

**S.P. Mandali's**  
**RAMNARAIN RUIA AUTONOMOUS COLLEGE**



Syllabus for: F. Y

Program: B. Sc.

Course Code: Botany (RUSBOT)

**Explore • Experience • Excel**

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

## SEMESTER I

Course Code	UNIT	TITLE	Credits	Lectures/ Week
<b>PLANT DIVERSITY I</b>				
RUSBOT 101	I	Algae	02	1
	II	Fungi		1
	III	Bryophyta		1
<b>FORM AND FUNCTION I</b>				
RUSBOT 102	I	Cell biology	02	1
	II	Ecology		1
	III	Genetics		1
RUSBOTP 101,102	Practicals	Plant Diversity I, Form and Function I (Practicals I and II)	02 06	2

## SEMESTER II

Course Code	UNIT	TOPICS	Credits	Lectures/ Week
<b>PLANT DIVERSITY II</b>				
RUSBOT 201	I	Pteridophytes	02	1
	II	Gymnosperms		1
	III	Angiosperms		1
<b>FORM AND FUNCTION II</b>				
RUSBOT 202	I	Anatomy	02	1
	II	Physiology		1
	III	Medicinal Botany		1
RUSBOTP 201,202	Practicals	Plant Diversity II, Form and Function II (Practicals I and II)	02 06	2

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**Course Code: RUSBOT 101**  
**Course Title: Plant Diversity I**  
**Academic year 2019 - 20**

**Learning Objectives:**

- Morphology, structure and importance of the organisms and differentiation between various groups of Algae, Fungi and Bryophyta.
- The life cycles of individuals belonging to Algae, Fungi and Bryophyta.

**Learning Outcomes:** Students will be able to understand the morphological and systematic knowledge about different plant groups. They will be able to make use of this knowledge for detailed study in their disciplines.

**Detailed Syllabus**

RUSBOT 101	Title: Plant Diversity I	Credits – 2
<b>UNIT I</b>	<b>Algae</b>	<b>15 Lectures</b>
	General characters of Chlorophyta and Cyanophyta. Outline of Classification according to G.M. Smith	
	Life cycle and systematic position of <i>Nostoc</i> and <i>Spirogyra</i> .	
	Economic importance of Algae.	
<b>UNIT II</b>	<b>Fungi</b>	<b>15 Lectures</b>
	Introduction, definition, general characters, mode of nutrition, thallus structure, reproduction, economic importance, Outline of Classification according to G. M. Smith	
	Structure, lifecycle and systematic position of <i>Rhizopus</i> and <i>Albugo</i>	
	Economic importance of Fungi.	
	Modes of nutrition in Fungi (Saprophytism, predation and Parasitism).	
<b>UNIT III</b>	<b>Bryophyta</b>	<b>15 Lectures</b>
	Outline of classification according to G.M. Smith	
	General characters of Hepaticae	
	Structure, life cycle and systematic position of <i>Riccia</i> .	
	Economic importance of Bryophyta	
<b>PRACTICALS</b>		
<b>RUSBOTP 101</b>	<b>Plant Diversity I</b>	<b>Credits - 1</b>
1	Study of stages in the life cycle of <i>Nostoc</i> from fresh/ preserved material and permanent slides	
2	Study of stages in the life cycle of <i>Spirogyra</i> from fresh/ preserved material and permanent slides	
3	Economic importance of algae: <i>Ulva</i> (food), <i>Scenedesmus</i> and <i>Chlorella</i> (Biofuel), <i>Spirulina</i> (Neutraceutical), <i>Gelidium</i> (Agar)	
4	Study of stages in the life cycle of <i>Rhizopus</i> from fresh/ preserved material and permanent slides	
5	Study of stages in the life cycle of <i>Albugo</i> from material and permanent slides	
6	Economic importance of Fungi: Mushroom, Yeast, wood rotting fungi (any bracket fungus).	
7	Study of stages in the life cycle of <i>Riccia</i> from fresh/ preserved material.	

**Course Code: RUSBOT 102**  
**Course Title: Form and function I**  
**Academic year 2019 - 20**

**Learning objectives:**

- The structure and functions of various plant cell organelles.
- The interactions taking place in the Ecosystems and the flow of energy.
- The ecological adaptations of various plants.
- The basic principles of Mendelian Genetics.

**Learning outcome:** Students will be able to understand the basic principles of plant cell organelles and plant ecology. They will further their knowledge in Mendelian Genetics. Students will perform experiments; gather data, test hypotheses, and draw conclusions based on data and understand the use of biometrics in biological sciences.

**Detailed Syllabus**

RUSBOT 102	Title: Form and Function I	Credits – 2
<b>UNIT I</b>	<b>Cell Biology</b>	<b>15 Lectures</b>
	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.	
<b>UNIT II</b>	<b>Ecology</b>	<b>15 Lectures</b>
	Energy pyramids, energy flow in an ecosystem.	
	Types of ecosystems: aquatic and terrestrial.	
	Biogeochemical cycles: Carbon, Nitrogen and Water.	
	Biodiversity Hotspots and PAN	
<b>UNIT III</b>	<b>Genetics</b>	<b>15 Lectures</b>
	Phenotype/Genotype, Mendelian Genetics- monohybrid, dihybrid ratios, test cross and back cross.	
	Epistatic and non epistatic interactions; multiple alleles.	
	<b>Sex determination</b> <b>Chromosomal Methods:</b> heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. Genic Balance Theory of sex determination in <i>Drosophila</i> , Lyon's Hypothesis of X chromosome inactivation. <b>Sex linked inheritance-</b> eye colour in <i>Drosophila</i> , Haemophilia, colour blindness <b>Sex influenced inheritance-</b> baldness in man	
<b>PRACTICALS</b>		
<b>RUSBOTP 101</b>	<b>Form and Function II</b>	<b>Credits - 1</b>
1	Examining various stages of mitosis in root tip cells ( <i>Allium</i> )	
2	Cell inclusions: Starch grains (Potato and Rice); Aleuronelayer, Maize	
3	Cystolith ( <i>Ficus</i> ); Raphides ( <i>Pistia</i> ); Sphaeraphides ( <i>Opuntia</i> ).	
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 ( <i>Pistia /Eichhornia</i> ), Rooted floating ( <i>Nymphaea</i> ), submerged ( <i>Hydrilla</i> ), Mesophytes (any common plant), Hygrophytes ( <i>Typha, Cyperus</i> )
6	Calculation of mean, median and mode.
7	Calculation of Standard deviation.
8	Frequency distribution, graphical representation of data- frequency polygon, histogram, pie chart.

**Course Code: RUSBOT 201**  
**Course Title: Plant Diversity II**  
**Academic year 2019 - 20**

**Learning Objectives:**

- Learn the life cycles of individuals belonging to Pteridophyta and differentiate between different types of steles.
- The classification, life history and economic importance of Gymnosperms.
- The taxonomical terminology and understand the meaning of the same.
- The morphology, structure and functions of various parts of plants.

**Learning Outcome:** Students will be able to understand the Pteridophyte and Gymnosperm life cycles, Angiosperm families and their economic importance and also their systematic position.

**Detailed Syllabus**

RUSBOT 201	Title: Plant Diversity II	Credits – 2
<b>UNIT I</b>	<b>Pteridophytes</b>	<b>15 Lectures</b>
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 <i>Selaginella</i> .	
3	Stelar evolution.	
4	Economic importance and propagation of ferns.	
<b>UNIT II</b>	<b>Gymnosperms</b>	<b>15 Lectures</b>
1	General characters, Outline of classification according to C.J. Chamberlin	
2	Structure life cycle systematic position and alternation of generations in <i>Cycas</i> .	
3	Economic importance of Gymnosperms.	
4	Geological time scale.	
<b>UNIT III</b>	<b>Angiosperms</b>	<b>15 Lectures</b>
1	Definition of taxonomy, systematic botany, concepts of taxonomy, aims of taxonomy.	
2	Study of following families: Magnoliaceae, Malvaceae, Leguminosae, Solanaceae, Amaryllidaceae.	
<b>PRACTICALS</b>		
RUSBOTP 201	Plant Diversity II	Credits - 1

1	Study of stages in the life cycle of <i>Selaginella</i> , T.S. of rachis.
2	T.S. of <i>Selaginella</i> stem
3	Stelar evolution with the help of permanent slides, Protostele, haplostele, actinostele, plectostele, mixed protostele, siphonostele, ectophloic, amphiphloic, dictyostele, eustele and atactostele.
4	<i>Cycas</i> : T.S of leaflet ( <i>Cycas</i> pinna) microsporophyll, megasporophyll, coralloid root, microspore, L.S. of ovule of <i>Cycas</i> – all specimens to be shown.
5	Economic importance of Gymnosperms: <i>Pinus</i> ( 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, <i>Drosera</i> or insectivorous plants.
7	Inflorescence: Racemose: simple raceme, spike, catkin, corymb, umbel, spadix, capitulum. Cymose, monochasial, dichasial, polychasial. Compound: Panicle, cyathium, verticillaster, hypanthodium.
8	Study of following families: Magnoliaceae, Malvaceae, Leguminosae, Solanaceae, Amaryllidaceae.
9	Propagation of ferns

**Course Code: RUSBOT 202**  
**Course Title: Form and function II**  
**Academic year 2019 - 20**

**Learning Objectives:**

- The primary anatomical structure and functions of various tissues System in plants. Primary Structure of Dicot and Monocotstem, leaf and root.
- The basic physiological processes including photosynthesis and differentiate between C<sub>3</sub>, C<sub>4</sub> and CAM plants.
- The use of plant resources for food and medicine.

