Resolution No.: AC/II(20-21).2.RUS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

(Affiliated to University of Mumbai)

RUIA COLLEGE
Explore ● Experience ● Excel

Syllabus for: UG

Program: B. Sc.

Program Code: BOTANY(RUSBOT)

(Credit Based Semester and Grading System for the academic year 2021–2022)

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.

PROGRAM OUTCOMES

PO	PO Description **A student completing Bachelor's Degree in Science program will be able to:**
PO 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.
PO 2	Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences
PO 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
PO 4	Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results.
PO 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.
PO 6	Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society.
PO 7	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.
PO 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 SPECIFIC OUTCOMES

PSO	PSO Description A student completing Bachelor's Degree in Science program in the subject of Botany will be able to:
PSO 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
PSO 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.
PSO 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.
PSO 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.
PSO 5	Gain knowledge about laws of inheritance, various genetic interactions, chromosomal aberrations, multiple alleles and mutations.
PSO 6	Analyze morphological and anatomical plant structures in the context of metabolic /physiological functions of plants, including embryological and palynological aspects
PSO 7	Apply ethnobotanical aspects and medicinal, dietary and cosmetic uses of plants with special reference to phytochemistry and usage as mentioned in different Pharmacoepia
PSO 8	Acquire the skills in handling scientific instruments, planning and performing laboratory experiments and application of suitable statistical tools.
PSO 9	Understand the finer aspects of emerging areas such as Molecular biology and Bioinformatics.
PSO 10	Develop practical skills in laboratory techniques in various fields of botany along with collection and interpretation of biological materials
PSO 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.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
F Y	I	**RUSBOT 101**	**PLANT DIVERSITY- I**	
		I	Microbes and Algae	**02**
		II	Fungi	
		III	Bryophyta	
		RUSBOT 102	**FORM AND FUNCTION- I**	
		I	Cell biology	**02**
		II	Ecology	
		III	Genetics	
			Practicals	
		RUSBOTP 101,102	Plant Diversity -I, Form and Function- I (Practicals I and II)	**02**
	II	**RUSBOT 201**	**PLANT DIVERSITY- II**	
		I	Pteridophytes	**02**
		II	Gymnosperms	
		III	Angiosperms	
		RUSBOT 202	**FORM AND FUNCTION – II**	**02**
		I	Anatomy	
		II	Physiology	
		III	Horticulture and Medicinal Botany	
			Practicals	
		RUSBOTP 201,202	Plant Diversity - II, Form and Function- II (Practicals I and II)	**02**
S Y	III	**RUSBOT 301**	**PLANT DIVERSITY- III**	
			Microbiology	**02**
		II	Thallophyta (Algae) and Bryophyta	
		III	Angiosperms	
		RUSBOT 302	**FORM AND FUNCTION – III**	
		I	Cell biology	**02**
		II	Cytogenetics	
		III	Molecular Biology	
		RUSBOT 303	**CURRENT TRENDS IN PLANT SCIENCES I**	
		I	Pharmacognosy and Phytochemistry	**02**
		II	Instrumentation	
		III	Horticulture & Industry based on plant products	
		RUSBOTP 301, 302, 303	**Practical based on all the three courses in theory**	**03**

	IV	**RUSBOT 401**	**PLANT DIVERSITY IV**	
		I	Thallophyta: Fungi, Plant Pathology and Lichens	**02**
		II	Pteridophyta and Paleobotany	
		III	Gymnosperms	
		RUSBOT 402	**FORM AND FUNCTION IV**	
		I	Anatomy	**02**
		II	Plant Physiology and Plant Biochemistry	
		III	Ecology and Environmental Botany	
		RUSBOT 403	**CURRENT TRENDS IN PLANT SCIENCES II**	
		I	Biotechnology	**02**
		II	Biostatistics and Bioinformatics	
		III	Research Methodology I	
		RUSBOTP 401, 402, 403	**Practical based on all the three courses in theory**	**03**
TY	**V**	**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	
		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 501, 502, 503,504	**Practical based on all the four courses in theory**	**06**
		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**

	VI	II	Angiosperms II	
		III	Embryology	
		IV	Plant micro techniques	
		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 601, 602, 603,604	**Practical based on all the four courses in theory**	**06**

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Syllabus for: F. Y

Program: B. Sc.

Program Code: Botany (RUSBOT)

(Credit Based Semester and Grading System for the academic year 2021–2022)

SEMESTER-I

Course Code	UNIT	TOPICS	Credits
RUSBOT 101	**PLANT DIVERSITY I**		
	I	Microbes and Algae	**02**
	II	Fungi	
	III	Bryophyta	
RUSBOT 102	**FORM AND FUNCTION I**		
	I	Cell biology	**02**
	II	Ecology	
	III	Genetics	
RUSBOTP 101, 102, 303	**Practicals**	**Practical based on all the two courses in theory**	**02**
			06

SEMESTER- II

Course Code	UNIT	TOPICS	Credits
RUSBOT 201	**PLANT DIVERSITY II**		
	I	Pteridophytes	**02**
	II	Gymnosperms	
	III	Angiosperms	
RUSBOT 202	**FORM AND FUNCTION II**		
	I	Anatomy	**02**
	II	Physiology	
	III	Horticulture and Medicinal Botany	
RUSBOTP 201, 202	**Practicals**	**Practical based on all the two courses in theory**	**02**
			06

SEMESTER- I

Course Code: RUSBOT 101

Course Title: Plant Diversity- I

Academic year 2021 - 22

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the fundamental concepts /diversity related to different Microorganisms
CO 2	Develop an understanding of fungi and appreciate their adaptive strategies
CO 3	Develop an understanding of fungi and appreciate their adaptive strategies
CO 4	Evaluate the significance of fungi and its different types
CO 5	Develop critical understanding about bryophytes and the life cycle of *Riccia*
CO 6	Analyze the anatomy and reproduction of *Riccia*

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 101	**Plant Diversity I**	**Credits-2**
UNIT I	**Microbes and Algae**	**Lectures-15**
	Introduction to Microbiology: Microorganisms in the living World, Groups of Microorganisms- Viruses, Bacteria,Rickettsiae, Mycoplasma, algae, Archaebacterium, Actinomycetes, fungi, Protozoa. Distribution of Microorganisms in Nature	
	Major Characteristics of Bacteria, Microscopic examination of bacteria- Basic principles of staining	
	Outline of Classification according to G.M. Smith and general characters of Cyanophyta and Chlorophyta	
	Life cycle and systematic position of *Nostoc* and *Spirogyra*.	
	Economic importance of algae with reference to biofuels, food and agar.	
UNIT II	**Fungi**	**Lectures-15**
	Outline of Classification according to G. M. Smith	
	General characters of Phycomycetes.	
	Structure, lifecycle and systematic position of *Rhizopus* and *Albugo*	
	Modes of nutrition in Fungi (Saprophytism, predation and Parasitism).	
	Economic importance of Fungi.	

