Resolution No.: AC/II(23-24).2.RUS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore • Experience • Excel

Syllabus for

Program: B.Sc.

Program Code: BOTANY(RUSBOT)

(Choice Based Credit System for the academic year2024-25)

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

GRADUATYE ATTRIBUTES

	Description **A student completing Bachelor's Degree in Science program will be able to:**
GA 1	Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science.
GA 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences
GA 3	Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools
GA 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
GA 5	Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner.
GA 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
GA7	Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it.
GA 8	Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner

PROGRAM OUTCOMES

PO	PO Description A student completing Bachelor's Degree in Science program in the subject of Botany will be able to:
PO 1	Understand the basic concepts of lower & higher plants their life cycle, economic and ecological importance, also evolution from algae to angiosperms and their industrial applications
PO 2	Develop an understanding of the principles underlying nomenclature and classification of Angiosperms, identify plants belonging to various families according to Bentham and Hooker's system.
PO 3	Elucidate ecological interconnectedness of life by energy and nutrient flow, relate the physical features of the environment to the structure of populations, communities, ecosystems, pollution, bioremediation, natural resources, sustainability and importance of conservation.
PO 4	Understand and relate priority areas such as genetics, cell and molecular biology, plant biotechnology and application of genetic engineering for the improvements of plants.
PO 5	Gain knowledge about laws of inheritance, various genetic interactions, chromosomal aberrations, multiple alleles and mutations.
PO 6	Analyze morphological and anatomical plant structures in the context of metabolic /physiological functions of plants, including embryological and palynological aspects
PO 7	Apply ethnobotanical aspects and medicinal, dietary and cosmetic uses of plants with special reference to phytochemistry and usage as mentioned in different Pharmacoepia
PO 8	Acquire the skills in handling scientific instruments, planning and performing laboratory experiments and application of suitable statistical tools.
PO 9	Understand the finer aspects of emerging areas such as Molecular biology and Bioinformatics.
PO 10	Develop practical skills in laboratory techniques in various fields of botany along with collection and interpretation of biological materials
PO 11	Apply research based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

COURSE OUTLINE

SEMESTER V

Course Code	UNIT	TOPICS	Credits
RUSBOT 501		**PLANT DIVERSITY - V**	
	I	Microbiology	2.5
	II	Algae	
	III	Bryophyta	
	IV	Biostatistics	
RUSBOT 502		**PLANT DIVERSITY - VI**	
	I	Angiosperms I	2.5
	II	Ethnobotany	
	III	Palynology	
	IV	Anatomy	
RUSBOTP 501	Practical	**Practicals based on RUSBOT 501& 502**	3
RUSBOT 503		**FORM AND FUNCTION- V**	
	I	Cytology and Molecular Biology	2.5
	II	Physiology I	
	III	Environmental Botany	
	IV	Bioinformatics	
RUSBOT 504		**CURRENT TRENDS IN PLANT SCIENCES III**	
	I	Pharmacognosy and Medicinal Botany	2.5
	II	Plants in Human Health	
	III	Plant tissue culture	
	IV	Research methodology II	
RUSBOTP 502	Practical	**Practicals based on RUSBOT 503& 504**	03
			16

SEMESTER VI

Course Code	UNIT	TOPICS	Credits
RUSBOT 601	PLANT DIVERSITY- VII		
	I	Fungi and Plant pathology	2.5
	II	Pteridophyta	
	III	Biotechnology I	
	IV	Biotechnology II	
RUSBOT 602	PLANT DIVERSITY - VIII		
	I	Paleobotany and Gymnosperms	2.5
	II	Angiosperms II	
	III	Embryology	
	IV	Plant micro techniques	
RUSBOTP 601	Practical	Practicals based on RUSBOT 601& 602	03
RUSBOT 603	FORM AND FUNCTION - VI		
	I	Physiology II	2.5
	II	Genetics	
	III	Cosmetology	
	IV	Post-Harvest Technology	
RUSBOT 604	CURRENT TRENDS IN PLANT SCIENCES- IV		
	I	Economic Botany	2.5
	II	Plant Geography and Environmental Botany	
	III	Instrumentation	
	IV	Research methodology III	
RUSBOTP 602	Practical	Practicals based on RUSBOT 603& 604	03
			16

