Resolution No.: AC/I(19-20).2.RUS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Syllabus for: T. Y

Program: B. Sc.

Course Code: Botany (RUSBOT)

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

SEMESTER V

Course Code	UNIT	TOPICS	Credits	Lectures/ Week
RUSBOT 501	PLANT DIVERSITY V			
	I	Algae	2.5	1
	II	Bryophyta		1
	III	Microbiology		1
	IV	Biostatistics		1
RUSBOT 502	PLANT DIVERSITY VI			
	I	Angiosperms I	2.5	1
	II	Ethnobotany		1
	III	Palynology		1
	IV	Anatomy		1
RUSBOT 503	FORM AND FUNCTION V			
	I	Cytology and Molecular Biology	2.5	1
	II	Physiology I		1
	III	Environmental Botany		1
	IV	Bioinformatics		1
RUSBOT 504	CURRENT TRENDS IN PLANT SCIENCES III			
	I	Pharmacognosy and Medicinal Botany	2.5	1
	II	Plants in Human Health		1
	III	Plant tissue culture		1
	IV	Research methodology II		1
RUSBOTP 501, 502, 503, 504	Practical	Practicals based on all the four courses in theory	06	16
			16	

SEMESTER VI

Course Code	UNIT	TOPICS	Credits	Lectures/ Week
RUSBOT 601	PLANT DIVERSITY VII			
	I	Fungi and Plant pathology	2.5	1
	II	Pteridophyta		1
	III	Biotechnology I		1
	IV	Biotechnology II		1
RUSBOT 602	PLANT DIVERSITY VIII			
	I	Paleobotany and Gymnosperms	2.5	1
	II	Angiosperms II		1
	III	Embryology		1
	IV	Plant micro techniques		1
RUSBOT 603	FORM AND FUNCTION VI			
	I	Physiology II	2.5	1
	II	Genetics		1
	III	Cosmetology		1
	IV	Post-Harvest Technology		1
RUSBOT 604	CURRENT TRENDS IN PLANT SCIENCES IV			
	I	Economic Botany	2.5	1
	II	Plant Geography and Environmental Botany		1
	III	Instrumentation		1
	IV	Research methodology III		1
RUSBOTP 601, 602, 603, 604	Practical	Practical based on all the four courses in theory	06	16
			16	

Course Code: RUSBOT 501
Course Title:Plant Diversity V
Academic year 2019 - 20

Learning Objectives: –

- The morphology, internal and reproductive structures of various algal forms along with their economic importance.
- The life cycles from Bryophyta, alternation of generations as well as exposure to evolutionary interpretations of various aspects.
- The different types of microbes, basics of microbial culturing and the use of microbes for the commercial production of alcohol and antibiotics.
- Biostatistics and its applications

Learning Outcomes:The students will be able to identify various algal, bryophyte specimens and their forms .They will be able to culture bacteria, prepare media and isolate pure cultures.The students will be able to apply techniques to subject experimental data to statistical analysis.

Detailed Syllabus

RUSBOT 501	**Title: Plant Diversity V**	**Credits – 2.5**
UNIT I	**Algae**	**15 Lectures**
	Division Rhodophyta • Classification and General Characters: Distribution, cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, alternation of generations, economic Importance. • Structure, life cycle and systematic position of o *Polysiphonia* o *Batrachospermum*	
	Division Bacillariophyta: • Classification and General Characters of Bacillariophyta: Distribution, cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, alternation of generations, economic Importance. • Structure, life cycle and systematic position of *Pinnularia*	
	Range of thallus structure in algae, Extraction of agar, Biofertlizer	
UNIT II	**Bryophyta**	**15 Lectures**
	Life cycle of *Marchantia* and *Funaria*	
	Evolution of sporophyte	
	Evolution of gametophyte	
UNIT III	**Microbiology**	**15 Lectures**
	Types of Microbes- Bacteria, *Rickettsiae*, Mycoplasma, algae, Archaebacterium, Actinomycetes, fungi, Protozoa	
	Culturing: Sterilization, media, staining, colony characters, Laboratory Safety measures	
	Pure culture	
	Role of microbes in fermentation: Industrial production of Alcohol and Antibiotics	
UNIT IV	**Biostatistics**	**15 Lectures**
	Test of significance student's *t*-test (paired and unpaired)	

	Box plot	
	Regression	
	ANOVA (one way)	
PRACTICALS		
RUSBOTP 501	**Plant Diversity V**	**Credits - 1**
1	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides • *Polysiphonia* • *Batrachospermum* • *Pinnularia*	
2	Range of thallus structure in algae	
3	Economic importance of algae	
4	Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides • *Marchantia* • *Funaria*	
5	Study of aeromicrobiota by petriplate exposed method • Fungal culture • Bacterial culture	
6	Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected micro organism	
7	Study of antimicrobial activity by the disc diffusion method	
8	*T-test* (paired and unpaired)	
9	Problems based on regression analysis	
11	ANOVA	

Course Code: RUSBOT 502
Course Title:Plant Diversity VI
AAcademic year 2019 - 20

Learning Objectives: –

- The influence of various fields on taxonomy, distinguishing characters of plants belonging to different families and Bentham and Hookers classification system of angiosperms.
- The principles of Ethnobotany.The ethnobotanical importance of sacred groves and the contribution of eminent contributors in the field.
- The structures and reasons of anatomical peculiaritites and palynological details of plants.

