - type operation, p - type operation, Negative differential resistance - thermo electric effect - Nano transistors – in elastic spectroscopy - NEGF formalism - input parameters - derivation of NEGF equations - Inflow / Outflow, quantum of conductance, Potential profile, Iterative procedure for self - consistent solution, Quantum capacitance. (20 h)

Unit -4: Nanoscale Device Modeling

Model Hamiltonian, SAM - Signals used to control and probe molecules, Synthesis; Fabrication and overview of Nano tube devices - their properties, Inadequacy of macroscopic models, Equilibrium, Non - Equilibrium, Density Matrix and current operator; NEGF Formalism – Broadening (18 h)

Unit-5: Ethical Social Implications and Applications

Environment - Society, Technology, and the Environment, Environmental Risks of Nanotechnology, Nanotechnology Solutions to Environmental Problems, Overall Risk and Precaution Application : Water Purification, Solar Energy, Human Implants, RF - ID Chipped Identification, Military – Nano Enabled Military, Nano enabled Defense System. (18 h)

3. Recommended Text books:

- Reed, M.A. and Lee, T. Molecular Nano electronics. American Scientific Publishers, 2003.
- Horst - Gunter Rubahn, Basics of Nano Technology, Wiley - VCH VerlagGmbh& Co, 2008.

- Chris Binns, Introduction to Nanoscience and Nanotechnology, John Wiley and Sons, 2010.

4. Recommended References:

- Fritz Allhoff, Patrick Lin, and Daniel Moore. What Is Nanotechnology and Why Does It Matter. Wiley Blackwell A John Wiley & Sons, Ltd., 2010

SuprioDutta Tutorial on, “Electrical Resistance - an atomistic view”, Purdue University

BS850402 ECOLOGY AND ECOINFORMATICS

Total Credits: 4

Total Hours: 90

1. Objective of the Course

The course aims to impart the fundamental concepts of ecology, important laws and conservation as well as restoration measures and finally introduces the student to ecoinformatics as it is relevant in the current big data era.

2. Course Content

Unit 1: Introduction to Ecology

Definition and scope of Ecology; Ecosystem: concept of ecosystem, significance of habitat, trophic levels, primary and secondary productivity; Population: population characteristics, population growth, biotic potential, factors affecting population growth, carrying capacity; Community ecology: classification of communities, qualitative, quantitative and synthetic characteristics. (22 h)

Unit 2: Phytogeography

Principles governing plant distribution; Phyto-geographic regions of the world and India; Adaptation; Speciation and extinction; Native, naturalized and exotic taxa; Endemism: Concept of endemism, endemic flora; Rarity: Rare, endangered and threatened category (IUCN) species.

(18 h)

Unit 3: Restoration of degraded lands

Reforestation of adverse sites, development of stress tolerant plants, use of mycorrhizae in reforestation, use of microbes for improving soil fertility, diverse aspects of reforestation of soils contaminated with heavy metals; Environment protection-issues and problems, International and national efforts for environment. (22 h)

Unit 4: Ecoinformatics

Introduction. Big data - novel data sources including remotely sensed data, social media, or citizen science, large scale patterns derived from Big data approaches regarding andasapes, pests and beneficial . Ecosystem Modeling – land use, soils and climate. Sensors in agriculture- - drone and big data management. Computation and informatics; applications of big data to animal production, crop and pest management, or breeding; decision - making based on big data. Privacy concerns regarding big data. Precision agriculture. (28 h)

3. Recommended Text books:

- Chapman and Reiss. Ecology principles and applications. Cambridge University.

- Odum E. P and Barret G W . Fundamentals of Ecology. W. B Saunders company, Philadelphia
- Odum E. P. Basic Ecology. Saunders College

4. Recommended References:

- Alleby M. Basics of Environmental Science. Routledge, New York
- Cunningham, W. P and Siago, B. W. Environmental science.
- Kewin T. P and Owen C. A., Introduction to global environmental issues. Routledge, London.
- Chiras,D.D, Environmental Science
- Goodchild, M.F., Parks, B.O., Steyaert, L.T., (Eds.), Environmental Modeling with GIS (Spatial Information Systems) Oxford University Press, USA, 1993.
- Agarwal, S.KEco-informatics, APH Publishing Corporation, 2002.
- Jorgensen, S. E., Chon, T-S.,Recknage, F. A., Handbook of Ecological Modeling and Informatics, WIT Press, 2009.