**Learning Outcomes:** Students will able to understand the anatomical structure and functions of various tissues System in plants. Understand physiological processes and their importance. Study the basic concept of primary and secondary metabolites. Study about the economic use, morphology, products and uses of several economically important plants.

**Detailed Syllabus**

RUSBOT 202	Title: Form and function II	Credits – 2
<b>UNIT I</b>	<b>Anatomy</b>	<b>15 Lectures</b>
1	Simple tissues, complex tissues, meristematic tissues, permanent tissues, wall ingrowths and transfer cells, adcrustation and incrustation, ergastic substances.	
2	Primary structure of dicot and monocot root, stem and leaf (Kranz anatomy).	
3	Epidermal tissue system: types of hair, monocot and dicot stomata.	
<b>UNIT II</b>	<b>Physiology</b>	<b>15 Lectures</b>
1	Photosynthesis: Light reactions, photolysis of water photophosph non-cyclic), carbon fixation phase (C <sub>3</sub> , C <sub>4</sub> and CAM pathways).	
2	Plant immune system	
<b>UNIT III</b>	<b>Medicinal Botany</b>	<b>15 Lectures</b>

1	History of medicinal botany	
2	Concept of primary and secondary metabolites, difference between primary and secondary metabolites.	
3	Grandma's pouch: Following plants have to be respect to botanical source, part of the plant used, active constituents present and medicinal uses: <i>Ocimum sanctum</i> , <i>Justicia adhatoda</i> , <i>Zinziber officinale</i> , <i>Curcuma longa</i> , <i>Santalum album</i> , <i>Aloe vera</i> .	
4	Functional Foods : Garlic, Carrot, Citrus, Jackfruit, Drumstick and Dill	
<b>PRACTICALS</b>		
<b>RUSBOTP 202</b>	<b>Form and function II</b>	<b>Credits - 1</b>
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: <i>Gossypium</i> /Radish Multicellular: <i>Lantana</i> /Sunflower Glandular: <i>Drosera</i> and Stinging: <i>Urtica</i> – only identification with permanent slides. Peltate: <i>Thespesia</i> Stellate: <i>Erythrina</i> / <i>Sidaacuta</i> / <i>Solanum</i> / <i>Helecteris</i> T-shaped: <i>Avicennia</i>	
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 tannins.	
9	Identification of plants/plant parts found in Grandma's Pouch.	
10	Identification of functional foods.	

Note: Two short 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.

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## MODALITY OF ASSESSMENT

### Theory Examination Pattern:

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

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

**B) External examination - 60 %**

### **Semester End Theory Assessment - 60 marks**

- i. Duration - These examinations shall be of **2 hours** duration.
- ii. Paper Pattern:
  1. There shall be **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:**

**(A) Internal Examination:**

Heading	Practical
Journal	05
Practical/ Field Report/ Presentation	15
<b>Total</b>	<b>20</b>

**(B) External (Semester end practical examination):**

Particulars	Practical
Laboratory work and/or <i>Viva voce</i>	30
<b>Total</b>	<b>30</b>

### PRACTICAL BOOK/JOURNAL

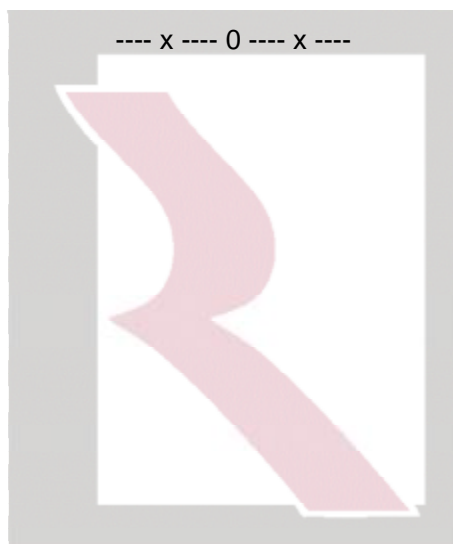
The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

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 and II

Course	101/201			102/202			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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Syllabus for: S. Y

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### SEMESTER III

Course Code	UNIT	TOPICS	Credits	Lectures/Week
RUSBOT 301	<b>PLANT DIVERSITY III</b>			
	I	Thallophyta (Algae) & Bryophyta	<b>02</b>	<b>1</b>
	II	Angiosperms		<b>1</b>
	III	Instrumentation		<b>1</b>
RUSBOT 302	<b>FORM AND FUNCTION III</b>			
	I	Cell biology	<b>02</b>	<b>1</b>
	II	Cytogenetics		<b>1</b>
	III	Molecular Biology		<b>1</b>
RUSBOT 303	<b>CURRENT TRENDS IN PLANT SCIENCES I</b>			
	I	Pharmacognosy and Phytochemistry	<b>02</b>	<b>1</b>
	II	Economic botany		<b>1</b>
	III	Industry based on plant products		<b>1</b>
RUSBOTP 301, 302, 303	Practicals	<b>Practical based on all the three courses in theory</b>	<b>03</b>	<b>09</b>
			<b>09</b>	

### SEMESTER IV

Course Code	UNIT	TOPICS	Credits	Lectures/Week
RUSBOT 401	<b>PLANT DIVERSITY IV</b>			
	I	Thallophyta: Fungi, Plant Pathology and Lichens	<b>02</b>	<b>1</b>
	II	Pteridophyta and Paleobotany		<b>1</b>
	III	Gymnosperms		<b>1</b>
RUSBOT 402	<b>FORM AND FUNCTION IV</b>			
	I	Anatomy	<b>02</b>	<b>1</b>
	II	Plant Physiology and Plant Biochemistry		<b>1</b>
	III	Ecology and Environmental Botany		<b>1</b>
RUSBOT 403	<b>CURRENT TRENDS IN PLANT SCIENCES II</b>			
	I	Biotechnology	<b>02</b>	<b>1</b>
	II	Biostatistics and Bioinformatics		<b>1</b>
	III	Research Methodology I		<b>1</b>
RUSBOTP 401, 402, 403	Practicals	<b>Practical based on all the three courses in theory</b>	<b>03</b>	<b>09</b>
			<b>09</b>	

**Course Code: RUSBOT 301**  
**Course Title: Plant Diversity III**  
**Academic year 2019 - 20**

**Learning Objectives –**

- The study of higher Algae, Bryophytes and detailed study of plant nomenclature, Angiospermic plant families by Bentham and Hookers system of classification.
- The instruments useful for practicals, learning the techniques and working of different instruments used to study plant diversity.

**Learning Outcomes –** The students will be able to identify Algae, Bryophytes and Angiosperms. Students will be able to appreciate the influence of various fields on taxonomy. Observation, collection of specimens from the nature by themselves for e.g. by going for excursion or short local visit to the places will enrich their knowledge further. They will also be able to grasp the working and handling of instruments and working on it for the specific practicals.

**Detailed Syllabus**

RUSBOT 301	Title: Plant Diversity III	Credits – 2
<b>UNIT I</b>	<b>Thallophyta (Algae) &amp; Bryophyta</b>	<b>15 Lectures</b>
	General Characters of Division Chrysophyta and Phaeophyta: Distribution, Cell structure, range of thallus, Economic Importance.	
	Structure, life cycle and systematic position of <i>Vaucheria</i> and <i>Sargassum</i>	
	General Account of Class <i>Anthocerotae</i>	
	Structure, life cycle and systematic position of <i>Pellia</i> and <i>Anthoceros</i>	
<b>UNIT II</b>	<b>Angiosperms</b>	<b>15 Lectures</b>
	Systematics: Categories and taxonomic hierarchy; <ul style="list-style-type: none"> <li>• Plant Nomenclature</li> <li>• Taxonomy in relation to <ul style="list-style-type: none"> <li>○ Anatomy</li> <li>○ Chemical constituents</li> </ul> </li> </ul>	
	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: <ul style="list-style-type: none"> <li>• Brassicaceae</li> <li>• Myrtaceae</li> <li>• Asteraceae</li> <li>• Acanthaceae</li> <li>• Amaranthaceae</li> <li>• Euphorbiaceae</li> <li>• Palmae</li> </ul>	
<b>UNIT III</b>	<b>Instrumentation</b>	<b>15 Lectures</b>
	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	
<b>PRACTICALS</b>		
<b>RUSBOTP 301</b>	<b>Plant Diversity III</b>	<b>Credits - 1</b>
1	Study of stages in the life cycle of <i>Vaucheria</i> and <i>Sargassum</i> from fresh/ preserved material and permanent slides.	
2	Economic importance and range of thallus in Phaeophyta	
3	Study of stages in the life cycle of and <i>Pellia</i> from fresh/ preserved material and permanent slides.	
4	Study of stages in the life cycle of <i>Anthoceros</i> from fresh/ preserved material and permanent slides.	
5	Study of plants for anatomy in relation to taxonomy	
6	Study of plants for Alkaloids, Tannins, Phenols and Flavonoids (chemotaxonomy)	
7	Study of one plant from each family prescribed for theory: <ul style="list-style-type: none"> <li>• Brassicaceae</li> <li>• Myrtaceae</li> <li>• Asteraceae</li> <li>• Acanthaceae</li> <li>• Amaranthaceae</li> <li>• Euphorbiaceae</li> <li>• Palmae</li> </ul>	
8	Morphological peculiarities and economic importance of the members of these families.	
9	Preparation of herbarium and wet preservation technique	

**Course Code: RUSBOT 302**  
**Course Title: Form and function III**  
**Academic year 2019 - 20**

**Learning Objectives–**

- The study of the fundamentals of Cell biology, Cytogenetics and Molecular Biology

**Learning Outcomes** – The students will be able to understand the details of cellular structures, causes and effects of chromosomal aberrations, sex determination and examples of extranuclear genetics. They also will be able to have a detailed understanding of the fundamentals of DNA replication and transcription.