Learning Outcomes: The students will be able to identify plants from the prescribed families and understand the principles underlying Bentham and Hooker's classification and studyethnomedicinal aspects of plants. The students will be able to understand anatomical adaptations and palynological details of plants and reasons for the same.

Detailed Syllabus

RUSBOT 502	**Title: Plant Diversity VI**	**Credits – 2.5**
UNIT I	**Angiosperms I**	**15 Lectures**
	Characters of Taxonomic Importance – Morphology, Palynology, Embryology, Cytology and Ecology	
	Complete classification of Bentham and Hooker(only for prescribed families), Merits and demerits	
	Bentham and Hooker's system of classification for flowering plants up to family with respect to the following prescribed families and economic and medicinal importance for members of the families • Capparidaceae • Umbelliferae • Cucurbitaceae • Rubiaceae • Convolvulaceae • Commelinaceae • Graminae	
UNIT II	**Ethnobotany**	**15 Lectures**
	Ethnobotany – Definition, History, Sources of data and methods of study.	
	Sacred grooves	
	Contributions of Dr. S.K. Jain, Madhav Gadgil, Dr. V. D. Vartak	
	Concept of sustainability for survival	
UNIT III	**Palynology**	**15 Lectures**
	Pollen Morphology	
	Pollen viability – storage	
	Germination and growth of pollen	
	Applications of Palynology in Taxonomy, Honey Industry, Coal and oil exploration, Aerobiology and Pollen Allergies, Forensic Science.	
UNIT IV	**Anatomy**	**15 Lectures**
	Anomalous secondary growth : in the Stems of *Bignonia*,	

	Salvadora, *Mirabilis*, *Aristolochia*, *Dracaena,* Storage roots of Beet, Radish	
	Root stem transition	
	Types of Stomata – Anomocytic, Anisocytic, Diacytic, Paracytic, and Graminaceous.	
	Wood Anatomy: Hard wood and Soft wood, Wood types: ring porous and diffuse porous wood, xylem parenchyma: Apotracheal and Paratracheal.	
	Ecological anatomy: Epiphytes and Parasites	
	Nodal Anatomy: Unilacunar, trilacunar and multilacunar nodes.	
PRACTICALS		
RUSBOTP 502	**Plant Diversity VI**	**Credits - 1**
1	Study of one plant from each of the following Angiosperm families • Capparidaceae • Umbelliferae • Cucurbitaceae • Rubiacae • Convolvulaceae • Commelinaceae • Graminae	
2	Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families	
3	Identifying the genus and species of a plant with the help of Flora	
4	Mapping of sacred groves in India/ Maharashtra	
5	Study of plants of ethnobotanical importance in Maharashtra – medicinal, fibre yielding, food plants, oil yielding plants.	
6	Literature survey of ethnobotanical reviews/reports	
7	Determination of pollen viability	
8	Pollen analysis from honey sample – unifloral and multifloral honey	
9	Effect of varying concentration of sucrose on *In vitro* Pollen germination	
10	Study of pollen morphology (NPC Analysis) of the following by Chitley's Method • *Hibiscus* • *Datura* • *Ocimum* • *Crinum* • *Pancratium* • *Canna*	
11	Study of anomalous secondary growth in the stems of the following plants usingdouble staining technique • *Bignonia* • *Salvadora* • *Mirabilis* • *Aristolochia* • *Dracaena*	
	Study of anomalous secondary growth in the roots of • Beet • Radish	
	Types of Stomata	

Course Code: RUSBOT 503
Course Title:Form and function V
Academic year 2019 - 20

Learning Objectives:

- Cellular basis of plant life and the molecular components of the genetic machinery for translation.
- Plant physiological processes and environmental clean-up technologies.
-
- Introduction to the tools available for protein structure analysis, multiple sequence analysis and phylogenetic analysis.
- The students will be able to use various Biotechnological tools.

Learning Outcomes: The students will be able to understand cellular basis of life and molecular genetic machinery for translation. They will gain insight into physiological aspects of plant life with reference to water relations, transport processes and growth as well as environmental clean-up technologies.Statistical analysis of experimental data.

Detailed Syllabus

RUSBOT 503	**Title: Form and function V**	**Credits – 2.5**
UNIT I	**Cytology and Molecular Biology**	**15 Lectures**
	Structure and function of nucleus (Complete detail)	
	Structure and function of vacuole	
	Structure and function of giant chromosomes	
	The Genetic Code- characteristics of the Genetic Code Translation in prokaryotes and eukaryotes	
UNIT II	**Physiology I**	**15 Lectures**
	Structure of biomolecules - carbohydrates (sugars, starch, cellulose, pectin), lipids (fatty acids, glycerol), proteins (amino acids)	
	Enzymes - Nomenclature, classification, mode of action, enzyme kinetics, Michaelis Menten equation, competitive, non competitive and uncompetitive inhibitors	
	Methods of enzyme immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).	
	Vegetative Growth: General phases of growth, Growth Curves, Factors affecting growth – External (environmental) and internal (genetic, hormonal, nutritional); Role of plant growth regulating substances – Auxins, Cytokinins and Gibberellins and their commercial applications.	
UNIT III	**Environmental Botany**	**15 Lectures**
	Pollution	
	Types of water pollution, Chemical and thermal, Nutrient pollution, Ground water, oil spillage	
	The Water Act, Ganga River Pollution: A case study	
	Bioremediation: Principles, factors responsible and microbial population in bioremediation.	
	Biomagnification, Bioaccumulation and Biotransformation.	