SEMESTER- V
Course Code: RUSBOT 501
Course Title:Plant Diversity – V

Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learners will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	Express the soil microbial diversity and processes
CO 2	Outline the life cycles of members Rhodophta, Bacillariophyta and Musci
CO 3	Analyze the anatomy and reproduction of Rhodophta, Bacillariophyta and Musci along with their ecological and economic importance
CO 4	Select appropriate methods in biometry for biological data analysis
CO 5	Test the hypothesis and its interpretation
CO 6	Evaluate the role of microbes in composting and bioremediation

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 501	**Title: Plant Diversity - V**	**Credits – 2.5**
UNIT I	**Microbiology**	**Lectures-15**
	Soil and Agricultural Microbiology: • Microbial flora of soil • Biogeochemical role of soil Microorganisms- Nitrogen, Carbon, Sulfur • Microorganisms as fertilizers- *Rhizobium, Azotobacter*, Phosphate solubilizing bacteria • Microorganisms as plant pathogens- List of major plant diseases caused by microorganisms, Crow n gall disease by *Agrobacterium*	
	Biodegradation and Bioremediation • Biodegradation of organic carbon compounds- Cellulose, hemicellulose, pectin and lignin degraders, role of microbes in composting • Role of microbes in degradation of pesticides and herbicides • Role of Microbes in degradation of xenobiotics	
UNIT II	**Algae**	**Lectures-15**

	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 III	**Bryophyta**	**Lectures-15**
	General characters of Musci	
	Life cycle of *Marchantia* and *Funaria*	
	Evolution of gametophyte	
	Evolution of sporophyte	
UNIT IV	**Biostatistics**	**Lectures-15**
	Test of significance student's *t*-test (paired and unpaired)	
	Box plot	
	Regression	
	ANOVA (one way)	
	PRACTICALS	
RUSBOTP 501	**Plant Diversity – V**	**Credits – 1.5**
1	Study of soil flora: Serial dilution technique	
2	Cultivation of *Acetobacter* and preparation of biofertilizer	
3	Study of the flora of compost	
4	Growth curve of *E.coli* (Demonstration)	
5	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides • *Polysiphonia* • *Batrachospermum* *Pinnularia*	
6	Range of thallus structure in algae	
7	Economic importance of algae	
8	Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides • *Marchantia* *Funaria*	

10	*T-test* (paired and unpaired)
11	Problems based on regression analysis
12	ANOVA

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Course Code: RUSBOT 502

Course Title:Plant Diversity – V

Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learners will be able to;

COURSE OUTCOMES	CO DESCRIPTION
CO 1	Identify ethnobotany as an interdisciplinary science
CO 2	Categorize various indigenous ethnic groups and their environmental practices
CO 3	Experiment with the concepts and fundamentals of plant anatomy and its role in adaptation
CO 4	Apply the fundamentals of palynology in various areas of science
CO 5	Employ the principles underlying Bentham and Hooker's classification and identify plants from the prescribed families
CO 6	Evaluate the Characters of taxonomic importance like Morphology, Palynology, Embryology, Cytology and Ecology

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/ Lectures
RUSBOT 502	**Title: Plant Diversity - VI**	**Credits – 2.5**
UNIT I	**Angiosperms I**	**Lectures-15**
	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 familiesand economic and medicinal importance for members of the families • Magnoliaceae • Rutaceae • Umbelliferae • Asteraceae • Cucurbitaceae • Polygonaceae • Commelinaceae • Graminae	

UNIT II	**Ethnobotany**	**Lectures-15**
	Ethnobotany – Definition, History, Sources of data and methods of study: field work, herbaria, ancient literature, archeological findings, temples and sacred places.	
	Sacred grooves	
	Contributions of Dr. S.K. Jain, Madhav Gadgil, Dr. V. D. Vartak	
	Ethnic communities of India and concept of sustainability for Survival	
UNIT III	**Palynology**	**Lectures-15**
	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**	**Lectures-15**
	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 – 1.5**
1	Study of one plant from each of the following Angiosperm families • Magnoliaceae • Rutaceae • Umbelliferae • Asteraceae • Cucurbitaceae • Polygonaceae • Commelinaceae • Graminae	
2	Identifying the genus and species of a plant with the help of Flora	
3	Mapping of sacred groves in India/ Maharashtra	

4	Study of plants of ethnobotanical importance in Maharashtra – medicinal, fibre yielding, food plants, oil yielding plants. (and Assignment post visit)
6	Determination of pollen viability
7	Pollen analysis from honey sample – unifloral and multifloral honey
8	Effect of varying concentration of sucrose on *In vitro* Pollen germination
9	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 using double staining technique • *Bignonia* • *Salvadora* • *Mirabilis* • *Aristolochia* • *Dracaena*
12	Study of anomalous secondary growth in the roots of • Beet • Radish
13	Types of Stomata