BS850403 GREEN HOUSE MANAGEMENT AND PLANT PROTECTION

Total Credits: 4

Total Hours: 90

1. Objective of the Course

The course is designed to make the student familiar with methods in green house management and related techniques followed for plant protection from weeds and pathogen/ pest attack.

2. Course content

Unit 1: Plant propagation structures

Green House, hot beds, cold frames and lath houses. Miscellaneous propagation structures- fluorescent light boxes and propagating frames Carbon dioxide enrichment in green house.Containers for propagating and growing young plants. (18 hrs)

Unit 2: Media for propagating and growing nursery plants

Media components: Sand, peat sphagnum moss, vermiculite, pumice, perlite, synthetic plastic aggregates and compost. Mixtures for container growing.Preplanting treatments of soil and soil mixes, heat treatments, fumigation with chemicals. (18 hrs)

Unit 3: Sanitation, soil enrichment and other requirements of propagation

Physical propagation facilities, propagation media and plant material. Supplementary fertilizers controlled release fertilizers. Salinity in soil mixtures, water quality and soil pH.Handling of container grown plants. (18 hrs)

Unit 4: Plant protection from weeds

Types of weeds, crop-weed competition and weed control methods. Classification of herbicides.Working of selective weed killers. Biological and integrated weed control. (16 hrs)

Unit 5: Plant protection from diseases

Diseases of crops-definition, nature, and causes.Control of diseases by fungicides and antibiotics. Control of insect pests: Principles, physical and mechanical control, cultural control, host plant resistance, biological control, legislature or regulatory method, chemical control and other methods of insect control. (20 hrs)

3. Recommended Text books

- Hann J.J., Holley W.D. and K.L.Goldsberry : Greenhouse management

4. Recommended References:

- Furuta, T. : Nursery management handbook

- Langhans R.W. :Green house management

BS020401 Laboratory course IV

Total Credits: 4

Total Hours: 180

1. Objective of the Course

The course is designed to introduce the students to basic techniques in tissue culture and genetic engineering.

2. Course content

Unit 1: Plant Cell and Tissue Culture

1.1. Formulation of tissue culture media-different types

1.2. Collection of explants material

1.3. Surface sterilization of explants materials

1.4. Preparation of explants and inoculation

1.5. Sub- culture of callus; Regeneration of plants from callus.

1.6. Hardening techniques of tissue culture plantlets.

1.7. Techniques for axillary bud proliferation.

1.8. Preparation of artificial seeds (100 hrs)

Unit 2: Techniques in Genetic Engineering

2.1. Isolation of genomic DNA from plant tissue.

2.2. Agarose gel electrophoresis of plasmid and chromosomal DNA.

2.3. Restriction endonuclease digestion of DNA.

2.4. DNA ligation methods.

2.5. Construction of recombinant DNA.

2.6. Transformation of competent *E. coli* cells. (80 hrs)

3. Recommended Text books

- Razdan, M. K. Introduction to Plant Tissue Culture. Science Publishers, 2003.
- Frederick. M.A., Roger. B.R., David. D. M., Seidman. J. G., John A. S., Kevin. S. Current Protocols in Molecular Biology. John Wiley and Son, Inc., 2003.

4. Recommended References:

- Dixon, R.A. and Gonzales, R.A (Eds.). Plant Cell Culture: A Practical approach.
- Sambrook, J., Russell, D. W., & Russell, D. W. Molecular Cloning: A Laboratory Manual (3-volume set). CSLP, 2001.