	Phytoremediation: Types, Metals-Mechanisms of sequestration,	
	Organic pollutants – Phytodegradation.	
	Environmental guidelines for industries	
UNIT IV	**Bioinformatics**	**15 Lectures**
	Sequence analysis: Basic concepts of sequence similarity, identity and homology, definitions of homologs, orthologs, paralogs. Basic concepts of sequence alignment, pairwise alignments. Use of pairwise alignments and Multiple sequence alignment	
	Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method]	
	Gene finding and motif finding	
PRACTICALS		
RUSBOTP 503	**Form and function V**	**Credits - 1**
1	Mounting of giant chromosome from *Chironomous* larva	
2	Smear preparation from *Tradescantia* buds	
3	Predicting the sequence of Amino acids in the polypeptide chain that will be formed following translation. (Prokaryotic and Eukaryotic)	
4	To estimate the activity of Gibberellic acid with respect to seed germination and mobilization of reserves.	
5	To study immobilization of enzymes using appropriate techniques	
6	Qualitative tests for carbohydrates, amino acids, lipids	
7	Estimation of the following in / of the given water sample: • Dissolved Oxygen Demand • Biological Oxygen Demand • Chemical Oxygen Demand • Hardness • Salinity • Acidity • Alkalinity	
8	Multiple Sequence Alignment	
9	Phylogenetic Analysis	
10	RASMOL / SPDBV	
11	Motif finding	

Course Code: RUSBOT 504
Course Title:Current Trends in Plant Sciences III
Academic year 2019 - 20

Learning Objectives:

- The basics of Pharmacognosy, antioxidant foods and nutraceuticals.
- Fundamentals of micropropagation and research techniques.

Learning Outcomes: The students will know the basics of medicinal Botany, contribution of plants in human health, with reference to specific function of antioxidants and phytochemicals as therapeutic agents. The students will get acquainted with the basics of plant tissue culture, techniques, applications and limitations. These advanced and applied techniques will inculcate research interest in students

Detailed Syllabus

RUSBOT 504	**Title: Current Trends in Plant Sciences III**	**Credits – 2.5**
UNIT I	**Pharmacognosy and Medicinal Botany**	**15 Lectures**
	Cultivation practices with reference to soil, propagation methods, irrigation, manuring, harvesting, processing, storage, marketing – *Saffron (Crocos sativus)*	
	Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants –*Woodfordia fruticosa, Symplocos racemosa*	
	Medicinal plants used against: • Diabetes • Anemia/ Jaundice • Obesity	
UNIT II	**Plants in Human Health**	**15 Lectures**
	Role of antioxidants in human health	
	Benefits of phytochemicals in disease prevention: • Sources and therapeutic efficacy • Flavonoids – Quercetin, Kaempferol, Rutin • Terpenoids – Ursolic acid, Lupeol • Phenolic acids – Gallic acid, Caffeic acid, Ferulic acid	
	Application of these phytochemicals to certain diseases like Diabetes and Jaundice.	
	Phytochemicals of nutraceutical importance: • Betasitosterol: *Linum usitatissimum, Carissa carandas* • Curcumin: *Curcuma longa*	
UNIT III	**Plant Tissue Culture**	**15 Lectures**
	Micropropagation of floricultural and medicinal plants	
	Anther culture and Pollen culture	
	Somatic embryogenensis and artificial seeds	
	Plant cell suspension cultures for the production of secondary metabolites	
	Protoplast isolation, culture and Somatic Hybridization	
UNIT IV	**Research Methodology II**	**15 Lectures**
	Introduction to Research: • Important concepts of research design	

	• Identification of a research problem • Generation of a research problem.	
	Data management • Data collection and documentation • Maintaining Lab records • Tabulation and generation of graphs	
PRACTICALS		
RUSBOTP 504	**Current Trends in Plant Sciences III**	**Credits - 1**
1	Extract and filtrate preparation using different solvents.	
2	Calculation of percent yield in different solvents. Additional exercise: Calibration of weighing balance.	
3	Maceration of stem drugs: *Symplocos racemosa*	
4	Powder microscopy of flowers: *Woodfordia fruticosa*	
5	Catalase activity from different food sources using paper disc method.	
6	Preparation of stock solutions.	
7	Preparation of MS medium- MS basal medium and defined medium	
8	Seed sterilization and inoculation technique.	
9	Callus induction and regeneration	
10	Encapsulation of axillary buds	
11	Tabulation of research data and generation of graphs	
12	Hands on training at industry: • Beer-Lambert's law • HPTLC, RPHPTLC, HPLC • Quality evaluation of *Saffron* using spectrophotometer.	