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Course Code: RUSBOT 503
Course Title:Form and Function – V
Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learners will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	Recall fundamental concepts related to plant cell organelles
CO 2	Illustrate molecular genetic machinery for translation
CO 3	Relate Water relation, transport processes, vegetative and reproductive growth of plants and various physiological processes
CO 4	Summarize the basics of environmental pollution and related concepts
CO 5	Execute the concept of pairwise alignment, multiple sequence alignment and phylogeny.of sequences, using algorithms
CO 6	Plan various environmental clean-up technologies

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectu Res
RUSBOT 503	**Title: Form and function – V**	**Credits – 2.5**
UNIT I	**Cytology and Molecular Biology**	**Lectures- 15**
	Structure and function of nucleus	
	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**	**Lectures-15**
	Water potential, components of water potential: solute, matrix and pressure potential, transport of water and inorganic solutes	
	Translocation of solutes: Composition of phloem sap, girdling experiment, phloem loading and unloading. Mechanisms of sieve tube translocation.	
	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, Gibberellins and abscisic acid	

	and their commercial applications.	
	Reproductive growth: Photoperiodism: Phytochrome Response and vernalization with reference to flowering in higher plants, Physico-chemical properties of phytochrome, Pr-Pfr interconversion, role of phytochrome in flowering of SDPs and LDPs;	
UNIT III	**Environmental Botany**	**Lectures-15**
	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 for bioremediation	
	Biomagnification, Bioaccumulation and Biotransformation.	
	Phytoremediation: Types, Metals-Mechanisms of sequestration,	
	Organic pollutants – Phytodegradation.	
	Environmental guidelines for industries	
	Bioprospecting and biopiracy.	
UNIT IV	**Bioinformatics**	**Lectures-15**
	Basic concepts of sequence alignment: • Methods of pairwise alignments and Multiple sequence alignment • Scoring matrices like BLOSUM and PAM • Tools for sequence alignment- BLAST, MUSCLE	
	Phylogeny: • Basic concepts in taxonomy and phylogeny, Definition and description of phylogenetic trees and various types of trees • Method of construction of Phylogenetic trees- distance based(UPGMA and NJ)and character based (Maximum parsimony) methods • Tool to study molecular evolution and phylogeneticanalysis – MEGA	
PRACTICALS		
RUSBOTP 503	**Form and Function - V**	**Credits – 1.5**
1	Mounting of giant chromosome from *Chironomous* larva	
2	Smear preparation from *Tradescantia* buds	
3	Determination of solute potential of plant tissue by plasmolytic method.	
4	To estimate the activity of Gibberellic acid with respect to seed germination and mobilization of reserves.	
5	Determination of effect of auxins on rooting of stem cuttings.	

6	Estimation of the following in / of the given water sample: • Dissolved Oxygen Demand • Biological Oxygen Demand • Chemical Oxygen Demand • Hardness • Salinity • Acidity • Alkalinity
7	BLAST and its variants
8	Tool for multiple sequence alignment: MUSCLE
9	Molecular visualisation using RASMOL

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Course Code: RUSBOT 504
Course Title: Current Trends in Plant Sciences – III
Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learner will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	Execute the concepts of phytochemistry to identify the chemical constituents of medicinal plants
CO 2	Apply the core concepts and fundamentals of plant tissue culture for micropropagation, somatic embryogenesis, anther culture and suspension culture
CO 3	Assess the contribution of plants in human health, with reference to specific function as therapeutic agents
CO 4	Design research problem
CO 5	Plan data collection and outcome generation and the process of scientific documentation

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 504	**Title: Current Trends in Plant Sciences- III**	**Credits – 2.5**
UNIT I	**Pharmacognosy and Medicinal Botany**	**Lectures-15**
	Monographs of drugs with reference to botanical source, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- *Strychnos* seeds, *Senna* leaves, Clove buds, *Allium sativum* and *Curcuma longa*	
	Medicinal plants used against: • Diabetes • Anemia • Jaundice • Obesity	
UNIT II	**Plants in Human Health**	**Lectures- 15**
	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	