UNIT III	**Bryophyta**	**Lectures-15**
	Outline of classification according to G.M. Smith	
	General characters and range of thallus organization in Hepaticae	
	Structure, life cycle and systematic position of *Riccia*.	
	Economic importance of Bryophyta	

PRACTICALS

RUSBOTP 101	**Plant Diversity I**	**Credit – 1**
1	To study bacteria using Gram staining method	
2	Study of viruses	
3	Study of stages in the life cycle of *Nostoc* from fresh/ preserved material and permanent slides	
4	Study of stages in the life cycle of *Spirogyra* from fresh/ preserved material and permanent slides	
5	Economic importance of algae: *Ulva* (food), *Scenedesmus and Chlorella* (Biofuel), *Spirulina*(Neutraceutical), *Gelidium* (Agar)	
6	Study of stages in the life cycle of *Rhizopus* from fresh/ preserved material and permanent slides	
7	Study of stages in the life cycle of *Albugo* from material and permanent slides	
8	Economic importance of Fungi: Mushroom, Yeast, *Ganoderma*, *Penicillium*, *Aspergillus*, mycorrhiza- AM .	
9	Study of stages in the life cycle of *Riccia* from fresh/ preserved material.	

References:

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- Cavers F.1976. The interrelationships of the Bryophytes. S.R. Technic, AshokRajpath, Patna.
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- Watson E.V. 1971. Structure and Life of Bryophytes.3rd Edition. HutchinsonUniversity Library, London.

Course Code: RUSBOT 102

Course Title: Form and function – I

Academic year 2021 - 2022

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand chemical composition and structure of cell wall and membrane
CO 2	Explain the ultra structure and functions of the cell organelles
CO 3	Understand the basic principles of plant ecology and examine the structure and functions of eco-system
CO 4	Critically analyze climate change, biodiversity and its conservation
CO 5	Gain conceptual understanding of Mendelian Genetics, genetic basis of loci and alleles and sex linked inheritance

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/ Lectures
RUSBOT 102	**Title: Form and Function- I**	**Credits – 2**
UNIT I	**Cell Biology**	**Lectures-15**
	Prokaryotic and eukaryotic cell structure , General structure of plant cell: cell wall, Plasma membrane (bilayer lipid structure, fluid mosaic model) Mitosis	
	Ultra structure and functions of the following cell organelles: Endoplasmic reticulum and Chloroplast.	
UNIT II	**Environmental Biology**	**Lectures-15**
	Types of ecosystems: aquatic and terrestrial.	
	Effect of climate change on ecosystems, role of IPCCC,	
	Biodiversity: types of biodiversity, endemics and wides	
	Biodiversity Hotspots and PAN	
	Conservation Biology*: ex situ* and *in situ* methods, People's Biodiversity Register,	
	The Biological Diversity Act, 2002; Convention on Biological Diversity	
UNIT III	**Genetics**	**Lectures-15**
	Phenotype/Genotype, Mendelian Genetics- monohybrid, dihybrid ratios, test cross and back cross.	
	Epistatic and non epistatic interactions; multiple alleles.	
	Sex determination	

	Chromosomal Methods: heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. Genic Balance Theory of sex determination in *Drosophila*, Lyon's Hypothesis of X chromosome inactivation. **Sex linked inheritance-** eye colour in *Drosophila*, Haemophilia, colour blindness **Sex influenced inheritance**- baldness in man	

PRACTICALS		
RUSBOTP 102	**Form and Function- I**	**Credit – 1**
1	Examining various stages of mitosis in root tip cells (*Allium*)	
2	Cell inclusions**:** Starch grains (Potato and Rice); Aleurone layer, Maize	
3	Cystolith (*Ficus*); Raphides (*Pistia*); Sphaeraphides (*Opuntia*).	
4	Identification of cell organelles with the help of photomicrograph Plastids: Chloroplast, Amyloplast, Endoplasmic reticulum and Nucleus.	
5	Identification of plants adapted to different environmental conditions and internal structure adaptations: Hydrophytes free floating (*Pistia /Eichhornia*), Rooted floating (*Nymphaea*), submerged (*Hydrilla),* Mesophytes (any common plant), Hygrophytes (*Typha, Cyperus*), Epiphytes (Orchid aerial root)	
6	Calculation of mean, median and mode.	
7	Calculation of Standard deviation.	
8	Frequency distribution, graphical representation of data- frequency polygon, histogram, pie chart.	
9	Study of Karyotype – Human and *Allium cepa*	

References

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- Brown TA. 2006. Gene Cloning and DNA Analysis. 5th Edition.
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- Purohit, S.S. and R. Ranjan. Ecology and Environmental Pollution, Agro-Bios Publishers, Jodhpur, India.

- Agrawal, K.C. 1996. Environmental Biology. Agro-Botanical Publisher, Bikaner India
- Heywood, V.H. and Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press, Cambridge.
- Hill, M. K. 1997. Understanding Environmental Pollution, Cambridge University Press.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

Internal Assessment - 40% :40 marks.