SEMESTER VI

Course Code: RUSBOT 601
Course Title:Plant diversity VII
Academic year 2019 - 20

Learning Objectives:

- The morphology, internal and reproductive structures of various fungal forms along with their economic importance.
- The epidemiology and control measures of disease causing fungi
- The life cycles from Pteridophyta, alternation of generations as well as exposure to evolutionary interpretations of various aspects.
- Modern tools for studying biodiversity at the molecular level, underlying principles, strategies and methodology involved and to emphasize the use of these for problem-solving.

Learning Outcomes: The students will be able to Identify Fungi, plant diseases, Pteridophytes and understand evolutionary relationships of members of these groups. Learn the basic principles of handling and analyzing genetic material and also use molecular techniques to resolve taxonomic problems.

Detailed Syllabus

RUSBOT 601	**Title: Plant diversity VII**	**Credits – 2.5**
UNIT I	**Fungi**	**15 Lectures**
	Basidiomycetes: Classification and general characters Life cycle of *Agaricus* and *Puccinia*	
	Deuteromycetae: Classification and general characters Life cycle of *Fusarium*	
	Plant Pathology - Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following. • Wilt: *Fusarium* • Tikka disease of ground nut: *Cercospora* • Damping off disease: *Pythium*	
UNIT II	**Pteridophyta**	**15 Lectures**
	Calamophyta – Classification, general characters, *Calamites*; Life cycle of *Pteris*	
	Pterophyta – Classification and general characters, Life cycle of *Marsilea*	
	Types of sori and evolution of sori	
UNIT III	**Plant Biotechnology I**	**15 Lectures**
	Construction of Genomic DNA libraries, Chromosome libraries and c-DNA Libraries.	
	Identification of specific cloned sequences in cDNA libraries and genomic libraries	
	Analysis of genes and gene transcripts – Restriction enzyme analysis of cloned DNA sequences.	
	Hybridization (Southern Hybridization).	
UNIT IV	**Plant Biotechnology II**	**15 Lectures**

	DNA sequence analysis – Maxam – Gilbert Method and Sanger's method	
	Polymerase chain reaction	
	DNA barcoding: basic features, nuclear genome sequence, chloroplast genome sequence, *rbc*L gene sequence, *mat*K gene sequence, present status of bar-coding in plants.	
PRACTICALS		
RUSBOTP 601	**Plant diversity VII**	**Credits – 1**
1	Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides • *Agaricus* • *Puccinia* • *Fusarium*	
2	Study of the following fungal diseases: • Wilt – Fusarium • Tikka disease in Groundnut • Damping off disease	
3	Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides • *Pteris* • *Marselia* • *Calamites*	
4	Growth curve of *E.coli*	
5	Plasmid DNA isolation and separation of DNA using AGE	
6	DNA sequencing- Sanger's method (give a sequence and let them show how the autoradigram will be)	
7	Identification: Restriction mapping,	
8	Southern blotting	
9	DNA barcoding of plant material by using suitable data	

Course Code: RUSBOT 602
Course Title: Plant diversity VIII
Academic year 2019 - 20

Learning Objectives: –

- The characteristic features and groups Gnetopsida and Angiosperms with the help of suitable examples.
- Basics of ecological anatomy and embryological studies of plants.

Learning Outcomes: The students will be able to identify fossil forms according to their structures. The students will be able to learn life cycles from Gnetopsida and alternation of generations. They will learn the use of different sources of taxonomic literature along with identification of different plants and the classical Hutchinson's system of classification. The students will learn to corelate structure with function through ecological anatomy. They will also understand the basic concepts of embryological studies in plants.

Detailed Syllabus

RUSBOT 602	**Title: Plant diversity VII**	**Credits – 2.5**
UNIT I	**Paleobotany**	**15 Lectures**

	Lepidodendron–All form genera - root, stem, bark, leaf, male and female fructification	
	Lyginopteris–All form genera - root, stem, leaf, male and female fructification	
	Pentoxylon–All form genera	
	Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow	
	Gymnosperms • Gnetopsida – Classification • Life cycle of *Gnetum*	
	Life cycle of *Ephedra*	
UNIT II	**Angiosperms**	**15 Lectures**
	Taxonomic literature - Library, Floras, Monographs, Dictionary, Periodicals, Index and Journals	
	Study of following plant families • Combretaceae • Rhamnaceae • Asclepiadaceae • Verbenaceae • Labiatae • Polygonaceae • Orchidaceae	
	Hutchinson's classification – merits and demerits	
	Major contributions of Takhtajan and Cronquist; Brief reference of Angiosperm Phylogeny Group (APG III) classification	
UNIT III	**Embryology**	**15 Lectures**
	Microsporogenesis– Structure of microsporangium, microsporogenesis and development of male gametophyte, Function of tapetum	
	Megasporogenesis– Structure of megasporangium, megasporogenesis and development of female gametophyte	
	Development of monosporic type: *Polygonum* type	
	Types of ovules	
	Double fertilization and its significance	
	Development of embryo – Dicotyledonous embryo*: Capsella* type	
UNIT IV	**Plant Microtechniques**	**15 Lectures**
	Staining procedures	
	Classification and chemistry of stains	
	Tissue preparation: living, fixed, coagulating and non-coagulating fixatives, tissue dehydration using graded solvent series, paraffin infiltration.	
	Microtomy and staining permanent sections	
PRACTICALS		
RUSBOTP 602	**Plant diversity VIII**	**Credits – 1**
1	Study of the following form genera with the help of permanent slides /Photomicrographs • *Lepidodendron* (All form genera, whichever available)	

