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.

Resolution No.: AC/II(21-22).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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- Vashista B.R, Sinha A.K and Singh V.P. 2005. Botany for degree students –Algae, S. Chand's Publication.
- Cavers F. 1976. The interrelationships of the Bryophytes. S.R. Technic, Ashok Rajpath, Patna.
- Chopra R.N. and Kumar P.K. 1988. Biology of Bryophytes. John Wiley & Sons, New York, NY.
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- Watson E.V. 1971. Structure and Life of Bryophytes. 3rd Edition. Hutchinson University Library, London.
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- Gurucharan Singh. 2005. Systematics theory and practice (Oxford IBH)
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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.	

References:

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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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