Sr No	Evaluation type	Marks
1	Assignment / Field Visit/ Submission/Case study/ Surveys/On-line test/Active Participation(attentiveness/ability to answerquestions)/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 **03** questions each of **16** marks and **01** question of **12** marks. On each unit there will be one question & last question will be based on all the **03** 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	16	Unit I
Q.2) A, B, C	Any 2 out of 3	16	Unit II
Q.3) A, B, C	Any 2 out of 3	16	Unit III
Q.4) 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
Practical/ 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- I

Course	101			102			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

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Semester-II
Course Code: RUSBOT 201

Course Title: Plant Diversity- II

Academic year 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the basic principles of classification and salient features of Pteridophytes, Gymnosperms, Angiosperms and their economic importance.
CO 2	Analyze the anatomy and reproduction of Pteridophytes and Gymnosperms.
CO 3	Understand the principles underlying Bentham & Hooker's system of classification and identify plants from prescribed families.
CO 4	Gain knowledge about novel groups of plants

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/ Lectures
RUSBOT 201	**Title: Plant Diversity – II**	**Credits – 2**
UNIT I	**Pteridophytes**	**Lectures-15**
1	Salient features and classification of Psilophyta and Lepidophyta upto orders according to G. M. Smith's classification.	
2	Structure life cycle, systematic position and alternation of generations in *Selaginella.*	
3	Stelar evolution.	
4	Economic importance and propagation of ferns.	
UNIT II	**Gymnosperms**	**Lectures-15**
1	General characters, Outline of classification according to C.J. Chamberlin	
2	Structure life cycle systematic position and alternation of generations in *Cycas.*	
3	Economic importance of Gymnosperms.	
4	Geological time scale.	
UNIT III	**Angiosperms**	**Lectures-15**
1	Definition of taxonomy, systematic botany, concepts of taxonomy, aims of taxonomy.	

2	Study of following families: Malvaceae, Leguminosae: Caesalpinaceae, Papilionaceae, Mimosae, Solanaceae, Convolvulaceae, Amaryllidaceae.	
3	Secret life of plants: Insectivorous and parasitic plants	

PRACTICALS		
RUSBOTP 201	**Plant Diversity – II**	**Credits – 1**
1	Study of stages in the life cycle of *Selaginella*, T.S. of rachis.	
2	T.S. of *Selaginella* stem	
3	Stelar evolution with the help of permanent slides, Protostele, haplostele , actinostele, plectostele, mixed protostele, siphonostele, ectophloic, amphiphloic, dictyostele, eustele and atactostele.	
4	*Cycas*: T.S of leaflet (*Cycas* pinna) microsporophyll, megasporophyll, coralloid root, microspore, L.S. of ovule of *Cycas*– all specimens to be shown.	
5	Economic importance of Gymnosperms: *Pinus* (turpentine, wood, seeds)	
6	Leaf: simple leaf, types of compound leaves, Incisions of leaf, leaf base, apex, margins and leaf shapes. Modifications of leaf: spine, tendril, hooks, phyllode, pitcher, *Drosera* or insectivorous plants.	
7	Inflorescence: Racemose: simple raceme, spike, catkin, corymb, umbel, spadix, capitulum. Cymose, monochasial, dichasial, polychasial. Compound: Panicle, cyathium, verticellaster, hypanthodium.	
8	Study of following families: Malvaceae, Leguminosae: Caesalpinaceae and Papilionaceae, Mimosae, Solanaceae, Convolvulaceae, Amaryllidaceae. Pollen morphology of the abovesaid families. Morphological peculiarities, palynological studies and economic importance of the members of these families.	
9	Identification and study of insectivorous and parasitic plants: *Drosera, Nepenthes, Utricularia,* Venus fly trap*, Cuscuta, Loranthus, Viscum, Orobanche*	
10	Propagation of ferns	

References:

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- Stewart W.N. and Rothwell G.W. 2005. Paleobotany and the Evolution of Plants.2nd Edition. Cambridge University Press.
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Course Code: RUSBOT 202
Course Title: Form and function - II
Academic year 2021 – 22

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Develop an understanding of concepts and fundamentals of plant anatomy.
CO 2	Evaluate the adaptive and protective systems of plants.
CO 3	Explain the significance of photosynthesis and nutritional requirements of plants.
CO 4	Gain knowledge about various branches of horticulture.
CO 5	Critically evaluate different cultivation practices.
CO 6	Recognize basic medicinal plants/ functional foods and know their applications.
CO 7	Understand the basic concept of primary and secondary metabolites.

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 202	**Title: Form and function – II**	**Credits – 2**
UNIT I	**Anatomy**	**Lectures-15**
	Simple tissues, complex tissues, meristematic tissues, permanent tissues, wall ingrowths and transfer cells, adcrustation and incrustation, ergastic substances.	
	Primary structure of dicot and monocot root, stem and leaf (Kranz anatomy).	
	Epidermal tissue system: types of hair, monocot and dicot stomata.	
UNIT II	**Physiology**	**Lectures-15**
	Photosynthesis: Plant pigments and their interaction with light, Light reactions, photolysis of water, cyclic and non-cyclic photophosphorylation, carbon fixation phase (C_3, C_4 and CAM pathways).	
	Role of macronutrients and micronutrients in plants.	
	Structures of amino acids.	
UNIT III	**Horticulture and Medicinal Botany**	**Lectures-15**
	Introduction to horticulture: Definition, importance and objectives of Horticulture, branches of Horticulture, Pomology, Olericulture, Landscape Gardening, Nurseries and development	
	Propagation practices: By Seeds: Advantages and disadvantages, method of seed propagation**,** Seed treatment to control diseases, Concept of microgreens	

	Artificial methods of plant propagation Cutting– Stem cutting and leaf cuttings.	
	Medicinal botany: Concept of primary and secondary metabolites, difference between primary and secondary metabolites.	
	Grandma's pouch: Following plants have to be respect to botanical source, part of the plant used, active constituents present and medicinal uses: *Ocimum sanctum, Justicia adhatoda, Zingiber officinale, Curcuma longa, Santalum album, Aloe vera*.	
	Functional Foods : Garlic, Carrot, Citrus, Jackfruit, Drumstick and Dill	
PRACTICALS		
RUSBOTP 202	**Form and function – II**	**Credit – 1**
1	Primary structure of dicot and monocot root.	
2	Primary structure of dicot and monocot stem.	
3	Study of dicot and monocot stomata.	
4	Epidermal outgrowths: with the help of mountings: Unicellular: *Gossypium*/Radish Multicellular: *Lantana*/Sunflower Glandular: *Drosera* and Stinging: *Urtica* – only identification with permanent slides. Peltate: *Thespesia* Stellate: *Erythrina*/ *Sida acuta*/ *Solanum*/ *Helecteris* T-shaped: *Avicennia*	
5	Separation of chlorophyll pigments by strip paper chromatography.	
6	Separation of amino acids using strip paper chromatography.	
7	Extraction of anthocyanin pigments and their use as a pH indicator.	
8	Tests for alkaloids and tannins, chromatographic separation of alkaloids.	
9	Identification of plants/plant parts found in Grandma's Pouch.	
10	Identification of functional foods.	
11	Seed germination and calculate the percentage germination	
12	Method of growing microgreens.	
13	Plant propagation by stem cutting (hard wood), leaf cutting.	
14	Terrarium/Bottle garden/ Dish garden	

Note: One field excursions for habitat studies are compulsory.
Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15 students.