	• *Lyginopteris* • *Pentoxylon*
2	Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides • *Gnetum* • *Ephedra*
3	Study of one plant from each of the following Angiosperm families • *Combretaceae* • *Rhamnaceae* • *Asclepiadaceae* • *Verbenaceae* • *Labiatae* • *Polygonaceae* • *Orchidaceae*
4	Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families
5	Identify the genus and species with the help of flora
6	Comparative study of angiosperms and gymnosperms using maceration technique • *Mangifera indica* • *Saracai ndica* • *Pinus roxburghii* • *Araucaria excelsa*
7	Study of various stages of microsporogenesis, megasporogenesis and embryo development with the help of permanent slides / photomicrographs
8	*In vivo* growth of pollen tube in *Portulaca*
9	Preparation of stains and fixatives

Course Code: RUSBOT 603
Course Title: Form and function VI
Academic year 2019 - 20

Learning Objectives:

- The structures of biomolecules, enzymology basics, and different aspects of nitrogen metabolism in relation to plants.
- Principles of genetic mapping, gene mutations and metabolic disorders.
- As an entrepreneurial component, studies on plant based antioxidants and their usage in the herbal cosmetic industry.
- Post-harvest techniques involving the preservation of fruits and vegetables

Learning Outcomes: The students will be able to: Understand biomolecular structures, learn about basics of enzyme function, and nitrogen metabolism. Carry out genetic mapping, detect gene mutations and identify metabolic disorders.Make, Use and sell herbal cosmetics so as to encourage entrepreneurship.

Detailed syllabus

RUSBOT 603	**Title: Form and function VI**	**Credits – 2.5**
UNIT I	**Physiology**	**15 Lectures**
	Translocation of solutes: Composition of phloem sap, girdling experiment, phloem loading and unloading. Mechanisms of sieve tube translocation.	

	Lipid Metabolism: Synthesis and breakdown of fatty acids, glycerol and fat molecules. Energetics of fatty acid and glycerol breakdown, gluconeogenesis or glyoxylate cycle: respiratory metabolism of germinating fatty seeds.	
	Bioenergenetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.	
	Nitrogen Metabolism Nitrogen cycle, root nodule formation and leg- haemoglobin, nitrogenase activity, assimilation of nitrates (NR,NiRactivity), assimilation of ammonia (amination and transamination reactions), nitrogen assimilation and carbohydrate utilization.	
UNIT II	**Genetics**	**15 Lectures**
	Genetic mapping in eukaryotes: discovery of genetic linkage, gene recombination, construction of genetic maps, three point crosses and mapping chromosomes	
	Gene mutations: definition, types of mutations, reverse and spontaneous mutations, causes of mutations, induced mutations, the Ames test, DNA repair mechanism	
	Metabolic disorders – enzymatic and non enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketonuria, albinism, sickle cell anaemia.	
UNIT III	**Herbal Cosmetology**	**15 Lectures**
	Role of antioxidants in cosmetology – Antioxidants, their functions, sources, antioxidant enzymes.	
	Current status of Herbal Cosmetic Industry in India, Problems and Future prospects of Herbal Cosmetic Industry in India: Few examples of cosmetic products, modern and ayurvedic.	
	Preparation of modern/ ayurvedic cosmetic formulations and its validation	
	Use of herbs and phytochemicals in cosmetic industry.	
	Collection and processing of herbal material.	
	Good lab practices in cosmetic industry.	
UNIT IV	**Post-Harvest Technology**	**15 Lectures**
	Importance of post-harvest management of food; causes of post-harvest losses; maturity, ripening and biochemical changes after harvesting; post-harvest loss reduction technology including aspects of post-harvest treatment;	
	General principles and method of preservation; • Drying and dehydration • Low temperature preservation/ freezing • Pickles, fruit chutney and sauces • Jam, jelly, marmalade and preserves • Canning of fruits and vegetables • Unfermented fruit beverages	
	Novel techniques in food processing and preservation, management of processing	
PRACTICALS		
RUSBOTP 603	**Form and function VI**	**Credits - 1**

1	Determination of alpha-amino nitrogen
2	Estimation of proteins by Lowry's method
3	Determination of NR activity in leaf discs
4	Problems based on three point crosses, construction of chromosome maps
5	Identification of types of point mutations from given DNA sequences
6	Study of mitosis using pre-treated root tips of *Allium*
7	Preparation of a herbal/ Ayurvedic cosmetic formulation and its analysis • TLC fingerprinting • Geographical variation using TLC • Powder microscopy
8	Quantitation of phytochemicals from plant source using TLC/ HPTLC • *Carissa carandas*/ Flax seeds- β-sitosterol • *Emblica officinalis* – Gallic acid
9	Estimation of ascorbic acid and effect of heat treatment on ascorbic acid content.
10	Preparation of: • Squash • Cordial • Nectar • Marmelade

Course Code: RUSBOT 604
Course Title: Current Trends in Plant Sciences IV
Academic year 2019 - 20

Learning Objectives:
The students will gain detailed knowledge of the various aspects of biodiversity from evolution to conservation. They will learn about the uses and working of various instruments and about the wide variety of economically important plants and their uses. As an entrepreneurial component, **Learning Outcomes:**The students will learn aboutbiodiversity basics and importance of conservation.They will learn the use of advanced instruments like UV – spectrophotometer, HPTLC, HPLC for the study of phytochemicals. Instrumentation techniques with calibration of instruments have been added. Few parameters of research methodology will be learnt.