MODEL QUESTION PAPERS

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

First Semester

BS020101 MICROBIOLOGY AND PLANT MOLECULAR BIOLOGY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Plasmids
2. Promoter sequences
3. What is numerical taxonomy?
4. Prions
5. What are antimicrobial substances?
6. Catabolism and Anabolism
7. Virulence
8. Nucleotypes
9. Interleukin
10. Jumping genes

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain the storage of microbes.
12. Briefly describe the microbial metabolism.
13. Explain the method of testing antimicrobial substances.
14. Lytic and Lysogenic cycle.
15. Repeatative sequences
16. Organs associated with immune system

17. Write a note on phenol co-efficient tes

18. Translation (6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. Give an account on antibiotic sensitivity testing procedure.

20. Explain the various types of microbial locomotion with examples.

21. What is mutation? Discuss in detail about induced mutation.

22. Explain gene expression in prokaryotes. (2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and TechnologyDegree (C.S.S.) Examination, Month, Year

First Semester

BS020102 PLANT PHYSIOLOGY, BIOCHEMISTRY AND ECOLOGY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Ecosystem
2. Population growth
3. Transpiration
4. Carotenoids
5. Habitat
6. Adaptation
7. Population
8. Ecology
9. Morphogenesis
10. Trophic levels

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Ecological pyramids
12. Give an account on DNA
13. Nucleic acids
14. Calvin cycle
15. Seed dormancy
16. What is CO_2 fixation?

17. What is PGP?

18. Write an essay on glycolysis and its significance.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Structure and classification of carbohydrates

20. Inorganic and organic nutrient requirements in plants

21. Write a short note on pigments present in plants

22. Give an account on Lipids

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

First Semester

BS020103 INTRODUCTION TO TRADITIONAL AND MODERN SYSTEMS OF MEDICINE

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is Mala theory?
2. Comment on Naturopathy
3. Define ethnobotany
4. What is Athuravritta?
5. Comment on Aromatherapy.
6. Medical Ecology
7. Dinacharya
8. Pranayama
9. Reflexology
10. Sowa Rigpa

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. What is Karmayoga?
12. Define Applied Medical Anthrapology.
13. Write short note on Quwa in Unani.
14. Concise note on “Sadvritha”
15. Comment on Tibetan Medicine.

16. Differentiate Ayurvedic pharmacopoeia from pharmacology.

17. Write short note on Ashtanga Ayurveda.

18. Explain Ritucharya.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Explain the development of Ayurvedic Medicine.

20. Point out the mutual influence of Ayurveda and Chinese Medicine.

21. Write an essay on Dietetics and supportive therapies

22. Briefly explain the concept of health and disease.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Practical Examination, Month, Year

First Semester

BS020104 LABORATORY COURSE I

(2019 admissions onwards)

Time: 9..30 am -4.30 pm Max. Weight: 15

1. Major experiment	(4 weight.)
2. Minor experiment 1	(1 weight.)
3. Minor experiment 2	(1 weight.)
4. Minor experiment 3	(1 weight.)
5. Record	(3 weight.)
6. Viva	(5 weight.)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Second Semester

BS020201 PRINCIPLES OF MANAGEMENT

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Management
2. Brainstorming
3. Directing
4. Delegation
5. Functions of planning
6. Motivation
7. Job rotation
8. Joint stock company.
9. Span of control
10. Advertising

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Functions of the top management
12. Line organization
13. Importance of trainings in HRD.
14. Suggest few sales promotion strategies applied to consumer products.

15. Explain various hurdles in a selection procedure.
16. Explain marketing control.
17. Describe about functional foreman.
18. Compare sales versus marketing.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Enumerate in detail about the selection process which is widely followed in selecting marketing professionals. Also highlight the different techniques used in selection process.
20. Describe about the important management theories you have been studied?
21. Discuss the main elements of Taylor's scientific management.
22. Explain different types of managerial decisions

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Second Semester

BS020202 MEDICINAL AND AROMATIC PLANTS: CONSERVATION, CULTIVATION AND MANAGEMENT

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What are kharif crops
2. Expand ICAR.
3. Define crops.
4. Name a natural auxin
5. What is planting density?
6. What is inbreeding?
7. Define mutation.
8. What is cost benefit analysis?
9. Define Agro climatic zones.
10. Define Edaphic factors.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. A brief account on pests and their control in crop protection.
12. Give an account on conventional methods of hybridization.
13. Briefly explain the role of growth regulation in crop production
14. Write a short note on plant pathology

15. Differentiate Broadcasting and Dutling.

16. Short note on Elasticity of plant.

17. What is transgenic Breading

18. What are mutagens? Give examples

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Narrate the history of medicinal plant cultivation in India.