**Detailed syllabus**

<b>RUSBOT 302</b>	<b>Title: Form and function III</b>	<b>Credits – 2</b>
<b>UNIT I</b>	<b>Cell biology</b>	<b>15 Lectures</b>
	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	

<b>UNIT II</b>	<b>Cytogenetics</b>	<b>15 Lectures</b>
	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- <ul style="list-style-type: none"> <li>• Chloroplast determines heredity - Plastid transmission in plants, Streptomycin resistance in <i>Chlamydomonas</i>.</li> <li>• Male sterility in maize</li> </ul>	
<b>UNIT III</b>	<b>Molecular Biology</b>	<b>15 Lectures</b>
	DNA replication : Modes of Replication, Messelson and Stahl experiment	
	DNA replication in prokaryotes and eukaryotes- enzymes involved and molecular mechanism of replication.	
	Protein Synthesis: <ul style="list-style-type: none"> <li>• Central dogma of protein synthesis</li> <li>• Transcription in prokaryotes and eukaryotes: promoter sites, initiation, elongation and termination.</li> </ul>	
	RNA processing: Adenylation and Capping	
<b>PRACTICALS</b>		
<b>RUSBOTP 302</b>	<b>Form and function III</b>	<b>Credits - 1</b>
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 (projects/ assignments)	
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)	
10	Horizontal and Vertical Gel Electrophoresis – Demonstration	



**Course Code: RUSBOT 303**  
**Course Title: Current trends in Plant Sciences I**  
**Academic year 2019 - 20**

**Learning Objectives-**

- The study of the pharmacognosy and phytochemistry using monographs from pharmacopoeia.
- The study of secondary metabolites and adulterants.
- To study economic botany.
- The applied usage of botanicals and understand industry applications of the same.

**Learning outcomes -**

Creating awareness about various pharmacopoeias and understanding the importance of pharmacopoeias in plant identification and standardization. Understanding forestry and the use of various forest products. Understanding the economic and commercial value of botanical products. Understanding the industrial relevance of botanicals with respect to current demands of industry.

**Detailed Syllabus**

RUSBOT 303	Title: Current trends in Plant Sciences I	Credits – 2
<b>UNIT I</b>	<b>Pharmacognosy and phytochemistry</b>	<b>15 Lectures</b>
	Introduction to pharmacopoeia	
	Indian pharmacopoeia, India Herbal pharmacopoeia, Ayurvedic pharmacopoeia	
	Study of monograph from pharmacopoeia; any one example.	
	Secondary metabolites: Sources, properties, uses and adulterants, regional and seasonal variations	
	Genuine and spurious drugs: <i>Saraca asoca</i> , <i>Phyllanthus amarus</i> and other species	
<b>UNIT II</b>	<b>Economic Botany</b>	<b>15 Lectures</b>
	Fibre yielding plants	
	Types of fibers: Jute and cotton	
	Paper yielding plants	
	Types of paper	
	Spices and condiments: Cardamom ( <i>Elettaria cardamomum</i> and <i>Amomum subulatum</i> ), Javitri and Jaiphal ( <i>Myristica fragrans</i> )	
	Commercial market of spices.	
<b>UNIT III</b>	<b>Industry based on plant products</b>	<b>15 Lectures</b>
	Aromatherapy- Introduction, Uses with few examples: <i>Calendula</i> , lemon, jasmine	
	Botanical and nutraceuticals - <i>Spirulina</i> , Vanillin, <i>Garcinia indica</i> / <i>Garcinia cambogia</i> , <i>Stevia</i> , and Kale.	
	Industrial enzymes: Extraction methods and application: Cellulases, Papain, Bromelain – Biofuels.	
<b>PRACTICALS</b>		
RUSBOTP 303	Current trends in Plant Sciences I	Credits - 1

1	Pharmacognostic evaluation of the following genuine and spurious drugs with reference to adulteration: <i>Phyllanthus amarus</i> , <i>Phyllanthus debilis</i> , <i>Saraca asoca</i> , <i>Polyalthia longifolia</i>
2	Sources of: Fibres & Paper; Spices & condiments
3	Identification of botanical sources used in aromatherapy and nutraceuticals (examples as per theory)
4	Extraction and evaluation of enzymes papain (fruit and leaf)/ bromelain (stem and fruit)
5	Identification of plants used in biofuels
6	Estimation of crude fibre in cereals & their products: (Assignment and projects)
7	Study of biodiversity (Visit to National Park/ Botanical Garden/ forests): Assignments/ projects

### **SEMESTER IV**

**Course Code: RUSBOT 401**  
**Course Title: Plant Diversity IV**  
**Academic year 2018-19**

#### **Learning Objective:**

- The study of Ascomycete fungi with two life cycles.
- Study of Plant pathology, Lichens, Pteridophyta, Paleobotany and Gymnosperms.
- Classification of each of the above and knowledge about their economic importance.

**Learning Outcomes** –The students will learn to identify and study the life cycles of fungi, fungi causing plant diseases, lichens, Pteridophytes, Gymnosperms, and fossil members mentioned in the syllabus.

#### **Detailed Syllabus**

<b>RUSBOT 401</b>	<b>Title: Plant Diversity IV</b>	<b>Credits – 2</b>
<b>UNIT I</b>	<b>Thallophyta: Fungi, Plant Pathology and Lichens</b>	<b>15 Lectures</b>
	General characters of Ascomycetae	
	Structure, life cycle and systematic position of <i>Aspergillus</i> and <i>Xylaria</i>	
	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.	
<b>UNIT II</b>	<b>Pteridophyta and Paleobotany</b>	<b>15 Lectures</b>
	Salient features and classification of Calamophyta and Pterophyta upto orders (G M Smith's system of classification)	
	Structure, life cycle and systematic position of <i>Equisetum</i> and <i>Lycopodium</i>	
	Paleobotany- Formation and types of fossils; Structure and systematic position of form genus <i>Rhynia</i>	
<b>UNIT III</b>	<b>Gymnosperms</b>	<b>15 Lectures</b>
	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 <i>Pinus</i>	
	Structure and systematic position of the form genus <i>Cordaites</i>	
<b>PRACTICALS</b>		
<b>RUSBOTP 401</b>	<b>Plant Diversity IV</b>	<b>Credits - 1</b>
1	Study of stages in the life cycle of <i>Aspergillus</i> from fresh/ preserved material and permanent slides.	
2	Study of stages in the life cycle of <i>Xylaria</i> 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 <i>Equisetum</i> and <i>Lycopodium</i> from fresh/ preserved material and permanent slides.	
6	Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs	
7	Study of stages in the life cycle of <i>Pinus</i> from fresh/ preserved material and permanent slides.	
8	Study of the form genus <i>Cordaites</i> with the help of permanent slide/ photomicrographs.	

**Course Code: RUSBOT 402**  
**Course Title: Form and function IV**  
**Academic year 2019 - 20**

**Learning Objectives-**

- The study of fundamentals of Anatomy, Plant Physiology and Plant Biochemistry, Ecology and Environmental Botany in detail

**Learning outcomes-** The students will be able to relate structure with function by studying different anatomical details. They will be able to understand the basic concepts and applications of respiration, photorespiration, photoperiodism and vernalisation. They will be able to grasp the principles governing ecology and environmental biology with reference to biogeochemical cycles, ecological factors, and community ecology.

**Detailed Syllabus**

<b>RUSBOT 402</b>	<b>Title: Form and function IV</b>	<b>Credits – 2</b>
<b>UNIT I</b>	<b>Anatomy</b>	<b>15 Lectures</b>
	Normal secondary growth in dicotyledonous stem and root. Growth rings, periderm, lenticels, tyloses	
	Mechanical tissue system and <ul style="list-style-type: none"> <li>• Tissues providing mechanical strength and support and their disposition</li> <li>• I-girders in aerial and underground organs</li> </ul> Conducting tissue system	
	Study of ecological adaptations: Xerophytes and halophytes	
<b>UNIT II</b>	<b>Plant Physiology and Plant Biochemistry</b>	<b>15 Lectures</b>
	<b>Respiration:</b> Aerobic: Glycolysis, TCA Cycle, ETS and Energetics of respiration; anaerobic respiration.	
	<b>Photorespiration:</b> Mechanism of photorespiration, Energetics and significance of photorespiration	
	<b>Photoperiodism:</b> 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;	
	Vernalization mechanisms and applications.	
<b>UNIT III</b>	<b>Ecology and Environmental Botany</b>	<b>15 Lectures</b>
	<b>Ecological factors:</b> Concept of environmental factors. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile.	
	<b>Community ecology</b> - Characters of community - Quantitative characters and Qualitative characters	
	Environmental Impact Assessment (EIA)	
<b>PRACTICALS</b>		
<b>RUSBOTP 402</b>	<b>Form and function IV</b>	<b>Credits - 1</b>
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 <i>Typha</i> ,	
3	Study of ecological adaptations: Xerophytes and halophytes	
4	Study of conducting tissues, Growth rings, periderm, lenticels, tyloses.	
5	Q <sub>10</sub> – germinating seeds using phenol red indicator.	
6	Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, Soil pH, Wind anemometer.	
7	Mechanical analysis of soil by the sieve method and pH of soil.	
8	Quantitative estimation of organic matter of the soil by Walkley and Blacks Rapid titration method.	
	<b>Projects:</b>	
1	Estimation of proteins by Lowry's method (Prepare standard graph).	
2	Study of vegetation by the list quadrat method.	