Detailed Syllabus

RUSBOT 604	**Title: Current Trends in Plant Sciences IV**	**Credits – 2.5**
UNIT I	**Economic Botany**	**15 Lectures**
	Essential Oils: Extraction, perfumes, perfume oils, oil of rose, patchouli, champaca, grass oils: *Citronella*.	
	Fatty oils : Drying oil (linseed and soybean oil), semidrying oils(sesame oil) and non-drying oils (olive oil and peanut oil),	
	Vegetable Fats: Coconut and Palm oil	
UNIT II	**Plant Geography and Forestry**	**15 Lectures**
	Phyto-geographical regions of India.	
	Biodiversity: • Definition, diversity of flora found in various forest types of India • Evolution of biodiversity with one example of an evolutionary tree	

	• Levels of biodiversity, Importance and status of biodiversity • Loss of biodiversity • Conservation of biodiversity	
	Genetic diversity - Molecular characteristics	
	Silviculture and social forestry: types and role.	
UNIT III	**Instrumentation**	**15 Lectures**
	Calibration of Instruments	
	Colorimetry and spectrophotometry (only visible but mention UV and IR) – Instrumentation, working, principle and applications	
	Chromatography: Principle, instrumentation and application – HPTLC, RP - HPTLC, HPLC	
UNIT IV	**Research Methodology**	**15 Lectures**
	Bibliography • Methods of citing references • Style manuals • Arrangement of references	
	Imaging of Tissue specimens • Photomicrography and Ultra-microscopy	
	Tools for research • Application of Scale Bar • Art of field photography • Remote sensing in research	
PRACTICALS		
RUSBOTP 604	**Current Trends in Plant Sciences IV**	**Credits - 1**
	PROJECT WORK • **Research methodology will be discussed** • **Well-defined materials and methods, discussion, results and conclusion, bibliography.** • **Presentation based on some advanced technique.** Any topic related to the syllabus, such as, 1. Biodiversity studies in non – vascular cryptogams 2. Identification of wood samples using wood anatomy studies 3. Ecological anatomy: Epiphytes and Parasites 4. Nodal Anatomy: Unilacunar, trilacunar and multilacunar nodes. 5. Pharmacognostic evaluation of Indian plants used in herbal industry/ Ayurveda 6. Pharmacological evaluation of Indian plants used in herbal industry/ Ayurveda 7. Evaluation of genuine and spurious drugs used in herbal industry/ Ayurveda 8. Estimation of macro and micro nutrients in plants 9. Essential oil extraction using Clevenger (Citronella Oil/ Patchouli etc) 10. Water potability analysis	

Reference Books

1. Introduction to Plant Physiology by Noggle and Fritz, Prentice Hall Publishers (2002)
2. An introduction to Genetic analysis Griffith Freeman and Company (2000)
3. Fundamentals of Biostatics by Rastogi,Ane Books Pvt. Ltd. (2009).
4. Instant Notes on Bioinformatics by Westhead (2002), Taylor Francis Publications.
5. DNA barcoding plants: taxonomy in a new perspective 2010. K Vijayan and C H Tsou, Current Science, 1530 – 1541.
6. Girdharilal, Siddappaa, G.S. and Tandon, G.L.1998. Preservation of fruits &Vegetables,ICAR, New Delhi
7. Crusess, W. B.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition,Pub: Agrobios India
8. Manay, S. and Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers
9. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products,Tata McGraw-Hill publishing company limited, Second edition.
10. Srivastava, R.P. and Kumar, S. 2006 . Fruits and Vegetables Preservation- Principles andPractices. 3rd Ed. International Book Distributing **Co**
11. Alexopoulus C. J, Mims C.W. and Blacwel M. I. 1996. Introductory Mycology. John Wiley and Sons Inc
12. Bold, H. C. and M. J. M. Wynne (1978) Introduction to the Algae - Structure andReproduction. Prentice Hall of India Pvt. Ltd New Delhi.
13. Chapman, V.J. and D.J. Chapman (1979). The Algae, English Language Book Soc&Mac Millons, London.
14. Ganguli, H.C. and Kar, A.K. (2001) College Botany Vol. I, Books and Allied Press LtdKolkata, India
15. Ganguli, H.C. and Kar, A.K. (2001) College Botany Vol. II, Books and Allied PresLtd Kolkata, India
16. Kumar H.D. 1988. Introductory Phycology, Affiliated East-West Press Ltd., New Delhi
17. Kumar H.D. and H. N. Singh (1976) A Text Book of Algae. Affiliated East West PressLtd., New Delhi, India.
18. Prescott, G.W. (1969) The Algae: A Review. Thomas Nelson and Press, London, U.K.
19. Puri, P. (1985) Bryophyta A Broad Perspective, Atma Ram and Sons, New Delhi,India. House.Pvt Ltd. New Delhi.
20. Saxena A. K. and R. M. Sarabhai (1992). Text Book of Botany-Vol. II Embryophyta.RatanPrakashanMandir, Agra, India
21. Vashishta, B.R. (2012) Botany for Degree Students-Algae S. Chand and Co Ltd., NewDelhi, India
22. Vashishta, P.C. (2010). Botany for Degree Students -Bryophyta. S. Chand and Co. Ltd.New Delhi, India.
23. Heywood, V. H. and Moore, D. M. (Eds.) (1984).Current Concepts in Plant Taxonomy,Academic Press, London, U.K.
24. Jeffrey, C.E. (1982). An Introduction to Plant Taxonomy, Cambridge University Press,Cambridge, London, U.K.
25. Lawrence, G. H. M. (1951) Taxonomy of Vascular Plants. McMillan, New York, U.S.A.
26. Naik, V.N. (1985) Taxonomy of Angiosperms. Tata McGraw-Hill Publ. Co. Ltd., New Delhi,India.
27. Sharma, O.P. (1993) Plant Taxonomy, .Tata McGraw Hill. Publ. Co. Ltd. New Delhi,India.
28. Singh, V. (1993) Taxonomy of Angiosperms Rastogi Publication, Meerut (U.P.)India.
29. Singh, V., Pande, P.C. and D. K. Jain (1994). A Text Book of Botany: Angiosperms.RastogiPublications, Meerut (U. P.), India.
30. Singh, M. P., Nayar, M.P. and R. P. Roy (1994).Text Book of Forest Taxonomy, AnmolPubl.P. (Ltd.) New Delhi, India.