20. Discuss about the scope of agronomy in medical plant sector.

21. Write an essay on *in sit*u conservation and its advantages.

22. Write about Vrikshayurveda.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Second Semester

BS020203 SYSTEMATIC BOTANY, BIODIVERSITY AND ECONOMIC BOTANY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Name the research institute where the plant resources of India are monitored.
2. Red data book
3. Field gene banks
4. Biosphere reserves
5. Monographs
6. Name two non- wood forest products
7. Principle of priority
8. Homestead gardens
9. Chemotaxonomy
10. Fatty oils and waxes

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Taxa and taxonomic hierarchy
12. Explain the need for Scientific names and system for plant nomenclature
13. Give a brief account on the factors causing biodiversity loss.
14. Differentiate between species diversity and genetic diversity

15. Explain the systems of classification- artificial, natural and phylogenetic.

16. Explain the importance of plant products to mankind.

17. Explain the preparation of herbarium.

18. Explain the concept

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. How biosystematics studies differ from taxonomic studies?

20. Describe the international biodiversity laws and national legislation in India.

21. Discuss about the different taxonomic evidences.

22. Discuss about the legal and ethical issues of biodiversity.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Practical Examination, Month, Year

Second Semester

BS020204 Laboratory Course II

(2019 admissions onwards)

Time: Max. Weight: 15

1. Major experiment	(4 weight.)
2. Minor experiment 1	(1 weight.)
3. Minor experiment 2	(1 weight.)
4. Minor experiment 3	(1 weight.)
5. Record	(3 weight.)
6. Viva	(5 weight.)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Third Semester

BS020301 CELL BIOLOGY AND BIOTECHNOLOGY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Ribosomes
2. Plasma membrane
3. β-chromosomes
4. Plant vacuoles.
5. Cytoskeleton
6. Peroxisomes
7. Functions of mitochondria
8. Cell cycle checkpoints
9. protoplast isolation and fusion
10. Gene therapy

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Chloroplast – ultra structure and function
12. Phases of cell cycle
13. Numerical aberrations in chromosomes
14. Applications of biotechnology in plant tissue culture
15. Ethical and social concerns regarding the use of genetically engineered organisms
16. Write a note on Nucleo-cytoplasmic transport.

17. Give an account of extra cellular cell signals.

18. Construction of gene libraries and its application

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. Write an essay on structure and function of cell membrane.

20. Elaborate on different stages of meiosis.

21. Elaborate on how a typical molecular cloning is performed with prokaryote as host system.

22. Write an essay on the applications of Biotechnology in medicine and industry.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Third Semester

BS020302 PHYTOCHEMISTRY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Carotenoids
2. Centrifugation
3. Liquid-liquid extraction
4. Antibodies
5. Lyophilization
6. Precipitation tests
7. Essential oils
8. 2D NMR
9. Co-pigmentation
10. Tissue printing

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2

11. Explain GC-MS
12. Explain finger printing of extracts
13. Give an account on RIA
14. Differentiate HPLC and HPTLC
15. Explain the basic principle of electrophoresis
16. What is autoradiography?

17. How are terpenes synthesized?

18. Explain photometry

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. What are immunological methods for identification of metabolites?