**Course Code: RUSBOT 403**  
**Course Title: Current Trends in Plant Sciences II**  
**Academic year 2019 - 20**

#### Learning Objectives –

- The study the basic principles and wider aspects of Horticulture, Biotechnology and Bioinformatics.
- Exposure to the field of research and methodology

**Learning outcomes** - The students will be able to identify horticulture garden plants and garden locations, work with various tissue culture techniques. They will be able to apply the tools of Biostatistics and Bioinformatics for analysis problem solving in Botany. Basic concepts of research and GLP shall be learnt by the students

#### Detailed Syllabus

<b>RUSBOT 403</b>	<b>Title: Current Trends in Plant Sciences II</b>	<b>Credits – 2</b>
<b>UNIT I</b>	<b>Biotechnology</b>	<b>15 Lectures</b>
	<b>Introduction to plant tissue culture</b>	
	<ul style="list-style-type: none"> <li>• A historic perspective</li> </ul>	

	<ul style="list-style-type: none"> <li>Laboratory organization and techniques in plant tissue culture</li> <li>Totipotency</li> <li>Morphogenesis(Organogenesis - Rhizogenesis, Caulogenesis)</li> <li>Organ culture – root cultures, meristem cultures, embryo culture</li> <li>Problems in plant tissue culture: contamination, phenolics and recalcitrance.</li> <li>Factors responsible for <i>in vitro</i> and <i>ex vitro</i> hardening</li> </ul>	
	<b>R-DNA technology-</b> <ul style="list-style-type: none"> <li>Gene cloning</li> <li>Enzymes involved in Gene cloning</li> <li>Vectors used for Gene cloning.</li> </ul>	
<b>UNIT II</b>	<b>Biostatistics and Bioinformatics</b>	<b>15 Lectures</b>
	Biostatistics: <ul style="list-style-type: none"> <li>The chi square test.</li> <li>Correlation – Calculation of coefficient of correlation.</li> </ul>	
	Bioinformatics <ul style="list-style-type: none"> <li>Introduction and Bioinformatics resources: Knowledge of various databases and bioinformatics tools available at these resources, data retrieval tools- Entrez</li> <li>Organization of biological data, databases-the major content of the databases, literature databases, databases of bioinformatics: Primary, secondary and tertiary</li> </ul>	
	Sequence-based Database Searches; BLAST and FASTA, various versions of basic BLAST and FASTA.	
<b>UNIT III</b>	<b>Research Methodology I</b>	<b>15 lectures</b>
	<b>Basic concepts of research:</b> <ul style="list-style-type: none"> <li>Review of literature and bibliography</li> <li>Identification and understanding a research problem.</li> </ul>	
	<b>Good laboratory practices</b> <ul style="list-style-type: none"> <li>Molarity and normality</li> <li>Preparation of solutions</li> <li>Dilutions</li> <li>Knowledge of common toxic chemical and safety measures in their handling</li> </ul>	
<b>PRACTICALS</b>		
<b>RUSBOTP 403</b>	<b>Current Trends in Plant Sciences II</b>	<b>Credits - 1</b>
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	Sequence search in NCBI BLAST	
10	Review of literature, its consolidation and bibliography	

11	Preparation of molar and normal solutions
12	Preparation of Serial dilutions

### Reference Books

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2. An introduction to Genetic analysis Griffith Freeman and Company (2000)
3. Fundamentals of Biostatistics by Rastogi, Ane Books Pvt. Ltd. (2009).
4. Instant Notes on Bioinformatics by Westhead (2002), Taylor Francis Publications.
5. Davis P.H and V.H Heywood (1963). Principles of Angiosperm Taxonomy. Oliver and Boyd London.
6. Gurucharan Singh (2005)- Systematics theory and practice (Oxford IBH)
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8. Lawrence, G.H.M 1951. Taxonomy of Vascular Plants. N.Y.
9. Stewart W.N. and Rathwell G.W. 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
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12. Theodore Cooke (1903)- The flora of The Presidency of Bombay Vol. I, II, III
13. Verma, V. (2007): Text Book Of Plant Physiology, Ane Books India, New Delhi.
14. Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology. 4th edition Academic Press, UK
15. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinauer Associates, Sunderland, Massachusetts, USA
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17. Helgi Olafsson, Stephen A. Rolfe, Arthur J. Willis. 2005. The Physiology of Flowering Plants, Cambridge University Press, UK
18. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
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21. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
22. Fundamental Molecular Biology ; Allison LA; 2007
23. Techniques for Molecular Biology ; Tagu D & Moussard C; INRA; 2006
24. Gene Cloning and DNA Analysis ; 5th Ed ; Brown TA ; 2006
25. Analysis of Genes and Genomes ; Reece RJ ; Wiley; 2004
26. Recombinant DNA and Biotechnology ; 2nd Ed ; Kreuzer H and Massey A ; ASM; 2006
27. Text book of biotechnology, R.C. Dubey, 2009, S. Chand, Delhi
28. Nanobiotechnology, Concepts, Applications and perspectives, C.M. Niemeyer and C.A. Mirkin ; 2004; WILEY-VCH,.



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### **MODALITY OF ASSESSMENT**

#### **Theory Examination Pattern:**

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

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

**D) External examination - 60 %**

**Semester End Theory Assessment - 60 marks**

- iii. Duration - These examinations shall be of **2 hours** duration.
- iv. Paper Pattern:
  - 3. 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.
  - 4. 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:**

<b>(A) Internal Examination:</b>	
<b>Heading</b>	<b>Practical I</b>
<b>Journal</b>	05
<b>Practical/ Field Report/ Presentation</b>	15
<b>Total</b>	20

**(B) External (Semester end practical examination):**

Particulars	Practical
Laboratory work and/or <i>Viva voce</i>	30
<b>Total</b>	<b>30</b>

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## 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 and IV

Course	301/401		302/402		303/403		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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**RAMNARAIN RUIA AUTONOMOUS COLLEGE**



Syllabus for: T. Y

Program: B. Sc.

**RUIA COLLEGE**  
Course Code: Botany (RUSBOT)

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

## SEMESTER V

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

## SEMESTER VI

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

Course Code: RUSBOT 501

Course Title: Plant Diversity V

Academic year 2019 - 20

Learning Objectives: –

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

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

Detailed Syllabus

RUSBOT 501	Title: Plant Diversity V	Credits – 2.5
UNIT I	Algae	15 Lectures
	Division Rhodophyta <ul style="list-style-type: none"><li>• Classification and General Characters: Distribution, cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, alternation of generations, economic Importance.</li><li>• Structure, life cycle and systematic position of<ul style="list-style-type: none"><li>○ <i>Polysiphonia</i></li><li>○ <i>Batrachospermum</i></li></ul></li></ul>	
	Division Bacillariophyta: <ul style="list-style-type: none"><li>• Classification and General Characters of Bacillariophyta: Distribution, cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual, alternation of generations, economic Importance.</li><li>• Structure, life cycle and systematic position of <i>Pinnularia</i></li></ul>	
	Range of thallus structure in algae, Extraction of agar, Biofertilizer	
UNIT II	Bryophyta	15 Lectures
	Life cycle of <i>Marchantia</i> and <i>Funaria</i>	
	Evolution of sporophyte	

	Evolution of gametophyte	
<b>UNIT III</b>	<b>Microbiology</b>	<b>15 Lectures</b>
	Types of Microbes- Bacteria, <i>Rickettsiae</i> , Mycoplasma, algae, Archaeobacterium, Actinomycetes, fungi, Protozoa	
	Culturing: Sterilization, media, staining, colony characters, Laboratory Safety measures	
	Pure culture	
	Role of microbes in fermentation: Industrial production of Alcohol and Antibiotics	
<b>UNIT IV</b>	<b>Biostatistics</b>	<b>15 Lectures</b>
	Test of significance student's <i>t</i> -test (paired and unpaired)	
	Box plot	
	Regression	
	ANOVA (one way)	
<b>PRACTICALS</b>		
<b>RUSBOTP 501</b>	<b>Plant Diversity V</b>	<b>Credits - 1</b>
1	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>• <i>Polysiphonia</i></li> <li>• <i>Batrachospermum</i></li> <li>• <i>Pinnularia</i></li> </ul>	
2	Range of thallus structure in algae	
3	Economic importance of algae	
4	Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>• <i>Marchantia</i></li> <li>• <i>Funaria</i></li> </ul>	
5	Study of aeromicrobiota by petriplate exposed method <ul style="list-style-type: none"> <li>• Fungal culture</li> <li>• Bacterial culture</li> </ul>	
6	Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected micro organism	

7	Study of antimicrobial activity by the disc diffusion method
8	<i>T-test</i> (paired and unpaired)
9	Problems based on regression analysis
11	ANOVA



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**Course Code: RUSBOT 502**

**Course Title: Plant Diversity VI**

**AAcademic year 2019 - 20**

**Learning Objectives: –**

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

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

**Detailed Syllabus**

<b>RUSBOT 502</b>	<b>Title: Plant Diversity VI</b>	<b>Credits – 2.5</b>
<b>UNIT I</b>	<b>Angiosperms I</b>	<b>15 Lectures</b>
	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 <ul style="list-style-type: none"><li>• Capparidaceae</li><li>• Umbelliferae</li><li>• Cucurbitaceae</li><li>• Rubiaceae</li><li>• Convolvulaceae</li><li>• Commelinaceae</li><li>• Graminae</li></ul>	
<b>UNIT II</b>	<b>Ethnobotany</b>	<b>15 Lectures</b>