References:

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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/Case study/ Survey report/ 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)	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 **03** questions each of **16** marks and **01** question of **12** marks. On each unit there will be one question & last question will be based on all the **03** 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	16	Unit I
Q.2) A, B, C	Any 2 out of 3	16	Unit II
Q.3) A, B, C	Any 2 out of 3	16	Unit III
Q.4) 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
Practical/ 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- II

Course	201			202			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	**40**	**60**	**100**	**40**	**60**	**100**	**200**
Practicals	**20**	**30**	**50**	**20**	**30**	**50**	**100**

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Resolution No.: AC/II(20-21).2.RUS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Syllabus for: S. Y

Program: B. Sc.

Program Code: Botany (RUSBOT)

(Credit Based Semester and Grading System for the academic year 2021 – 2022)

SEMESTER III

Course Code	UNIT	TOPICS	Credits
RUSBOT 301	**PLANT DIVERSITY III**		
	I	Microbiology	**02**
	II	Thallophyta (Algae) and Bryophyta	
	III	Angiosperms	
RUSBOT 302	**FORM AND FUNCTION III**		
	I	Cell biology	**02**
	II	Cytogenetics	
	III	Molecular Biology	
RUSBOT 303	**CURRENT TRENDS IN PLANT SCIENCES I**		
	I	Pharmacognosy and Phytochemistry	**02**
	II	Instrumentation	
	III	Horticulture Industry based on plant products	
RUSBOTP 301, 302, 303	**Practicals**	**Practical based on all the three courses in theory**	**03**
			09

SEMESTER IV

Course Code	UNIT	TOPICS	Credits
RUSBOT 401	**PLANT DIVERSITY IV**		
	I	Thallophyta: Fungi, Plant Pathology and Lichens	**02**
	II	Pteridophyta and Paleobotany	
	III	Gymnosperms	
RUSBOT 402	**FORM AND FUNCTION IV**		
	I	Anatomy	**02**
	II	Plant Physiology and Plant Biochemistry	
	III	Ecology and Environmental Botany	
RUSBOT 403	**CURRENT TRENDS IN PLANT SCIENCES II**		
	I	Biotechnology	**02**
	II	Biostatistics and Bioinformatics	
	III	Research Methodology I	
RUSBOTP 401, 402, 403	**Practicals**	**Practical based on all the three courses in theory**	**03**
			09

SEMESTER -III

Course Code: RUSBOT 301

Course Title:Plant Diversity III

Academic year 2021 - 2022

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Examine the general characteristics of bacteria, their reproduction and culturing.
CO 2	Understand the applications of microorganisms in various fields and evaluate the Plant- Microbe interactions
CO 3	Develop critical understanding of the life cycles of algae and bryophytes
CO 4	Evaluate the economic importance and significance of algae and bryophytes
CO 5	Understand the principles underlying Bentham and Hooker's classification and identify plants from the prescribed families
CO 6	Analyse taxonomy in relation to anatomy and secondary metabolites

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 301	**Title: Plant Diversity III**	**Credits – 2**
UNIT I	**Microbiology**	**Lectures-15**
	Reproduction and Growth in Bacteria Nutritional types, Physical conditions for growth	
	Cultivation of Bacteria- Bacteriological Media, Sterilization Pure culture techniques, Cultural Characteristics of bacteria.	
	Plant- Microbe interactions- Rhizosphere and Phylloshere microorganisms Plant growth promoting bacteria(PGPB) Root nodule associated bacteria- *Rhizobium*- infection process and the mutualist association, Actinorhizae	
UNIT II	**Thallophyta (Algae) and Bryophyta**	**Lectures-15**
	General Characters of Division Chrysophyta and Phaeophyta: Distribution, Cell structure, range of thallus, Economic Importance.	
	Structure, life cycle and systematic position of *Vaucheria* and *Sargassum*	
	General account of Class *Anthocerotae*	
	Structure, life cycle and systematic position of *Pellia and Anthoceros*	
UNIT III	**Angiosperms**	**Lectures-15**
	Systematics: Categories and taxonomic hierarchy; • Plant Nomenclature	

	• Taxonomy in relation to ○ Anatomy ○ Chemical constituents	
	With the help of Bentham and Hooker's system of Classification for flowering plants study the vegetative, floral characters and economic importance of the following families: • Brassicaceae • Capparidaceae • Myrtaceae • Combretaceae • Rubiaceae • Amaranthaceae • Euphorbiaceae • Palmae	
PRACTICALS		
RUSBOTP 301	**Plant Diversity III**	**Credit - 1**
1	Sterilization of glassware, preparation of media, slants and plates.	
2	Slide burial technique for rhizoplane fungi.	
3	Cultivation and staining of *Rhizobium*	
4	Study of stages in the life cycle of *Vaucheria* and *Sargassum* from fresh/ preserved material and permanent slides.	
5	Economic importance and range of thallus in Phaeophyta	
6	Study of stages in the life cycle of and *Pellia* from fresh/ preserved material and permanent slides.	
7	Study of stages in the life cycle of *Anthoceros* from fresh/ preserved material and permanent slides.	
8	Study of plants for anatomy in relation to taxonomy	
9	Study of plants for Alkaloids, Tannins, Phenols and Flavonoids (chemotaxonomy)	
10	Study of one plant from each family prescribed for theory: • Brassicaceae • Capparidaceae • Myrtaceae • Combretaceae • Rubiaceae • Amaranthaceae • Euphorbiaceae • Palmae	
11	Morphological peculiarities, palynological studies and economic importance of the members of these families.	
12	Preparation of herbarium and wet preservation technique	

References:

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Course Code: RUSBOT 302

Course Title:Form and function - III

Academic year 2021 - 2022

COURSE OUTCOMES :

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Develop understanding on the ultra structure and functions of the cell organelles
CO 2	Critically understand the process of cell division and the structure of nucleic acids.
CO 3	Understand the details of cellular structures, causes and effects of variations in chromosome structure and number, extranuclear genetics.
CO 4	Gain an understanding of the fundamentals of molecular biology, understand and differentiate DNA replication and transcription.