31. Subramanayam, N.S. (1997) Modern Plant Taxonomy, Vikas Publ. House, New Delhi,India.
32. Sivarajan,V.V.(1984) Introduction to Principles of Plant Taxonomy. Oxford & I. B. H.Publishing co. New Delhi, India.
33. A Text Book of Cell and Molecular Biology, RastogiPublication, Meerut. India,Gupta, P.K. (1999)
34. Molecular Biology of Gene, Watson J. D.
35. Cell Biology, Genetics, Molecular biology, Evolution and Ecology.3rd edition S.Chand &co.New Delhi, India.Verma, P. S., V. K. Agrawal. (2008)
36. DeRobertis and DeRobertis Cell And Molecular Biology 8Ed (2017)
37. Molecular Cell Biology, 4th editionHarvey et al.New York: W. H. Freeman; 2000.ISBN-10: 0-7167-3136-3
38. Amar Sing (1977) Practical Plant Physiology. Kalyani Publishers, New Delhi- Ludhiana.
39. Daniel, M. (1991) Methods in Plant Chemistry and Economic Botany. KaiyaniPublishers, Ludhiana, India.
40. Daniel, M. and S.D. Sabnis (1990) A Phytochemical Approach to Economic Botany.Kaiyani Publishers, Ludhiana, India
41. Devlin, R.M. and Witham, F.H. (1986), Plant Physiology (Fourth edition), CBSPublishers and Distributers, Delhi, 110032.
42. Grewal, R.C. (2010) Plant physiology, Campus Book International, New Delhi, India.
43. Harborne, T.C. (1981) Phytochemical Methods : A Guide To Modem Techniques ofPlant Analysis. Chapman and Hall, London, U.K
44. Hopkins, W.G (1985) Introduction to Plant Physiology; John Wiley and Sons. Incl. New York, U.S.A
45. Jain, V.K. (1997) Fundamentals of Plant Physiology. Atrnaram& Sons, New DelhiIndia
46. Lincoln, Taiz and EduardonZeiger (2010) Plant Physiology SinauerAssociates,Inc.
47. Mukherjee, S and A.K. Ghose (1996). Plant Physiology, Vikas Publishing House, NewDelhi, India.
48. Mukharji, S. and Ghosh, A.K. (2012), Plant Physiology, New Central Book Agency (P)Ltd. Kolkata, 700009.
49. Pandey, S.K and B.L.Sinba (.994) Plant Physiology, Vikas Publishing House, NewDelhi, India.
50. Sarabhai, B.P. (1995), Elements of Plant Physiology, Amol Publications, New Delhi,India.
51. Salisbury and Ross (2007) Plant Physiology. CBS Publishers & Distributers4596/1A.11 Darya Ganj, New Delhi-110002 (India).
52. Verma, V. (1984) Introduction to Plant Physiology. Emkey Publications, New Delhi,India.
53. Agrawal, K.C. (1996). Environmental Biology,Agro-Botanical Publisher, Bikaner India
54. Ambasta, R.S.(1988).A Text of Plant Ecology, Student Friends &Co. Varanasi, India.
55. Ambasta,R.S.(1990).Environmental and Pollution, Student Friends & co. Varanasi,India.
56. Chapman, J.L. and Reiss, M.J.(1998). Ecology: Principles and Applications. CambridgUniversity Press, Cambridge
57. Dash, M.C.(1993).Fundamentals of Ecology, Tata McGraw Hill Publishing Co. Ltd.New Delhi, India.
58. Heywood, V.H. and Watson, R.T.(1995). Global Biodiversity Assessment, CambridgeUniversity Press, Cambridge.
59. Hill, M. K. (1997). Understanding Environmental Pollution, Cambridge University Press,Cambridge.
60. Kapur, P. And Govil, S.R.(2000).Experimental Plant Ecology.S.K.Jain for CBSPublishers and Distributors, New Delhi, India.
61. Kothari, A.(1997).Understanding Biodiversity: Life Sustainability and Equity.OrientLongman.
62. Krebs, C.J.(1989).Ecological Methodology. Harper and Row,NewYork,USA.
63. Kumar, H.D. (1996). Modern Concept of Ecology (4th Ed.)Vikas Publishing House(P.)Ltd. New Delhi.