	Ethnobotany – Definition, History, Sources of data and methods of study.	
	Sacred grooves	
	Contributions of Dr. S.K. Jain, Madhav Gadgil, Dr. V. D. Vartak	
	Concept of sustainability for survival	
<b>UNIT III</b>	<b>Palynology</b>	<b>15 Lectures</b>
	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.	
<b>UNIT IV</b>	<b>Anatomy</b>	<b>15 Lectures</b>
	<b>Anomalous secondary growth</b> : in the Stems of <i>Bignonia</i> , <i>Salvadora</i> , <i>Mirabilis</i> , <i>Aristolochia</i> , <i>Dracaena</i> , Storage roots of Beet, Radish	
	Root stem transition	
	Types of Stomata – Anomocytic, Anisocytic, Diacytic, Paracytic, and Gramineous.	
	<b>Wood Anatomy:</b> Hard wood and Soft wood, Wood types: ring porous and diffuse porous wood, xylem parenchyma: Apotracheal and Paratracheal.	
	<b>Ecological anatomy:</b> Epiphytes and Parasites	
	<b>Nodal Anatomy:</b> Unilacunar, trilacunar and multilacunar nodes.	
<b>PRACTICALS</b>		
<b>RUSBOTP 502</b>	<b>Plant Diversity VI</b>	<b>Credits - 1</b>
1	Study of one plant from each of the following Angiosperm families <ul style="list-style-type: none"> <li>• Capparidaceae</li> <li>• Umbelliferae</li> <li>• Cucurbitaceae</li> <li>• Rubiaceae</li> <li>• Convolvulaceae</li> <li>• Commelinaceae</li> </ul>	

	<ul style="list-style-type: none"> <li>• Graminae</li> </ul>
2	Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families
3	Identifying the genus and species of a plant with the help of Flora
4	Mapping of sacred groves in India/ Maharashtra
5	Study of plants of ethnobotanical importance in Maharashtra – medicinal, fibre yielding, food plants, oil yielding plants.
6	Literature survey of ethnobotanical reviews/reports
7	Determination of pollen viability
8	Pollen analysis from honey sample – unifloral and multifloral honey
9	Effect of varying concentration of sucrose on <i>In vitro</i> Pollen germination
10	<p>Study of pollen morphology (NPC Analysis) of the following by Chitley's Method</p> <ul style="list-style-type: none"> <li>• <i>Hibiscus</i></li> <li>• <i>Datura</i></li> <li>• <i>Ocimum</i></li> <li>• <i>Crinum</i></li> <li>• <i>Pancreaticum</i></li> <li>• <i>Canna</i></li> </ul>
11	<p>Study of anomalous secondary growth in the stems of the following plants using double staining technique</p> <ul style="list-style-type: none"> <li>• <i>Bignonia</i></li> <li>• <i>Salvadora</i></li> <li>• <i>Mirabilis</i></li> <li>• <i>Aristolochia</i></li> <li>• <i>Dracaena</i></li> </ul>
	<p>Study of anomalous secondary growth in the roots of</p> <ul style="list-style-type: none"> <li>• Beet</li> <li>• Radish</li> </ul>
	Types of Stomata

**Course Code: RUSBOT 503**

**Course Title:Form and function V**

**Academic year 2019 - 20**

**Learning Objectives:**

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

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

**Detailed Syllabus**

<b>RUSBOT 503</b>	<b>Title: Form and function V</b>	<b>Credits – 2.5</b>
<b>UNIT I</b>	<b>Cytology and Molecular Biology</b>	<b>15 Lectures</b>
	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	
<b>UNIT II</b>	<b>Physiology I</b>	<b>15 Lectures</b>
	<b>Structure of biomolecules</b> - carbohydrates (sugars, starch, cellulose, pectin), lipids (fatty acids, glycerol), proteins (amino acids)	
	<b>Enzymes</b> - Nomenclature, classification, mode of action, enzyme kinetics, Michaelis Menten equation, competitive, non competitive and uncompetitive inhibitors	

	Methods of enzyme immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).	
	<b>Vegetative Growth:</b> General phases of growth, Growth Curves, Factors affecting growth – External (environmental) and internal (genetic, hormonal, nutritional); Role of plant growth regulating substances – Auxins, Cytokinins and Gibberellins and their commercial applications.	
<b>UNIT III</b>	<b>Environmental Botany</b>	<b>15 Lectures</b>
	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	
<b>UNIT IV</b>	<b>Bioinformatics</b>	<b>15 Lectures</b>
	<b>Sequence analysis:</b> Basic concepts of sequence similarity, identity and homology, definitions of homologs, orthologs, paralogs. Basic concepts of sequence alignment, pairwise alignments. Use of pairwise alignments and Multiple sequence alignment	
	<b>Phylogeny:</b> Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method]	
	<b>Gene finding</b> and motif finding	
<b>PRACTICALS</b>		
<b>RUSBOTP 503</b>	<b>Form and function V</b>	<b>Credits - 1</b>

1	Mounting of giant chromosome from <i>Chironomous</i> larva
2	Smear preparation from <i>Tradescantia</i> buds
3	Predicting the sequence of Amino acids in the polypeptide chain that will be formed following translation. (Prokaryotic and Eukaryotic)
4	To estimate the activity of Gibberellic acid with respect to seed germination and mobilization of reserves.
5	To study immobilization of enzymes using appropriate techniques
6	Qualitative tests for carbohydrates, amino acids, lipids
7	<p>Estimation of the following in / of the given water sample:</p> <ul style="list-style-type: none"> <li>• Dissolved Oxygen Demand</li> <li>• Biological Oxygen Demand</li> <li>• Chemical Oxygen Demand</li> <li>• Hardness</li> <li>• Salinity</li> <li>• Acidity</li> <li>• Alkalinity</li> </ul>
8	Multiple Sequence Alignment
9	Phylogenetic Analysis
10	RASMOL / SPDBV
11	Motif finding

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**Course Code: RUSBOT 504**

**Course Title: Current Trends in Plant Sciences III**

**Academic year 2019 - 20**

**Learning Objectives:**

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

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

**Detailed Syllabus**

<b>RUSBOT 504</b>	<b>Title: Current Trends in Plant Sciences III</b>	<b>Credits – 2.5</b>
<b>UNIT I</b>	<b>Pharmacognosy and Medicinal Botany</b>	<b>15 Lectures</b>
	<b>Cultivation practices</b> with reference to soil, propagation methods, irrigation, manuring, harvesting, processing, storage, marketing – <i>Saffron (Crocus sativus)</i>	
	<b>Monographs</b> of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants – <i>Woodfordia fruticosa, Symplocos racemosa</i>	
	<b>Medicinal plants used against:</b> <ul style="list-style-type: none"> <li>• Diabetes</li> <li>• Anemia/ Jaundice</li> <li>• Obesity</li> </ul>	
<b>UNIT II</b>	<b>Plants in Human Health</b>	<b>15 Lectures</b>
	Role of antioxidants in human health	
	Benefits of phytochemicals in disease prevention: <ul style="list-style-type: none"> <li>• Sources and therapeutic efficacy</li> <li>• Flavonoids – Quercetin, Kaempferol, Rutin</li> <li>• Terpenoids – Ursolic acid, Lupeol</li> <li>• Phenolic acids – Gallic acid, Caffeic acid, Ferulic acid</li> </ul>	
	Application of these phytochemicals to certain diseases like Diabetes and Jaundice.	

	Phytochemicals of nutraceutical importance: <ul style="list-style-type: none"> <li>• Betasitosterol: <i>Linum usitatissimum</i>, <i>Carissa carandas</i></li> <li>• <i>Curcuma longa</i></li> </ul> Curcumin:	
<b>UNIT III</b>	<b>Plant Tissue Culture</b>	<b>15 Lectures</b>
	Micropropagation of floricultural and medicinal plants	
	Anther culture and Pollen culture	
	Somatic embryogenesis and artificial seeds	
	Plant cell suspension cultures for the production of secondary metabolites	
	Protoplast isolation, culture and Somatic Hybridization	
<b>UNIT IV</b>	<b>Research Methodology II</b>	<b>15 Lectures</b>
	<b>Introduction to Research:</b> <ul style="list-style-type: none"> <li>• Important concepts of research design</li> <li>• Identification of a research problem</li> <li>• Generation of a research problem.</li> </ul>	
	<b>Data management</b> <ul style="list-style-type: none"> <li>• Data collection and documentation</li> <li>• Maintaining Lab records</li> <li>• Tabulation and generation of graphs</li> </ul>	
<b>PRACTICALS</b>		
<b>RUSBOTP 504</b>	<b>Current Trends in Plant Sciences III</b>	<b>Credits - 1</b>
1	Extract and filtrate preparation using different solvents.	
2	Calculation of percent yield in different solvents. Additional exercise: Calibration of weighing balance.	
3	Maceration of stem drugs: <i>Symplocos racemosa</i>	
4	Powder microscopy of flowers: <i>Woodfordia fruticosa</i>	
5	Catalase activity from different food sources using paper disc method.	
6	Preparation of stock solutions.	