Detailed syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 302	**Title: Form and function – III**	**Credits – 2**
UNIT I	**Cell biology**	**Lectures-15**
	Ultra Structure and functions of the following cell organelles: Mitochondrion (membranes, cristae, F1 particles and matrix) Peroxisomes and Glyoxysomes, Ribosomes (prokaryotic, eukaryotic and subunits)	
	Cell Division and its significance: Cell Cycle, structure of Interphase Nucleus(nuclear envelope, chromatin network, nucleolus and nucleoplasm) Meiosis, Differences between Mitosis and Meiosis	
	Nucleic Acids: Types, structure and functions of DNA and RNA	
UNIT II	**Cytogenetics**	**Lectures-15**
	Variation in Chromosome structure (Chromosomal aberrations) Definition, Origin, Cytological and Genetic effects of the following: Deletions, Duplications, Inversions and Translocations.	
	Variation in Chromosome number: Origin and production, morphological and cytological features, applications in crop improvement and evolution of aneuploids and euploids (monoploids, autopolyploids and allopolyploids)	
	Extra nuclear Genetics -Organelle heredity- • Chloroplast determines heredity - Plastid transmission in plants, Streptomycin resistance in *Chlamydomonas*. • Male sterility in maize	

UNIT III	**Molecular Biology**	**Lectures-15**
	DNA replication : Modes of Replication, Messelson and Stahl experiment	
	DNA replication in prokaryotes and eukaryotes- enzymes involved and molecular mechanism of replication.	
	Protein Synthesis: • Central dogma of protein synthesis • Transcription in prokaryotes and eukaryotes: promoter sites,initiation, elongation and termination.	
	RNA processing: Adenylation and Capping	

PRACTICALS		
RUSBOTP 302	**Form and function – III**	**Credit – 1**
1	Study of the ultra-structure of cell organelles prescribed for theory from photomicrographs	
2	Estimation of DNA from plant material (one standard and one unknown)	
3	Estimation of RNA from plant material (one standard and one unknown)	
4	Chromatography: Separation of amino acids by circular paper chromatography	
5	Separation of Carotenoids by thin layer chromatography	
6	Study of inheritance pattern with reference to Plastid inheritance	
7	Study of cytological consequences of chromosomal aberrations (Laggards, Chromosomal Bridge, Ring chromosome, Chromosomal ring) from permanent slides or photomicrographs.	
8	Study of meiosis from suitable plant material	
9	Determining the sequence of amino acids in the protein molecule synthesised from the given m-RNA strand (prokaryotic and eukaryotic)	

References:

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Course Code: RUSBOT 303

Course Title:Current trends in Plant Sciences - I

Academic year 2021 – 2022

COURSE OUTCOMES :

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the importance of pharmacopoeias in plant identification and standardization.
CO 2	Understand the fundamental concepts of phytochemistry
CO 3	Classify and explain the principles of chromatography and microscopy
CO 4	Execute the techniques of plant propagation
CO 5	Understand the economic and commercial value of botanical products
CO 6	Understand the industrial relevance of botanicals with respect to current demands of industry

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 303	**Current trends in Plant Sciences – I**	**Credits – 2**
UNIT I	**Pharmacognosy and phytochemistry**	**Lectures-15**
	Introduction to pharmacopoeia. Indian pharmacopoeia, India Herbal pharmacopoeia, Ayurvedic pharmacopoeia Study of monograph from pharmacopoeia; any one example.	
	Study of secondary metabolites: Sources, properties, extraction, active constituents and therapeutic uses of alkaloids, glycosides, phenolic compounds (tannins, flavonoids) and terpenoids (volatile oils).	
	Classification of crude drugs, drug adulteration.	
UNIT II	**INSTRUMENTATION**	**Lectures-15**
	Preservation methods :Dry and Wet method	
	Microscopy – Principle and working of Light, phase contrast, fluorescent and electron microscope.	
	Chromatography- Principles and techniques of paper and thin layer chromatography.	
	Principles and techniques of Horizontal and Vertical Gel electrophoresis	
UNIT III	**Horticulture and Industry based on plant products**	**Lectures-15**

	Horticulture	
	Propagation practices: Layering – Definition, Types: Air Layering.	
	Grafting-Definition, advantages and disadvantages. Types: Splice, Tongue	
	Urban Horticulture: Definition, objectives and types.	
	Green Tourism: Concept, scope, Green tourism in India, centres, Case study: Horti tourism in Sikkim.	
	Industry based on plant products	
	Fibre yielding plants, Paper yielding plants, Spices and condiments: Cardamom (*Elettaria cardamomum* and *Amomum subulatum*), Jaivitri and Jaiphal (*Myristica fragrans*)	
	Aromatherapy- Introduction, Botanical source and uses: *Calendula*, Lemon, Jasmine	
	Botanicals and nutraceuticals - *Spirulina*, Vanillin, *Garcinia indica/ Garcinia cambogia, Stevia*, and Kale.	
	Industrial enzymes: Extraction methods and application: Cellulases, Papain, Bromelain.	
PRACTICALS		
RUSBOTP 303	**Current trends in Plant Sciences I**	**Credit– 1**
1	Tests for secondary metabolites: • Tests/TLC for alkaloids from *Strychnos* (seeds) and *Holarhhena* (bark) • Tests for glycosides from *Glycyrhhiza* rhizome/*Aloe* leaf • Tests/TLC for tannins from *Terminalia arjuna bark / Acacia catechu.* • Tests/TLC for flavonoids from *Momordica charantia/ Trigonella foenum-graecum* • Tests/TLC for terpenoids from *Mentha viridis/Coleus aromaticus*	
2	Study of Stomatal index (use of micrometer for measurement of size of stoma)	
3	Study of vein islet number	
4	Study of drug adulterants in black pepper seeds, cinnamon bark, turmeric powder, chilli powder)	
5	Horizontal and Vertical Gel Electrophoresis – Demonstration	
6	Plant propagation by Air layering, Grafting and Budding	
7	Sources of: Fibres and Paper; Spices and condiments	
8	Identification of botanical sources used in aromatherapy and nutraceuticals (examples as per theory)	
9	Extraction and evaluation of enzymes papain (fruit and leaf)/ bromelain (stem and fruit)	
10	Study of biodiversity (Visit to National Park/ Botanical Garden/ forests)	