20. Write about types of spectroscopy.

21. Discuss the isolation and characterization of anthocyanins in plants.

22. Explain the structural elucidation and synthesis of bioactive steroids

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Third Semester

BS020303 PHARMACOGNOSY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. GMP
2. What are organoleptic characters
3. Define ' Rasa'
4. Pharmacognosy
5. Scarification
6. Asexual propagation and sexual propagation
7. What is Ash Content?
8. Name two seeds used as crude drug
9. Explain cosmoceuticals
10. What is direct crystallization?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Write on raw drug documentation
12. Describe the criteria for the classification of powdered drug
13. Write on factors causing drug contamination
14. Describe holistic concept of drugs

15. Write on single plant drug formulations in Ayurveda
16. Classical means of drug administration
17. What is aroma therapy?
18. Write a note on medicinal plants prohibited to export from India.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Write an easy on scope and application of pharmacognosy
20. Explain the methods of collection,processing and storage of medicinal and aromatic plants
21. Describe saptapadarthas in DravyaGuna
22. What are the steps to detect the antimicrobial properties of a drug?

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Practical Examination, Month, Year

Third Semester

BS020304 Laboratory Course III

(2019 admissions onwards)

Time: Max. Weight: 15

1. Major experiment	(4 weight.)
2. Minor experiment 1	(1 weight.)
3. Minor experiment 2	(1 weight.)
4. Minor experiment 3	(1 weight.)
5. Record	(3 weight.)
6. Viva	(5 weight.)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS830401 RESEARCH METHODOLOGY AND SCIENCE COMMUNICATION

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. What is the general format of a research paper?
2. What is meant by pure and applied research?
3. What are the prospects of publishing in an Open Access Journal?
4. What is impact factor? What factors affect its credibility?
5. When is a student t-test done?
6. What is meant by experimental design?
7. Explain ANOVA.
8. What is the role of effective communication in science?
9. What is an RSS feed?
10. How is research carried out effectively?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Explain the various ways in which research is carried out.
12. Give an account of experimental designs.
13. Give an account of different reference citation styles.
14. Write a note on Bibliometrics and Webometrics
15. Explain a chi-square test.

16. Write a short note on R software

17. Discuss on ethical issues in scientific research and academics

18. Write a short note on literature collection and report writing

(**6 x 2 = 12**)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. Write an essay on research outlook.

20. Elaborate on the various factors and aspects linked to research publication

21. Write an essay on different avenues in practicing science communication.

22. Discuss on the basic statistical tools used in a biological research.

(**2 x 5 = 10)**

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS830402 PRODUCT DEVELOPMENT, QUALITY CONTROL AND IPR

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. People's biodiversity register
2. ELISA
3. Biopiracy
4. Define Acute Reference Dose
5. What is swelling index?
6. Pharmacopoeia of the Peoples Republic of China
7. Pesticide residue in herbal drugs
8. Total Ash Content
9. What are endotoxins?
10. Regulatory bottleneck with herbal drugs.

(8 x 1 = 8)

Section B

11. (Answer any **six** questions. Each question carries a weight of 2)Method of preparation of kaajjali
12. British pharmacopoeia
13. Explain limit test for lead.
14. Raw material evaluation
15. Explain Congealing Range and its determination.
16. GMP
17. Biological Assay
18. What are PrathinidhiDravyas

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. Describe the microbiological evaluation of herbal drugs.

20. Discuss about the Sui Genesis System for the protection of traditional knowledge.

21. Discuss the chromatographic methods are useful in herbal medicine standardization.

22. WHO guidelines for assessment of herbal drugs

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and TechnologyDegree (C.S.S.) Examination, Month, Year

Second Semester

BS830403BASICS OF PLANT TISSUE CULTURE

(2019 admissions onwards)

Time :Three Hour Maximum Weight : 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Disinfection
2. Somaclonal variation
3. Depth Filters
4. Give few examples of filers used in sterilization
5. Fumigation
6. Sucrose
7. DMSO
8. Acclimatization
9. Mercuric chloride
10. Stress resistant mutants (8 x 1= 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Instruments used in Plant Tissue Culture Laboratory
12. Isolation of somaclonal variants
13. Production of disease resistant mutants.
14. Sterilization scheme for culture chamber.
15. Freezing and storage.