7	Preparation of MS medium- MS basal medium and defined medium
8	Seed sterilization and inoculation technique.
9	Callus induction and regeneration
10	Encapsulation of axillary buds
11	Tabulation of research data and generation of graphs
12	Hands on training at industry: <ul style="list-style-type: none"> <li>• Beer-Lambert's law</li> <li>• HPTLC, RPHPTLC, HPLC</li> <li>• Quality evaluation of <i>Saffron</i> using spectrophotometer.</li> </ul>



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## SEMESTER VI

Course Code: RUSBOT 601

Course Title: Plant diversity VII

Academic year 2019 - 20

### Learning Objectives:

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

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

### Detailed Syllabus

RUSBOT 601	Title: Plant diversity VII	Credits – 2.5
UNIT I	Fungi	15 Lectures
	Basidiomycetes: Classification and general characters Life cycle of <i>Agaricus</i> and <i>Puccinia</i>	
	Deuteromycetae: Classification and general characters Life cycle of <i>Fusarium</i>	
	<b>Plant Pathology</b> - Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following. <ul style="list-style-type: none"><li>• Wilt: <i>Fusarium</i></li><li>• Tikka disease of ground nut: <i>Cercospora</i></li><li>• Damping off disease: <i>Pythium</i></li></ul>	
UNIT II	Pteridophyta	15 Lectures

	Calamophyta – Classification, general characters, <i>Calamites</i> ; Life cycle of <i>Pteris</i>	
	Pterophyta – Classification and general characters, Life cycle of <i>Marsilea</i>	
	Types of sori and evolution of sori	
<b>UNIT III</b>	<b>Plant Biotechnology I</b>	<b>15 Lectures</b>
	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).	
<b>UNIT IV</b>	<b>Plant Biotechnology II</b>	<b>15 Lectures</b>
	DNA sequence analysis – Maxam – Gilbert Method and Sanger's method	
	Polymerase chain reaction	
	DNA barcoding: basic features, nuclear genome sequence, chloroplast genome sequence, <i>rbcl</i> gene sequence, <i>matK</i> gene sequence, present status of bar-coding in plants.	
<b>PRACTICALS</b>		
<b>RUSBOTP 601</b>	<b>Plant diversity VII</b>	<b>Credits – 1</b>
1	Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>• <i>Agaricus</i></li> <li>• <i>Puccinia</i></li> <li>• <i>Fusarium</i></li> </ul>	
2	Study of the following fungal diseases: <ul style="list-style-type: none"> <li>• Wilt – <i>Fusarium</i></li> <li>• Tikka disease in Groundnut</li> <li>• Damping off disease</li> </ul>	
3	Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides	

	<ul style="list-style-type: none"> <li>• <i>Pteris</i></li> <li>• <i>Marselia</i></li> <li>• <i>Calamites</i></li> </ul>
4	Growth curve of <i>E.coli</i>
5	Plasmid DNA isolation and separation of DNA using AGE
6	DNA sequencing- Sanger's method (give a sequence and let them show how the autoradigram will be)
7	Identification: Restriction mapping,
8	Southern blotting
9	DNA barcoding of plant material by using suitable data

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

**Learning Objectives: –**

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

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

**Detailed Syllabus**

RUSBOT 602	Title: Plant diversity VII	Credits – 2.5
<b>UNIT I</b>	<b>Paleobotany</b>	<b>15 Lectures</b>
	<i>Lepidodendron</i> –All form genera - root, stem, bark, leaf, male and female fructification	
	<i>Lyginopteris</i> –All form genera - root, stem, leaf, male and female fructification	
	<i>Pentoxylon</i> –All form genera	
	Contribution of Birbal Sahni, Birbal Sahni Institute of Paleobotany, Lucknow	

	<b>Gymnosperms</b> <ul style="list-style-type: none"> <li>• Gnetopsida – Classification</li> <li>• Life cycle of <i>Gnetum</i></li> </ul>	
	Life cycle of <i>Ephedra</i>	
<b>UNIT II</b>	<b>Angiosperms</b>	<b>15 Lectures</b>
	Taxonomic literature - Library, Floras, Monographs, Dictionary, Periodicals, Index and Journals	
	Study of following plant families <ul style="list-style-type: none"> <li>• Combretaceae</li> <li>• Rhamnaceae</li> <li>• Asclepiadaceae</li> <li>• Verbenaceae</li> <li>• Labiatae</li> <li>• Polygonaceae</li> <li>• Orchidaceae</li> </ul>	
	Hutchinson's classification – merits and demerits	
	Major contributions of Takhtajan and Cronquist; Brief reference of Angiosperm Phylogeny Group (APG III) classification	
<b>UNIT III</b>	<b>Embryology</b>	<b>15 Lectures</b>
	<b>Microsporogenesis</b> – Structure of microsporangium, microsporogenesis and development of male gametophyte, Function of tapetum	
	<b>Megasporogenesis</b> – Structure of megasporangium, megasporogenesis and development of female gametophyte	
	Development of monosporic type: <i>Polygonum</i> type	
	Types of ovules	
	Double fertilization and its significance	
	Development of embryo – Dicotyledonous embryo: <i>Capsella</i> type	
<b>UNIT IV</b>	<b>Plant Microtechniques</b>	<b>15 Lectures</b>
	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	
<b>PRACTICALS</b>		
<b>RUSBOTP 602</b>	<b>Plant diversity VIII</b>	<b>Credits – 1</b>
1	Study of the following form genera with the help of permanent slides /Photomicrographs <ul style="list-style-type: none"> <li>• <i>Lepidodendron</i> (All form genera, whichever available)</li> <li>• <i>Lyginopteris</i></li> <li>• <i>Pentoxylon</i></li> </ul>	
2	Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides <ul style="list-style-type: none"> <li>• <i>Gnetum</i></li> <li>• <i>Ephedra</i></li> </ul>	
3	Study of one plant from each of the following Angiosperm families <ul style="list-style-type: none"> <li>• <i>Combretaceae</i></li> <li>• <i>Rhamnaceae</i></li> <li>• <i>Asclepiadaceae</i></li> <li>• <i>Verbenaceae</i></li> <li>• <i>Labiatae</i></li> <li>• <i>Polygonaceae</i></li> <li>• <i>Orchidaceae</i></li> </ul>	
4	Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families	
5	Identify the genus and species with the help of flora	
6	Comparative study of angiosperms and gymnosperms using maceration technique <ul style="list-style-type: none"> <li>• <i>Mangifera indica</i></li> <li>• <i>Saracai ndica</i></li> <li>• <i>Pinus roxburghii</i></li> <li>• <i>Araucaria excelsa</i></li> </ul>	
7	Study of various stages of microsporogenesis, megasporogenesis and embryo development with the help of permanent slides / photomicrographs	
8	<i>In vivo</i> growth of pollen tube in <i>Portulaca</i>	
9	Preparation of stains and fixatives	

**Course Title: Form and function VI**  
**Academic year 2019 - 20**

**Learning Objectives:**

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

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

**Detailed syllabus**

RUSBOT 603	Title: Form and function VI	Credits – 2.5
<b>UNIT I</b>	<b>Physiology</b>	<b>15 Lectures</b>
	<b>Translocation of solutes:</b> Composition of phloem sap, girdling experiment, phloem loading and unloading. Mechanisms of sieve tube translocation.	
	<b>Lipid Metabolism:</b> 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.	
	<b>Bioenergetics:</b> Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.	
	<b>Nitrogen Metabolism</b> 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.	
<b>UNIT II</b>	<b>Genetics</b>	<b>15 Lectures</b>
	<b>Genetic mapping in eukaryotes:</b> discovery of genetic linkage, gene recombination, construction of genetic maps, three point crosses and mapping chromosomes	
	<b>Gene mutations:</b> definition, types of mutations, reverse and spontaneous mutations, causes of mutations, induced mutations, the Ames test, DNA repair mechanism	

	<b>Metabolic disorders</b> – enzymatic and non enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketonuria, albinism, sickle cell anaemia.	
<b>UNIT III</b>	<b>Herbal Cosmetology</b>	<b>15 Lectures</b>
	<b>Role of antioxidants in cosmetology</b> – Antioxidants, their functions, sources, antioxidant enzymes.	
	<b>Current status</b> of Herbal Cosmetic Industry in India, Problems and Future prospects of Herbal Cosmetic Industry in India: Few examples of cosmetic products, modern and ayurvedic.	
	Preparation of modern/ ayurvedic cosmetic formulations and its validation	
	Use of herbs and phytochemicals in cosmetic industry.	
	Collection and processing of herbal material.	
	Good lab practices in cosmetic industry.	
<b>UNIT IV</b>	<b>Post-Harvest Technology</b>	<b>15 Lectures</b>
	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; <ul style="list-style-type: none"> <li>• Drying and dehydration</li> <li>• Low temperature preservation/ freezing</li> <li>• Pickles, fruit chutney and sauces</li> <li>• Jam, jelly, marmalade and preserves</li> <li>• Canning of fruits and vegetables</li> <li>• Unfermented fruit beverages</li> </ul>	
	Novel techniques in food processing and preservation, management of processing	
<b>PRACTICALS</b>		
<b>RUSBOTP 603</b>	<b>Form and function VI</b>	<b>Credits - 1</b>
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 <i>Allium</i>
7	Preparation of a herbal/ Ayurvedic cosmetic formulation and its analysis <ul style="list-style-type: none"> <li>• TLC fingerprinting</li> <li>• Geographical variation using TLC</li> <li>• Powder microscopy</li> </ul>
8	Quantitation of phytochemicals from plant source using TLC/ HPTLC <ul style="list-style-type: none"> <li>• <i>Carissa carandas</i>/ Flax seeds- <math>\beta</math>-sitosterol</li> <li>• <i>Embllica officinalis</i> – Gallic acid</li> </ul>
9	Estimation of ascorbic acid and effect of heat treatment on ascorbic acid content.
10	Preparation of: <ul style="list-style-type: none"> <li>• Squash</li> <li>• Cordial</li> <li>• Nectar</li> <li>• Marmelade</li> </ul>

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

**Learning Objectives:**

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

**Detailed Syllabus**

<b>RUSBOT 604</b>	<b>Title: Current Trends in Plant Sciences IV</b>	<b>Credits – 2.5</b>
<b>UNIT I</b>	<b>Economic Botany</b>	<b>15 Lectures</b>
	<b>Essential Oils:</b> Extraction, perfumes, perfume oils, oil of rose, patchouli, champaca, grass oils: <i>Citronella</i> .	
	<b>Fatty oils :</b> Drying oil (linseed and soybean oil), semidrying oils( sesame oil) and non-drying oils (olive oil and peanut oil),	