References:

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MODALITY OF ASSESSMENT

Theory Examination Pattern:

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

Sr No	Evaluation type	Marks
1	Assignment/Field Visit/Case study/Survey report/ 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)	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 **03** questions each of **16** marks and **01** question of **12** marks. On each unit there will be one question & last question will be based on all the **03** 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	16	Unit I
Q.2) A, B, C	Any 2 out of 3	16	Unit II
Q.3) A, B, C	Any 2 out of 3	16	Unit III
Q.4) a, b, c, d , e.	Any 3 out of 5	12	All units

Practical Examination Pattern:

Internal Examination:

Heading	**Practical I**
Journal	05
Practical participation	05
Field visit/Institute visit report/ Assignment	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- III

Course	**301**		**302**		**303**		**Total per Course**	**Grand Total**
	Internal	**External**	**Internal**	**External**	**Internal**	**External**		
Theory	**40**	**60**	**40**	**60**	**40**	**60**	**100**	**300**
Practicals	**20**	**30**	**20**	**30**	**20**	**30**	**50**	**150**

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SEMESTER -IV

Course Code: RUSBOT 401

Course Title:Plant Diversity - IV

Academic year 2021-22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Develop critical understanding of the life cycles of fungi, plant diseases and their control measures.
CO 2	Develop an understanding of lichens and appreciate their adaptive strategies
CO 3	Demonstrate an understanding of Pteridophytes, Gymnosperms and fossil members
CO 4	Analyze the anatomy and reproduction of Pinus along with its ecological and economic importance.

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 401	**Plant Diversity – IV**	**Credits – 2**
UNIT I	**Thallophyta: Fungi, Plant Pathology and Lichens**	**Lectures-15**
	General characters of Ascomycetae	
	Structure, life cycle and systematic position of *Aspergillus* and *Xylaria*	
	Plant Pathology - symptoms, causative organism, disease cycle and control measures of Powdery mildew and Late blight of potato	
	Lichens- classification, structure, method of reproduction, economic importance and ecological significance of lichens.	
UNIT II	**Pteridophyta and Paleobotany**	**Lectures-15**
	Salient features and classification of Calamophyta and Pterophyta upto orders (G M Smith's system of classification)	
	Structure, life cycle and systematic position of *Equisetum and Lycopodium*	
	Paleobotany- Formation and types of fossils; Structure and systematic position of form genus *Rhynia*	
UNIT III	**Gymnosperms**	**Lectures-15**
	Salient features, classification up to orders (with examples of each) (Chamberlain's system of classification to be followed)	

	Structure life cycle and systematic position of *Pinus*	
	Structure and systematic position of the form genus *Cordaites*	
PRACTICALS		
RUSBOTP 401	**Plant Diversity IV**	**Credit - 1**
1	Study of stages in the life cycle of *Aspergillus* from fresh/ preserved material and permanent slides.	
2	Study of stages in the life cycle of *Xylaria* from fresh/ preserved material and permanent slides.	
3	Study of fungal diseases as prescribed for theory.	
4	Study of Lichens (crustose, foliose and fruticose).	
5	Study of stages in the life cycle of *Equisetum and Lycopodium* from fresh/ preserved material and permanent slides.	
6	Study of form genera *Rhynia* with the help of permanent slides/ photomicrographs	
7	Study of stages in the life cycle of *Pinus* from fresh/ preserved material and permanent slides.	
8	Study of the form genus *Cordaites* with the help of permanent slide/ photomicrographs.	

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Course Code: RUSBOT 402

Course Title:Form and function - IV

Academic year 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the fundamental concepts of plant anatomy with respect to secondary growth, mechanical and conducting tissue systems and their role in adaptations to various habitats.
CO 2	Understand the basic concepts and explain the significance of carbohydrate metabolism, respiration, photorespiration and fundamentals of enzymology
CO 3	Connect the principles governing ecology and environmental biology with respect to biogeochemical cycles, edaphic factors, and community ecology
CO 4	Classify the soils on the basis of physical, chemical and biological components

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 402	**Title: Form and function – IV**	**Credits – 2**
UNIT I	**Anatomy**	**Lectures-15**
	Normal secondary growth in dicotyledonous stem and root.	
	Growth rings, periderm, lenticels, tyloses	
	Mechanical tissue system and • Tissues providing mechanical strength and support and their disposition • I-girders in aerial and underground organs Conducting tissue system	
	Study of ecological adaptations: Xerophytes and halophytes	
UNIT II	**Plant Physiology and Plant Biochemistry**	**Lectures-15**
	Carbohydrates: Structure(sugars, starch, cellulose, agar and pectin) and metabolism(biosynthesis and degradation of sucrose, starch and cellulose)	
	Respiration: Aerobic: Glycolysis, TCA Cycle, ETS and Energetics of respiration; anaerobic respiration.	
	Photorespiration: Mechanism of photorespiration, Energetics and significance of photorespiration	
	Enzymes - Nomenclature, classification, mode of action, enzyme kinetics, Michaelis Menten equation, competitive, non competitive and uncompetitive inhibitors	
UNIT III	**Ecology and Environmental Botany**	**Lectures-15**
	Ecological factors: Concept of environmental factors. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile.	