16. Continuous culture.
17. Embryo rescue
18. Technique of Endosperm culture (6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Define cloning. Describe the technique of isolation of single cells.
20. Describe the technique of micropropogation.
21. How variants can be selected in induced mutation breeding experiments?
22. What are transgenic plants? Give an account on transgenics for insect resistance in crop plant.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS840401 PHARMACOLOGY, CLINICAL TRIAL AND BIOSTATISTICS

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Arithmetic mean
2. Pharmacokinetics
3. Cphedrine
4. Anti-hepatotoxic agents from plants
5. Therapeutic trial design
6. Standard deviation
7. Degrees of freedom
8. *Rauvolfiaserpentina*
9. Biotransformation
10. Therapeutic index

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Discuss about Ethnopharmacology and importance of ethnopharmacological studies
12. Drug abuse and iatrogenic diseases
13. Explain the process of new drug development.
14. Synthetic substitutes for therapeutically active plant constituents
15. Explain the qualitative and quantitative aspects of drug action.
16. Active principles from plants

17. Explain the record linkage by computer and computerized database creation of medicinal plants.
18. Describe F-test and modified F- test and explain the significance in drug development.

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Describe the application of statistics in experimental design of drug development.
20. Discuss about the clinical trials of new drug and ethical issues related to it.
21. Explain ADR and drug poisoning.
22. Pharmacological activity of plant drugs.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS840402BUSINESS PLAN AND ENTREPRENEURSHIP DEVELOPMENT

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)\

1. Entrepreneur
2. Techno Economic Feasibility Report
3. Market opportunity analysis
4. Working capital
5. Market demand
6. Cultivation cost
7. Intrapreneur
8. Portfolio models of planning
9. Marketing
10. Long term funds

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Steps involved in screening of project ideas.
12. Write about economic evaluation.
13. Write about technology development.
14. Discuss about the requirements for estimation of working capital.
15. Comment on various criteria to determine economic value.
16. Social cost benefit analysis

17. Discuss about import and export policies.
18. Environmental appraisal for projects

(6 x 2 = 12)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss about various acquisition-decisions on appropriate technology.
20. Explain the preparation of Detail Project Report.
21. Explain various demand forecasting methods.
22. Explain the value of raw and processed drugs and their costs of marketing.

(2 x 5 = 10)

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS840403TRANSGENIC TECHNIQUES FOR CROP IMPROVEMENT

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight**questions. Each question carries a weight of 1)

1. Selection marker gene in chloroplast transformation
2. QTL
3. Cytogenetic maps
4. Binary vector
5. Linkage
6. Regeneration of plantlets after *Agrobacterium*-mediated transformation.
7. Advantages of Chloroplast engineering
8. Biological Containment levels
9. Physical maps using in- situ hybridization
10. barnase/ barstar system

(8 x 1 = 8)

Section B

(Answer any**six**questions. Each question carries a weight of 2)

11. Explain any one model of T-DNA insertion into plant chromosomal DNA.
12. Explain gene tagging and write about its application in crop improvement.
13. Write in detail about in situ hybridization and its applications.
14. Compare and contrast RAPD and SSR markers.
15. Mitochondrial engineering
16. Write an essay on genetic mapping.
17. Give case studies of development of virus resistant transgenic plant
18. What are gene banks? Write a note on their significance.

(**6 x 2 = 12**)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. Explain in detail about genetic mapping using RFLP.
20. Explain in detail the steps involved in chloroplast engineering.
21. Give a detailed account on the structure of Ti plasmid and Agrobacterium- mediated transformation.
22. Write an essay on insect resistant and herbicide resistant transgenic plants.

(**2 x 5 = 10)**

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS850401 INTRODUCTION TO NANOTECHNOLOGY

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define nanotechnology
2. What is Moore's Law?
3. What are carbon nano materials?
4. What are inorganic nano materials?
5. What do you mean by Fermi function?
6. Define Quantum capacitance.
7. Define Density matrix.
8. Explain Model Hamiltonian.
9. Describe Human Implants.
10. Explain Broadening.

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. What are the Zero Dimensional Nano-Structures?