	Phytochemicals of nutraceutical importance: • Betasitosterol: *Linum usitatissimum, Carissa carandas* Lycopene: Tomato, Omega 3 fatty acids: Linseed/ Chiaseeds/walnuts	
UNIT III	**Plant Tissue Culture**	**Lectures-15**
	Micropropagation of floricultural and medicinal plants	
	Anther culture and Pollen culture	
	Somatic embryogenensis and artificial seeds	
	Plant cell suspension cultures for the production of secondarymetabolites	
	Protoplast isolation- Various methods of isolation	
UNIT IV	**Research Methodology II**	**Lectures-15**
	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 – 1.5**
1	Macroscopic/ Microscopic characters and Chemical tests for active constituents ofthe following plants. • *Allium sativum* • *Curcuma longa* • *Strychnos nux-vomica*	
2	TLC for separation and detection of • Flavonoids - *Azadirachta indica* • Terpenoids – *Centella asiatica and Bacopa monnieri* • Omega 3 fatty acids: Linseed oil/Flax seed oil/ chia seed oil	
3	Powder analysis of medicinal plant material for detection of adulterants	
4	MIC and anti- microbial activity of secondary metabolites.	
5	Identification of plants for human health and their benefits.	
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 using excel.

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MODALITY OF ASSESSMENT

Theory Examination Pattern:

Internal Assessment - 40%: **40 marks.**

Sr No	Evaluation type	Marks
1	Assignment / Field Visit/ Submission/ On-line test/Case study/ Surveys /Participation in academic or Co-curricular activities	20
2	One class Test (multiple choice questions)	20

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:

Internal Examination:

Heading	Practical
Journal	05
Practical participation	05
Field Report/ Presentation	10
Total	20

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

Course	501		502		503		504		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

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SEMESTER-VI

Course Code: RUSBOT 601

Course Title: Plant diversity - VII

Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learners will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	Explain the morphology and life-cycles of Fungi and plant pathogens in the syllabus
CO 2	Interpret the morphology, anatomy and reproduction of Pteridophytes and evolutionary relationships of members of these groups.
CO 3	Outline the basic principles of Genomic/chromosome and cDNA libraries, DNA sequencing techniques and PCR
CO 4	Identify common Pteridophytes of India
CO 5	Apply the molecular techniques to resolve taxonomic problems

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 601	**Title: Plant diversity – VII**	**Credits – 2.5**
UNIT I	**Fungi**	**Lectures- 15**
	Basidiomycetae: 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**	**Lectures- 15**
	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	
	Common ferns of India	
UNIT III	**Plant Biotechnology I**	**Lectures-15**
	of Genomic DNA libraries, Chromosome libraries and c-DNA Construction 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**	**Lectures-15**
	DNA sequence analysis – Maxam – Gilbert Method and Sanger's method, Pyrosequencing.	
	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 – 1.5**
1	Study of stages in the life cycle of the following Fungi from fresh / preserved materialand 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	Isolation and separation of Plasmid DNA using AGE	
5	Isolation and separation of Genomic DNA using AGE	
6	DNA sequencing- Sanger's method (give a sequence and let them show how the autoradiogram will be) and DNA sequencing using a pyrogram.	
7	Identification: Restriction mapping,	
8	Southern blotting	
9	DNA barcoding of plant material by using suitable data	

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Course Code: RUSBOT 602
Course Title: Plant diversity – VIII
Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learners will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	Describe the structure of fossil forms prescribed in the syllabus.
CO 2	Outline the general characters and life cycles of prescribed members of Gnetopsida
CO 3	Express fundamental concepts of plant embryology
CO 4	Apply the principles underlying Benthem and Hookers classification and identify the plants from the prescribed families
CO 5	Execute the concepts of plant microtechnique for preparing permanent slides
CO 6	Evaluate the traditional as well as recent phylogenetic systems of classification of Angiosperms.

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 602	**Plant diversity – VII**	**Credits – 2.5**
UNIT I	**Paleobotany**	**Lectures- 15**
	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 and general characters • Life cycle of *Gnetum* • Life cycle of *Ephedra* Distribution of Gymnosperms in India	