	Community ecology - Characters of community - Quantitative characters and Qualitative characters	
	Environmental Impact Assessment (ESIA)	
PRACTICALS		
RUSBOTP 402	**Form and function IV**	**Credit – 1**
1	Study of normal secondary growth in the stem and root of a Dicotyledonous plant (Sunflower, stem and root)	
2	Study of mechanical tissues in *Typha leaf , Salvia stem and Cyperus leaf*	
3	Study of ecological adaptations: Xerophytes and halophytes	
4	Study of conducting tissues, Growth rings, periderm, lenticels, tyloses.	
5	Tests for carbohydrates	
6	Q_{10} – germinating seeds using phenol red indicator.	
7	Enzymes: HRP effect of pH variation on enzyme activity.	
8	Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, Soil pH, Wind anemometer.	
9	Mechanical analysis of soil by the sieve method and pH of soil.	
10	Quantitative estimation of organic matter of the soil by Walkley and Blacks Rapid titration method.	
11	Study of vegetation by the list quadrat method.	

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Course Code: RUSBOT 403

Course Title:Current Trends in Plant Sciences – II

Academic year 2021 - 2022

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the core concepts and fundamentals of plant tissue culture and its applications
CO 2	Describe the fundamentals of R-DNA technology.
CO 3	Apply the concepts of Biostatistics for problem solving
CO 4	Comprehend the fundamental concepts related to descriptive and inferential biostatistics
CO 5	Understand the concept of databases and its applications
CO 6	Recall the basic concepts of research and GLP

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 403	**Title: Current Trends in Plant Sciences- II**	**Credits – 2**
UNIT I	**Biotechnology**	**Lectures15**
	Introduction to plant tissue culture • A historic perspective • Laboratory organization and techniques in plant tissue culture • Totipotency • Morphogenesis(Organogenesis - Rhizogenesis, Caulogenesis) • Organ culture – root cultures, meristem cultures, embryo culture • Problems in plant tissue culture: contamination, phenolics and recalcitrance. • Factors responsible for *in vitro* and *ex vitro* hardening	
	R-DNA technology- • Gene cloning • Enzymes involved in Gene cloning • Vectors used for Gene cloning.	
UNIT II	**Biostatistics and Bioinformatics**	**Lectures-15**
	Biostatistics: • The chi square test. • Correlation – Calculation of coefficient of correlation.	
	Bioinformatics:	

	• Introduction to bioinformatics and its applications
	• Introduction and Bioinformatics resources:
	  ○ Bioinformatics resources: NCBI, EMBL- EBI, DDBJ, PIR and SWISSPROT
	  ○ Knowledge of various databases - Organization of biological data- Primary, secondary and tertiary
	  ○ Structure database, sequence database, Literature database
	• Data base Search engine - Entrez
	• Biological file format- FASTA, PDB, FASTQ
	• Sequence analysis: Basic concepts of sequence similarity, identity and homology, definitions of homologs, orthologs, paralogs.	

UNIT III	**Research Methodology I**	**Lectures-15**
	Basic concepts of research: • Review of literature and bibliography • Identification and understanding a research problem.	
	Good laboratory practices • Molarity and normality • Preparation of solutions • Dilutions • Knowledge of common toxic chemical and safety measures in their handling	

PRACTICALS		
RUSBOTP 403	**Current Trends in Plant Sciences II**	**Credits– 1**
1	Various sterilization techniques	
2	Preparation of Stock solutions	
3	Preparation of MS medium.	
4	Seed sterilization and inoculation	
5	Callus induction	
6	Identification of the cloning vectors – pBR322, pUC 18, Ti plasmid.	
7	Chi square test	
8	Calculation of coefficient of correlation	
9	Use of bioinformatics resources and databases.	
10	Basic and advanced search methods w.r.t Biological databases, use of Entrez	
11	Use of Excel for biological data analysis	
12	Review of literature, its consolidation and bibliography	
13	Preparation of molar and normal solutions	
14	Good Laboratory practices:handling and disposal of hazardous chemicals.	

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MODALITY OF ASSESSMENT

Theory Examination Pattern:

Internal Assessment - 40%: 40 marks.

Sr No	Evaluation type	Marks
1	Assignment / Field Visit/ Submissions/Survey reports/Case study/ 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)	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 **03** questions each of **16** marks and **01** question of **12** marks. On each unit there will be one question & last question will be based on all the **03** 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	16	Unit I
Q.2) A, B, C	Any 2 out of 3	16	Unit II
Q.3) A, B, C	Any 2 out of 3	16	Unit III
Q.4) a, b, c, d , e.	Any 3 out of 5	12	All units

Practical Examination Pattern:

Internal Examination:

Heading	Practical I
Journal	05
Practical participation	05
Field visit/Institute visit report/ Assignment	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- IV

Course	401		402		403		Total per Course	Grand Total
	Internal	External	Internal	External	Internal	External		
Theory	40	60	40	60	40	60	100	300
Practicals	20	30	20	30	20	30	50	150

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Resolution No.: AC/II(20-21).2.RUS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Syllabus for: T. Y

Program: B. Sc.

Program Code: Botany (RUSBOT)

(Credit Based Semester and Grading System for the academic year 2021–2022)

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	
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 501, 502, 503, 504	Practical	**Practicals based on all the four courses in theory**	06
			16

SEMESTER VI

Course Code	UNIT	TOPICS	Credits
RUSBOT 601	I	Fungi and Plant pathology	2.5
	II	Pteridophyta	
	III	Biotechnology I	
	IV	Biotechnology II	
RUSBOT 602	I	Paleobotany and Gymnosperms	2.5
	II	Angiosperms II	
	III	Embryology	
	IV	Plant micro techniques	
RUSBOT 603	I	Physiology II	2.5
	II	Genetics	
	III	Cosmetology	
	IV	Post-Harvest Technology	
RUSBOT 604	I	Economic Botany	2.5
	II	Plant Geography and Environmental Botany	
	III	Instrumentation	
	IV	Research methodology III	
RUSBOTP 601, 602, 603, 604	Practical	**Practical based on all the four courses in theory**	06
			16

SEMESTER- V

Course Code: RUSBOT 501

Course Title:Plant Diversity – V

Academic year 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the soil microbial diversity, processes and applications in the environment
CO 2	Analyze role of microbes in composting and bioremediation
CO 3	Develop critical understanding of the life cycles of algae and bryophytes
CO 4	Analyze the anatomy and reproduction of algae and bryophytes along with their ecological and economic importance
CO 5	Develop skills in data tabulation, hypothesis testing analysis and interpretation
CO 6	Understand use of biometry in biological sciences.