	<b>Vegetable Fats:</b> Coconut and Palm oil	
<b>UNIT II</b>	<b>Plant Geography and Forestry</b>	<b>15 Lectures</b>
	Phyto-geographical regions of India.	
	<b>Biodiversity:</b> <ul style="list-style-type: none"> <li>• Definition, diversity of flora found in various forest types of India</li> <li>• Evolution of biodiversity with one example of an evolutionary tree</li> <li>• Levels of biodiversity, Importance and status of biodiversity</li> <li>• Loss of biodiversity</li> <li>• Conservation of biodiversity</li> </ul>	
	<b>Genetic diversity</b> - Molecular characteristics	
	<b>Silviculture</b> and social forestry: types and role.	
<b>UNIT III</b>	<b>Instrumentation</b>	<b>15 Lectures</b>
	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	
<b>UNIT IV</b>	<b>Research Methodology</b>	<b>15 Lectures</b>
	<b>Bibliography</b> <ul style="list-style-type: none"> <li>• Methods of citing references</li> <li>• Style manuals</li> <li>• Arrangement of references</li> </ul>	
	<b>Imaging of Tissue specimens</b> <ul style="list-style-type: none"> <li>• Photomicrography and Ultra-microscopy</li> </ul>	
	<b>Tools for research</b> <ul style="list-style-type: none"> <li>• Application of Scale Bar</li> <li>• Art of field photography</li> <li>• Remote sensing in research</li> </ul>	
<b>PRACTICALS</b>		

RUSBOTP 604	Current Trends in Plant Sciences IV	Credits - 1
	<p><b>PROJECT WORK</b></p> <ul style="list-style-type: none"> <li>• <b>Research methodology will be discussed</b></li> <li>• <b>Well-defined materials and methods, discussion, results and conclusion, bibliography.</b></li> <li>• <b>Presentation based on some advanced technique.</b></li> </ul> <p>Any topic related to the syllabus, such as,</p> <ol style="list-style-type: none"> <li>1. Biodiversity studies in non – vascular cryptogams</li> <li>2. Identification of wood samples using wood anatomy studies</li> <li>3. Ecological anatomy: Epiphytes and Parasites</li> <li>4. Nodal Anatomy: Unilacunar, trilacunar and multilacunar nodes.</li> <li>5. Pharmacognostic evaluation of Indian plants used in herbal industry/ Ayurveda</li> <li>6. Pharmacological evaluation of Indian plants used in herbal industry/ Ayurveda</li> <li>7. Evaluation of genuine and spurious drugs used in herbal industry/ Ayurveda</li> <li>8. Estimation of macro and micro nutrients in plants</li> <li>9. Essential oil extraction using Clevenger (Citronella Oil/ Patchouli etc)</li> <li>10. Water potability analysis</li> </ol>	

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## MODALITY OF ASSESSMENT

### Theory Examination Pattern:

#### E) Internal Assessment - 40%: 40 marks.

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

#### F) External examination - 60 %

#### Semester End Theory Assessment - 60 marks

- v. Duration - These examinations shall be of **2 hours** duration.
- vi. Paper Pattern:
  - 5. 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.
  - 6. All questions shall be compulsory with internal choice within the questions.

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

### Practical Examination Pattern:

#### (A)Internal Examination:

Heading	Practical
Journal	05
Practical/ Field Report/ Presentation	15
<b>Total</b>	<b>20</b>

**(B) External (Semester end practical examination):**

Particulars	Practical
Laboratory work and/or <i>Viva voce</i>	30
<b>Total</b>	<b>30</b>

**PRACTICAL BOOK/JOURNAL**

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

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

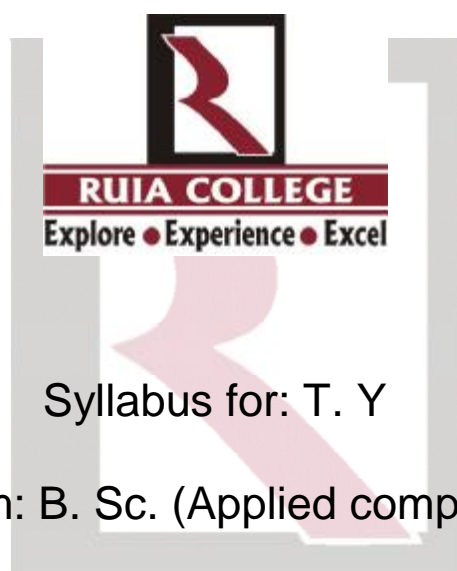
**Overall Examination and Marks Distribution Pattern**

**Semester- V and VI**

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

Resolution No.: AC/II(18-19).2.RUS4

**S.P. Mandali's**  
**RAMNARAIN RUIA AUTONOMOUS COLLEGE**



Syllabus for: T. Y

Program: B. Sc. (Applied component)

Course Code: Horticulture and gardening  
(RUSACHOR)

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



## SEMESTER V

Course Code	UNIT	TITLE	Credits	L / Week
RUSACHOR501	Horticulture and Gardening -I		2	4
	I	Introduction to horticulture	2	1
	II	Propagation practices		1
	III	Manures, fertilizers and diseases		1
	IV	Garden operations for horticulture		1
RUSACHORP 501	Practicals based on all courses in theory		2	4

## SEMESTER VI

Course Code	UNIT	TITLE	Credits	L / Week
RUSACHOR 601	Horticulture and Gardening - II		2	4
	I	Landscape gardening	2	1
	II	Horticulture produce		1
	III	Commercial production		1
	IV	Post-harvest technology & entrepreneurship in horticulture		1
RUSACHORP 601	Practicals based on all the courses in theory		2	4

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**Course Code: RUSACHOR 501**  
**Course Title: Horticulture and Gardening – I**  
**Academic year 2019 - 20**

**Learning objectives:**

- Horticulture and gardening as an applied component is to nurture the interest and awareness about the various techniques in horticulture (propagation practices, use of various fertilizers and manures, gardening operations)
- The basic and fundamental aspects of horticulture.
- General foundation for further studies and practice in horticulture or its allied fields.

**Learning Outcomes:** Upon successful completion of this course, students will acquire basic knowledge about the fundamental aspects of horticulture. The students in turn will find it easier to undergo other horticultural courses. They will be able to propagate plants by various methods they learnt and will be able to perform different garden operations, organic farming, knowledge about the selection and use of various fertilizers and manures.

**Detailed syllabus**

RUSACHOR 501	Title: Horticulture and Gardening – I	Credits – 2
<b>UNIT I</b>	<b>Introduction To Horticulture</b>	<b>15 Lectures</b>
	Definition, importance and objectives of Horticulture, branches of Horticulture, Pomology, Olericulture, Landscape Gardening, Nurseries and development	
	Allied branches – Apiculture – Bee box, honey bee life cycle and role of apiculture in pollination, Sericulture – Silkworm life cycle, different types with host plant, Social Forestry, Exhibition: aims and objectives.	
	Important Horticulture Research Institutes and Government Schemes for strategy plantations <ul style="list-style-type: none"> <li>• Konkan Krishi Vidyapeeth – Dapoli</li> <li>• National Research Centre for grapes – Nashik.</li> <li>• Regional Fruit Research centre – Pune</li> <li>• National Institute of post harvest technology – Talegaon</li> <li>• Central Potato Tuber Research Institute ( CPTRI) – Shimla</li> </ul>	
	Role of Horticulture in rural economy and employment generation	
	Horticulture Consultancy	
	Urban Horticulture and Ecotourism	
<b>UNIT II</b>	<b>Propagation Practices</b>	<b>15 Lectures</b>
	<b>By Seeds:</b> Advantages and disadvantages, method of seed propagation, production of seeds, handling, collection and storage Sowing, transplanting of seedlings and hardening, seed treatment to control diseases, seedling diseases and their control.	
	<b>By specialized Vegetative structures:</b> Bulbs, tubers, corms, rhizomes, root stock, runners, offsets and suckers.	
	<b>Artificial methods of plant propagation</b> <ul style="list-style-type: none"> <li>• Cutting– Root cutting, stem cuttings, and leaf cuttings. Use of PGR's for rooting.</li> <li>• Layering – Definition, Types: Simple, compound, (Serpentine) Tip, Trench, Mound, Air Layering.</li> <li>• Grafting-Definition, advantages and disadvantages. Types: Splice, whip/ tongue, side, veneer, cleft, bark, epicotyls, approach, repair</li> </ul>	