12. Draw the energy level diagram and give a short account on the same.

13. What is thermoelectric effect?

14. Describe NEGF Formalism.

15. What are the properties of nanotube devices?

16. Discuss on the environmental risks of nanotechnology.

17. Brief on the solutions to environmental problems that nanotechnology can offer?

18. What are nano transistors?

(**6 x 2 = 12**)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

19. Discuss on nano enabled military defence system.

20. Discuss on p-type operation and n-type operation.

21. Elaborate on the Molecular building blocks in nanostructure systems

22. Write a detailed description on Scanning Probe Microscope.

(**2 x 5 = 10)**

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS850402 ECOLOGY AND ECOINFORMATICS

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Define Ecoinformatics
2. What are the factors affecting population growth?
3. Describe the different trophic levels.
4. What is the concept of endemism?
5. Elaborate on Exotic taxa.
6. Give the different microbe used for improving soil fertility.
7. What is reforestation?
8. What is precision agriculture?
9. Give a note on Ecosystem Modelling.
10. What do you mean by community ecology?

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Give the significance of habitat.
12. Discuss on Speciation and Extinction.
13. Discuss on the use of mycorrhizae in reforestation.
14. What are the privacy concerns regarding Big data?
15. Discuss on the development of stress tolerant plants.
16. Familiarize on the Phyto-geographic regions in India.
17. What are the principles governing plant distribution?

(**6 x 2 = 12**)

Section C

(Answer any **two** questions. Each question carries a weight of 5.)

18. Discuss on Primary and Secondary productivity.
19. Give an account on Rare, endangered and threatened category (IUCN) species.
20. Discuss on the diverse aspects of reforestation of soils contaminated with heavy metals.
21. Give the applications of big data to animal production and pest management.
22. Discuss on the International and national efforts in restoration of degraded lands.

(**2 x 5 = 10)**

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Examination, Month, Year

Fourth Semester

BS850403 GREEN HOUSE MANAGEMENT AND PLANT PROTECTION

(2019 admissions onwards)

Time: Three hours Max. Weight: 30

Section- A

(Answer any **eight** questions. Each question carries a weight of 1)

1. Pumice
2. Calcifuge
3. Temporary wilt
4. Soil moisture deficit
5. Ebb & flow
6. Compound fertilizers
7. Inorganic fertilizers
8. Compost
9. Hot beds
10. Lath houses

(8 x 1 = 8)

Section B

(Answer any **six** questions. Each question carries a weight of 2)

11. Write about various plant propagation structures.
12. Write about fertilizers and their types.
13. Write about salinity in soil mixture.
14. Classification of weeds.
15. Write about Importance of soil pH. How can soil pH be adjusted?
16. What is the need for soil drainage and explain different types of artificial drainage?
17. What do you understand by Crop-weed Competition
18. Explain the role of fungicide in plant protection

(**6 x 2 = 12**)

Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Write in detail about different weed management strategies.
20. Write about pest, its effect on cultivation and different strategies for control of insect pests .
21. Explain alternative propagation media.
22. Write in detail about handling of container grown plants.

(**2 x 5 = 10)**

Model Question Paper

QP Code (to be assigned by Exam Section) **Reg. No. ……**

Name …….

M.Sc. Phytomedical Science and Technology Degree (C.S.S.) Practical Examination, Month, Year

Fourth Semester

BS020401 Laboratory Course IV

(2019 admissions onwards)

Time: Max. Weight: 15

1. Major experiment	(4 weight.)
2. Minor experiment 1	(1 weight.)
3. Minor experiment 2	(1 weight.)
4. Minor experiment 3	(1 weight.)
5. Record	(3 weight.)
6. Viva	(5 weight.)

10. FORMAT OF AWARDS TO BE ISSUED TO STUDENTS

10.1 GRADE CARDS/ MARK CUM GRADE CARDS FOR EACH SEMESTER

10.2 CONSOLIDATED GRADE CARD

10.3 PROVISIONAL CERTIFICATE

10.4 DEGREE CERTIFICATE