UNIT II	**Angiosperms**	**Lectures-15**
	Taxonomic literature - Library, Floras, Monographs, Dictionary, Periodicals, Index and Journals	
	Study of following plant families • Rhamnaceae • Apocynaceae • Asclepiadaceae • Scrophulariaceae • Acanthaceae • Verbenaceae • Labiatae • 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**	**Lectures-15**
	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**	**Lectures-15**
	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 – 1.5**
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 • Rhamnaceae • Apocynaceae • Asclepiadaceae • Scrophulariaceae • Acanthaceae • Verbenaceae • Labiatae • Orchidaceae
5	Identify the genus and species with the help of flora
6	Comparative study of angiosperms and gymnosperms using maceration technique • *Mangifera indica* • *Saraca indica* • *Pinus roxburghii* • *Araucaria excels*
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	Study of dicot and monocot embryo.(Castor, maize, *Citrus*, Scoparia, Cucumber)
10	Microtomy – Assignment

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Course Code: RUSBOT 603
Course Title: Form and function – VI
Academic year 2023–2024

COURSE OUTCOMES:
Upon successful completion of this course, learners will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	State the principles governing bioenergetics.
CO 2	Relate the concepts of lipid and nitrogen metabolism & enzyme immobilization to its industrial application
CO 3	Analyze the effect of gene mutations on gene functions
CO 4	Evaluate the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
CO 5	Formulate herbal cosmetics.
CO 6	Propose the techniques in food processing and preservation of horticultural produce
CO 7	Construct genetic maps, three pointcrosses and mapping chromosomes

Detailed syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 603	**Form and function – VI**	**Credits – 2.5**
UNIT I	**Physiology**	**Lectures-15**
	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.	
	Lipid Metabolism: Structures of fatty acids and glycerol. 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.	
	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.	
	Methods of enzyme immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).	
UNIT II	**Genetics**	**Lectures-15**
	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**	**Lectures-15**
	Role of antioxidants in cosmetology – Antioxidants, their functions, sources, antioxidant enzymes.	
	Collection and processing of herbal material.	
	Preparation of ayurvedic cosmetic formulations and its validation	
	Current status of Herbal Cosmetic Industry in India, problems and future prospects. Few examples of herbal cosmetic products	
	Good lab practices in cosmetic industry.	
UNIT IV	**Post-Harvest Technology**	**Lectures- 15**
	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 – 1.5**
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 face pack for dry/normal /oily skin, hair oil, herbal shampoo, herbal hair dye, lip balm, moisturizing cream, kajal. -Assignment
8	Estimation of ascorbic acid and effect of heat treatment on ascorbic acid content.
9	Preparation of Squash
10	Quantitation of phytochemicals from plant source using TLC/ HPTLC • *Mentha viridis* - Menthol • *Emblica officinalis* – Gallic acid

References:

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- Panda,H. 2015.Herbal Cosmetics Hand Book, 3rd Revised edition, Asia Pacefic Business Press inc. (e-book **)**

Course Code: RUSBOT 604
Course Title: Current Trends in Plant Sciences - IV
Academic year 2023–2024

COURSE OUTCOMES:

Upon successful completion of this course, learners will be able to;

COURSE OUTCOME	CO DESCRIPTION
CO 1	Review the role of Silviculture and social forestry in human and environment welfare
CO 2	Apply the principles of extraction for essential oils, fatty oils, vegetable oils and their value addition
CO 3	Operate advanced instruments like UV –spectrophotometer, HPTLC, HPLC for the study of phytochemicals
CO 4	Employ the methods of citing references and art of photo micrography
CO 5	Differentiate the phytogeographical regions of India

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 604	**Title: Current Trends in Plant Sciences – IV**	**Credits – 2.5**
UNIT I	**Economic Botany**	**Lectures- 15**
	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	
	Kokkam butter, Cocoa butter	
UNIT II	**Plant Geography and Forestry**	**Lectures-15**
	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**	**Lectures-15**
	Calibration of Instruments	
	Colorimetry and spectrophotometry (only visible but mention UV and IR) – Instrumentation, working, principle and applications	
	Chromatography: Principle, instrumentation and application – HPTLC, HPLC	
UNIT IV	**Research Methodology**	**Lectures-15**
	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 – 1.5**
	PROJECT WORK (Any topic related to the syllabus)	

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MODALITY OF ASSESSMENT

Theory Examination Pattern:

Internal Assessment - 40%: **40 marks.**

Sr No	Evaluation type	Marks
1	Assignment / Field Visit/ Submission/ On-line test/Case study/ Survey report / Participation in academic or Co-curricular activities	20
2	One class Test (multiple choice questions)	20

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:

Internal Examination:

Heading	Practical
Journal	05
Practical participation	05
Field Report/ Presentation	10
Total	20

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- VI

Course	601	602	603	604	Total per Course	Grand Total

	Internal	External	Internal	Extern Al	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**

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