	<p>grafting – Enarching, bridge and bracing.</p> <ul style="list-style-type: none"> <li>• Budding – Definition advantages and disadvantages. Types: T-budding, shield, patch, ring budding.</li> <li>• Developing new varieties: Technique of emasculation and bagging, role of polyploidy in the production of seedless varieties in plants.</li> </ul>	
	Application of Tissue Culture in relation to Horticulture.	
<b>UNIT III</b>	<b>Manures, Fertilizers And Diseases</b>	<b>15 Lectures</b>
	<b>Manures:</b> Definition, importance, important manures FYM(compost), oil cakes, green manure, organic manures and vermicompost.	
	<b>Fertilizers:</b> Definition, Types – Straight, Compound and mixed. Nitrogenous (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> , Urea, Ca(NO <sub>3</sub> ) <sub>2</sub> , NH <sub>4</sub> Cl, Phosphatic (Superphosphate, Bone meal), Potassic (Muriate of potash, K <sub>2</sub> SO <sub>4</sub>	
	<b>Biofertilizers:</b> Bacteria, Cyanobacteria, Mycorrhiza, Sea weeds.	
	<b>Horticultural plant diseases</b> and their control.	
	Fungal diseases- Rust, Smut, Powdery mildew.	
	Bacterial – Citrus canker, Bacterial wilt.	
	Viral – TMV, Leaf curl.	
	Pests – common pests on horticultural crops – Aphids, mealy bugs, beetle, stem borer, caterpillars, and rats.	
	Friends of farmers: Earthworm, snakes and predaceous fungi.	
	Scouting for insect and pests.	
<b>UNIT IV</b>	<b>Garden Operations For Horticulture</b>	<b>15 Lectures</b>
	Selection of site, Preparation of soils for garden	
	Mulching, top- dressing, blanching	
	Sowing, transplanting, tree transplanting,	
	Irrigation - Overhead, Surface, Underground	
	Weeding and pruning- Principles, Objectives and general technique.	
	Water management and conservation through horticulture, Dry land Horticulture.	
	<b>Organic Farming:</b> Definition, Scope, Indian scenario, Future scope.	
<b>PRACTICALS</b>		
<b>RUSACHORP 501</b>	<b>Horticulture and Gardening – I</b>	<b>Credits - 2</b>
1	Garden implements and their uses.	
2	Different types of pots & Potting medium , Potting and repotting	
3	Propagation practices by seed, Vegetative propagation, cutting, layering, budding,grafting .	
4	Identification of : Fertilizers – Identification by physical and chemical methods –Urea , Ammonium sulphate , Potassium sulphate, super phosphate . Manures – Identification of plants as green manure – <i>Gliricidia</i> , <i>Crotolaria</i> , <i>Leucaena</i> Biofertilizers – Identification (material as slides) VAM, <i>Nostoc</i> , <i>Rhizobium</i> .	
5	Soil pH, Use of soil testing Kit for organic testing Electrical conductivity, pH of water.	
6	Diseases and pests Fungal – Powdery mildew ,Rust ,Wilt, Blight, Smut, Bacterial – Canker ,Wilt Viral – Leaf curl ,yellow vein Mosaic Insects – Sucking, Biting, Chewing, Borers &Ants, Scouting for insect and pests Non Insects pests- Nematodes, Rodents.	
7	Preparation of natural insecticides – Neemarka, Dashparniarka, Seetaphal powder, Tobacco extracts. Biopesticides: <i>Beauveria/ Verticillium/ Trichoderma</i>	
8	Liquid fertilizers (Assignments)	

9	Project – Each student should individually <b>initiate</b> a project related to any topic from the syllabus.
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## SEMESTER VI

**Course Code: RUSACHOR 601**  
**Course Title: Horticulture and Gardening – II**  
**Academic year 2019 - 20**

### Learning objectives:

- Basic principles of landscape design.
- The importance of environmental conditions to landscape plant selection and placement.
- Alternative farming technology, vertical gardening, post-harvest techniques

**Learning Outcomes:** Upon successful completion of this course, students will be able to: Suggest plants suitable for various locations in a garden, Discuss growth and development patterns for fruit and vegetable species, Explain production conditions and practices for fruit, vegetable crops and soilless cultivation and compare the various cultural systems, Develop management plans for soil fertility, irrigation, and pest control in fruit and vegetable production. Discuss and evaluate horticulture as a business.

### Detailed Syllabus

RUSACHOR 601	Title: Horticulture and Gardening – II	Credits – 2
<b>UNIT I</b>	<b>Landscape gardening</b>	<b>15 Lectures</b>
	Principles of landscaping and types of garden: Formal and Informal.	
	Indoor plants and indoor gardens- Terrarium/ Bottle garden, Dish garden.	
	Vertical garden.	
	Important garden features- Paths and Avenues, Hedges and Edges, Lawn, Flowerbeds, Arches and Pergolas, Fencing, Water bodies, Rock garden & Plants suitable for different locations and climates.	
	Lawn- Purpose of preparation of lawn, Method of preparation of lawn, management of lawn and lawn plants.	
	Soil manipulation for plantation of desirable varieties.	
	Mughal, Buddhist, Botanical garden, Theme park Important Gardens of India - Shalimar (Shrinagar), Vrindavan (Mysore), Veer Jijamata Udyan (Mumbai), Sanjay Gandhi National Park	
<b>UNIT II</b>	<b>Horticultural Produce</b>	<b>15 Lectures</b>
	<b>High –tech Horticultural production-</b> Green house technology- Meaning, types, layout and construction, irrigation systems. Care and attention. Hardening of plants. Space gardens.	
	Hydroponics: Types and techniques	
	Importance of Horticulture in food and nutritional security	
	<b>Floriculture</b> – Scope and importance, soil and climatic requirement and cultivation practices and Economics of green house production of Gerbera, Carnation, Roses, Orchids. Propagation techniques, packaging and marketing, enhancing and delaying period of bloom by special methods. Floral decoration, Florist shop management.	
	<b>Types and roles of pollinators</b>	
<b>UNIT III</b>	<b>Commercial production</b>	<b>15 Lectures</b>

	<p><b>Commercial production of the following</b> – in relation to propagation, post plantation care, harvesting, post harvest management &amp; varieties.</p> <ul style="list-style-type: none"> <li>• Rhizomes- Ginger</li> <li>• Vegetables- Spinach</li> <li>• Fruits- Mango, Grapes &amp; Coconut- products like coco peat/ Coir etc.</li> <li>• Spices/condiments- <i>Cinnamomum zeylanicum</i></li> <li>• Medicinal plants- <i>Moringa pterigosperma</i>, <i>Stevia rebaurdina</i> (Madura)</li> <li>• Aromatic plant- <i>Vetiveria zizanooides</i>, Patchouli</li> </ul>	
<b>UNIT IV</b>	<b>Post-Harvest Technology &amp; Entrepreneurship In Horticulture</b>	<b>15 Lectures</b>
	Maturity- Factors responsible for maturity & ripening methods used for delaying ripening.	
	Harvest- Time of harvest, harvesting and handling of harvested products	
	Storage of fresh produce- Types of storage of fruits & vegetables	
	Fruit & vegetables preservation technology.	
	Marketing- grading, packing and transportation. Ways of increasing the market value and shelf life of horticultural produce.	
	Horticultural business, management and Entrepreneurship development	
	Horticulture as a business: definition and nature, organization, planning and operation of Horticulture farm business	
<b>PRACTICALS</b>		
<b>RUSACHORP 601</b>	<b>Horticulture and Gardening – II</b>	<b>Credits - 2</b>
1	Preparation of garden layout	
2	List of plants suitable for garden locations- 2-3 plants for each location .	
3	<p>Identification of important horticultural plants</p> <ol style="list-style-type: none"> <li>1. Herbs – foliage any 2 and flowering any 2</li> <li>2. Shrubs – foliage any 2 flowering any 2</li> <li>3. Trees – foliage any 2 and flowering any 2</li> <li>4. Climbers – any 2</li> <li>5. Lianas – any 2</li> <li>6. Epiphytes – any 2</li> <li>7. Creepers –any 2</li> <li>8. Trailers – any 2</li> <li>9. Aquatic plants – any 3 ( preferably various habitat)</li> <li>10. Succulents – any 2</li> <li>11. Weeds –any 10</li> </ol>	
4	Method of preparing Bonsai, Bottle Garden/Terrarium, Hanging Baskets, Dish Garden	
5	Flower arrangements –Indian (Gajara , veni, garland , bouquet - Baskets , hand ,torch type , table floral arrangement/ Floating rangoli/Biorangoli), Japanese and western type, dry flower arrangement	
6	Preparation of Jams, Jellies, Squashes/ Syrups, Pickle, sauces	
7	Varieties of banana/ watermelon/ brinjal/ grapes/chilli	
8	Drying of vegetables and fruits Gavar/chickoo/carrot/ beetroot/spinach/ lemon grass/ wheat grass/ginger	
9	Blanching of different plant foods.	
10	Fruit and vegetable carving, Bio-jewelry (Demonstrations)	
11	Green house plants- Information regarding to soil, temperature, irrigation, fertilizer requirements and propagation methods for <i>Anthurium</i> , <i>Gerbera</i> , Orchids, Carnation, Roses, Capsicum, Tomato, Strawberry	
12	<b>Project – Each student should individually present a project related to Horticulture .It should be duly certified presented at practical examination. Project presentation at college level compulsory.</b>	

**Visits** : To Garden /Parks / Nurseries/ Exhibition / Horticulture industries / Research Station and record of visits should be duly certified and presented at practical examination.

**Journal:** Students will not be allowed for practical examination without their journal duly certified.

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## MODALITY OF ASSESSMENT

### Theory Examination Pattern:

#### **G) Internal Assessment - 40%: 40 marks.**

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

#### **H) External examination - 60 %**

##### **Semester End Theory Assessment - 60 marks**

- vii. Duration - These examinations shall be of **2 hours** duration.
- viii. Paper Pattern:
7. 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.
  8. All questions shall be compulsory with internal choice within the questions.

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

### **Practical Examination Pattern:**

#### **(A) Internal Examination:**

Heading	Practical
Journal	05
Practical/ Field Report/ Presentation	35
<b>Total</b>	<b>40</b>

#### **(B) External (Semester end practical examination):**

Particulars	Practical



Laboratory work and/or <i>Viva voce</i>	60
<b>Total</b>	<b>60</b>



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## PRACTICAL BOOK/JOURNAL

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

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

### Overall Examination and Marks Distribution Pattern

Semester- V and VI						
Course	501/601		502/602		Total per Course	Grand Total
	Internal	External	Internal	External		
Theory	40	60	40	60	100	200
Practicals	40	60	40	60	100	200

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