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 solubalizers • Microorganisms as plant pathogens- List of major plant diseases caused by microorganisms, Crown 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 indegradation 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	Study of cellulose and pectin degraders	
5	Growth curve of *E.coli* (Demonstration)	
6	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides • *Polysiphonia* • *Batrachospermum* • *Pinnularia*	
7	Range of thallus structure in algae	
8	Economic importance of algae	
9	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 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOMES	CO DESCRIPTION
CO 1	Understand the principles underlying Bentham and Hooker's classification and identify plants from the prescribed families.
CO 2	Comprehend the role of various fields in Angiosperm taxonomy.
CO 3	Conceptualize ethnobotany as an interdisciplinary science
CO 4	Categories various indigenous ethnic groups and their environmental practices
CO 5	Develop an understanding of concepts and fundamentals of plant anatomy and its significance and role in adaptation.
CO 6	Understand the palynological details of plants and its applications in various areas

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 families and 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	Morphological peculiarities, palynological features 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* • *Cann*
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 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Comprehend different fundamental concepts related to plant cell organelles
CO 2	Understand molecular genetic machinery for translation
CO 3	Understand Water relation of plants with respect to various physiological processes
CO 4	Gain insight into physiological aspects of plant life with reference to water relations, transport processes, vegetative and reproductive growth
CO 5	Understand the basics of environmental pollution and related concepts
CO 6	Develop skills on environmental clean-up technologies
CO 7	Understand the concept of pairwise alignment of sequences using algorithms.
CO 8	Understand the concept of multiple sequence alignment and phylogeny.

Detailed Syllabus

Course Code/Unit	Course/ Unit Title	Credits/Lectures
RUSBOT 503	**Title: Form and function – V**	**Credits – 2.5**
UNIT I	**Cytology and Molecular Biology**	**Lectures-15**
	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**	**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 abscicic 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 and microbial population in 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 phylogenetic analysis – 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	Predicting the sequence of Amino acids in the polypeptide chain that will be formed following translation. (Prokaryotic and Eukaryotic)	
4	Determination of solute potential of plant tissue by plasmolytic method.	
5	To estimate the activity of Gibberellic acid with respect to seed germination and mobilization of reserves.	
6	Determination of effect of auxins on rooting of stem cuttings.	

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	BLAST and its variants
9	Tool for multiple sequence alignment: MUSCLE
10	Molecular visualisation using RASMOL

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Course Code: RUSBOT 504

Course Title:Current Trends in Plant Sciences – III

Academic year 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the fundamental concepts of phytochemistry.
CO 2	Develop the skills of solvent extraction
CO 3	Understand the contribution of plants in human health, with reference to specific function as therapeutic agents
CO 4	Increase the awareness and appreciation of plants and plant products encountered in everyday life
CO 5	Understand the core concepts and fundamentals of plant tissue culture.
CO 6	Develop their competency on different types of plant tissue culture techniques
CO 7	Understand the concept of research and different types of research
CO 8	Develop competence on data collection and 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* • *Senna angustifolia* • *Strychnos nux-vomicaEugenia caryophyllata*	
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/Active Participation (attentiveness/ability to answer questions)/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 2021 - 2022

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, plant diseases
CO 2	Develop critical understanding on morphology, anatomy and reproduction of Pteridophytes and evolutionary relationships of members of these groups.
CO 3	Identify common Pteridophytes of India
CO 4	Gain an insight in to the basic principles of Genomic/chromosome and cDNA libraries, DNA sequencing techniques and PCR
CO 5	Use 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**
	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**	**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**
	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**	**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 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the structures of fossil forms.
CO 2	Explain life cycles Gnetopsida members.
CO 3	Develop critical understanding of different sources of taxonomic literature along with identification of different plants according to Bentham and Hookers system
CO 4	Learn the principles and outlines of traditional as well as recent phylogenetic systems of classification of Angiosperms.
CO 5	Understand the fundamental concepts of plant embryology.
CO 6	Understand the basic concepts of plant microtechnique

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
4	Morphological peculiarities, palynological characters 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* • *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

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Course Code: RUSBOT 603

Course Title: Form and function – VI

Academic year 2021 - 22

COURSE OUTCOMES:

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand principles governing bioenergetics.
CO 2	Comprehend different fundamental concepts related lipid and nitrogen metabolism and applications of enzyme immobilization
CO 3	Carry out genetic mapping, detect gene mutations and analyze the effect of mutations on gene functions
CO 4	Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
CO 5	Understand the fundamentals of basic cosmetology and herbals associated
CO 6	Develop the skills to formulate herbal cosmetics.
CO 7	Develop their competency on post-harvest technology of horticultural produce

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

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	To study immobilization of enzymes using appropriate techniques
8	Preparation of face pack for dry/normal /oily skin, hair oil, herbal shampoo, herbal hair dye, lip balm, moisturizing cream, kajal.
9	Estimation of ascorbic acid and effect of heat treatment on ascorbic acid content.
10	Preparation of: • Squash • Nectar • Marmelade • Sauces
11	Quantitation of phytochemicals from plant source using TLC/ HPTLC • *Mentha viridis* - Menthol • *Emblica officinalis* – Gallic acid

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Course Code: RUSBOT 604

Course Title: Current Trends in Plant Sciences - IV

Academic year 2021 - 22

COURSE OUTCOMES:

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

COURSE OUTCOME	CO DESCRIPTION
CO 1	Understand the concept of essential oils, fatty oils and vegetable oils, their value addition
CO 2	Analyze the phytogeography of India
CO 3	Learn about biodiversity basics and importance of conservation
CO 4	Implement the use of advanced instruments like UV –spectrophotometer, HPTLC, HPLC for the study of phytochemicals.
CO 5	Understand the important aspects of research methodology.

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, RP - 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) • **Research methodology will be discussed** • **Well-defined materials and methods, discussion, results and conclusion, bibliography.**	

References

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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/Active Participation (attentiveness/ability to answer questions)/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	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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