64. Kumar, H.D. (1997). General Ecology, Vikas Publishing House (P.) Ltd. New Delhi,
65. Kochhar, P. L. Plant Ecology, Genetics and Evolution, S. Nagin& Co. Ltd. New Delhi,
66. Moore,P.W. and Chapman,S.B. (1986).Method in Plant Ecology. Blackwell ScientificPublications.
67. Mukherjee B. Environmental Biology, Tata McGraw HillPublishing Co. Ltd.New Delhi,India.
68. Odum,E,P.(1983).Basic Ecology, Saunders, Philadelphia.
69. Odum, E. P. (1986).Fundamental of Ecology, Natraj Publishers, Dehra –Dun, India.
70. Purohit, S.S. and R. Ranjan. Ecology and Environmental Pollution, Agro-BiosPublishers, Jodhpur, India.
71. Sharma, P.D. Ecology And Environment, Rastogi publication, Meerut, India.
72. Subrahmanyam, N. S. And Sambamurty, A.V.S.S. (2000), Ecology Narosa PublishingHouse, New Delhi, India.
73. Swaminathan, M. S. And Kocchar, S. L.(Eds.)(1989).Plant and Society. MacmillanPublications Ltd. London, U.K.
74. Verma, P. S. and V.K. Agrawal, Principles of ecology. S. Chand & co. (Pvt.) Ltd. RamNagar, New Delhi. India
75. Chawla, H.S 2008 Plant Biotechnology: Laboratory Manual For PlantBiotechnology, Oxford and IBH Publishing, New Delhi
76. Gupta, P. K. 2010, Elements of Biotechnology, Rastogi Publications,
77. Jogdand, S.N. (1993) Advances in Biotechnology. Himalaya Publ. House. NewDelhi,India.
78. Kumar, U. (2000) Methods in Plant Tissue Culture, Agrobios, Jodhpur. India.
79. Purohit, S.S. (2003). Agricultural Biotechnology, Agrobias, Jodhpur, India. Smith,I.E. Biotechnology, Cambridge University Press. Cambridge.
80. Martin G. J. (1995) Ethnobotany: A Methods Manual, Chapman & Hall, London,U.K.
81. Sinha, Rajiv, K and S.Sinha (2001).Ethnobiology, Sura Publications, Jaipur, India.
82. Patil D.A. (2008). Useful plants, Navyug Publishers and Distributors, New Delhi,India.
83. P.C.Trivedi and Niranjan Sharma (2011). T.B. of Ethnobotany, Pointer publisher,Jaipur.
84. Sambamurthy, A.V.S.S. and Subramanyam, N.S. (1989). A Text of Economic Botany WikesEastern Ltd., New Delhi, India.
85. Swaminathan, MS. and Kocchar, S.L. (Eds.) (1989). Plants Society, MacMillanPublications, Ltd. London, U.K.
86. Ashalata D Rozario and DipakMukherji (2004). A Hand Book of Ethnobotany,KalyaniPublishers Ludhiana

MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40%: 40 marks.

Sr No	Evaluation type	Marks
1	Assignment / Field Visit/ Submission/ On-line test/Active Participation (attentiveness/ability to answer questions)/Participation in academic or Co-curricular activities	20
2	One class Test (multiple choice questions / objective)	20

B) External examination - 60 %

Semester End Theory Assessment - 60 marks

i. Duration - These examinations shall be of **2 hours** duration.
ii. Paper Pattern:
   1. There shall be **05** questions each of **12**marks and **01** question of **12** marks. On each unit there will be one question & last question will be based on all the **04** units.
   2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1) A, B, C	Any 2 out of 3	12	Unit I
Q.2) A, B, C	Any 2 out of 3	12	Unit II
Q.3) A, B, C	Any 2 out of 3	12	Unit III
Q.4) A, B, C	Any 2 out of 3	12	Unit IV
Q.5) a, b, c, d , e.	Any 3 out of 5	12	All units

Practical Examination Pattern:

(A)Internal Examination:

Heading	Practical
Journal	05
Practical/ Field Report/ Presentation	15
Total	20

(B) External (Semester end practical examination):

Particulars	Practical
Laboratory work and/or *Viva voce*	30
Total	**30**

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester- V and VI

Course	501/601		502/602		503/603		504/604		Total per Course	Grand Total
	Internal	External	Internal	External	Internal	External	Internal	External		
Theory	40	60	40	60	40	60	40	60	100	400
Practicals	20	30	20	30	20	30	20	30	50	200

---- x ---- 0 ---- x ----