



Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

(Autonomous College)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for the T.Y.B.Sc.

Program: B.Sc. BOTANY

Program Code: RJSUBOT

(CBCS 2020-2021)

T.Y.B.Sc Botany Syllabus Semester V & VI**DISTRIBUTION OF TOPICS AND CREDITS****T.Y.B.Sc. BOTANY SEMESTER V**

Course	Nomenclature	Credits	Topics
RJSUBOT501	Plant Diversity III	2.5	1. Microbiology 2. Algae 3. Fungi 4. Plant Pathology
RJSUBOT502	Plant Diversity IV	2.5	5. Palaeobotany 6. Angiosperms I 7. Anatomy I 8. Palynology
RJSUBOT503	Form and Function III	2.5	9. Cytology and Molecular Biology. 10. Physiology 11. Environmental Botany 12. Plant Tissue Culture
RJSUBOT504	Current Trends in Plant Sciences II	2.5	13. Ethnobotany and Mushroom Industry 14. Biotechnology I 15. Instrumentation 16. Pharmacognosy and Medicinal botany
RJSUBOTP501, RJSUBOTP502, RJSUBOTP503 &RJSUBOTP504	Practical I, II, III & IV	06	

T.Y.B.Sc. BOTANY SEMESTER VI

Course	Nomenclature	Credits	Topics
RJSUBOT601	Plant Diversity III	2.5	1. Bryophyta 2. Pteridophyta 3. Bryophytes and Pteridophytes: Applied Aspects. 4. Gymnosperms
RJSUBOT602	Plant Diversity IV	2.5	5. Angiosperms II 6. Anatomy II 7. Embryology 8. Biostatistics
RJSUBOT603	Form and Function III	2.5	9. Plant Biochemistry 10. Plant Physiology II 11. Genetics 12. Bioinformatics
RJSUBOT604	Current Trends in Plant Sciences II	2.5	13. Plant Biotechnology II 14. Plant Geography 15. Economic Botany 16. Post-Harvest Technology
RJSUBOTP601, RJSUBOTP602, RJSUBOTP603 &RJSUBOTP604	Practical I, II, III & IV	06	

T.Y.B.Sc Botany Syllabus Semester V & VI

SEMESTER V (THEORY)		L	Cr
Paper-I: PLANT DIVERSITY- III	Paper Code: RJSUBOT501	60	2.5
UNIT I		15	
Microbiology			
1	Types of Microbes.		
2	Culturing: Sterilization, media- types and composition, staining, colony characters.		
3	Pure cultures.		
4	Role of microbes in fermentation: Alcohol and Antibiotics- Penicillin		
UNIT II		15	
ALGAE			
1	Division Rhodophyta: Outline Classification upto order as per G. M. Smith. General Characters based on: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual. Economic Importance of Rhodophytes.		
2	<i>Polysiphonia</i> – Systematic position, Life cycle and Alternation of generations.		
3	Division Chrysophyta: Outline Classification upto class as per G. M. Smith. General Characters of Xanthophyceae based on: Distribution, Cell structure, pigments, reserve food, range of thallus, reproduction: asexual and sexual. Economic Importance of Chrysophyta.		
4	<i>Vaucheria</i> : Systematic position, Life cycle and Alternation of generations.		
UNIT III		15	
FUNGI			
1	Basidiomycetes: Outline Classification upto order as per G. M. Smith. General Characters based on: Thallus, Reproduction.		
2	<i>Agaricus</i> - Systematic position, Life cycle and Alternation of generations.		
3	<i>Puccinia</i> - Systematic position, Life cycle and Alternation of generations.		
4	Deuteromycetes: Outline Classification upto order as per G. M. Smith. General Characters.		
5	Life cycle of <i>Alternaria</i> .		

T.Y.B.Sc Botany Syllabus Semester V & VI

UNIT IV		15	
PLANT PATHOLOGY			
1	Study of plant diseases: Causative organism, symptoms, predisposing factors, disease cycle and control measures of the following: a) White Rust – <i>Albugo</i> sp. b) Tikka disease of ground nut: <i>Cercospora</i> sp. c) Citrus canker – <i>Xanthomonas</i> sp. d) Leaf curl – leaf curl virus. e) Plant disease caused by insect pest- Aphids		
2	Study of Physical, chemical and biological control methods of plant diseases.		
SEMESTER V (THEORY)		L	Cr
Paper-II: PLANT DIVERSITY- IV		Paper Code: RJSUBOT502	
		60	2.5
UNIT I		15	
PALAEOBOTANY			
1	<i>Calamites</i> – All form genera Stem, leaf, male and female frutification.		
2	<i>Lepidodendron</i> – All form genera root, stem, bark, leaf, male and female frutification.		
3	<i>Lyginopteris</i> – All form genera root, stem, and leaf, male and female frutification.		
4	<i>Pentoxylon</i> – All form genera.		
5	Contributions of Birbal Sahni, (Birbal Sahni Institute of Palaeobotany, Lucknow).		
UNIT II		15	
ANGIOSPERMS- I			
1	Morphology of fruits- Simple, Aggregate and Composite.		
2	Complete classification of Bentham and Hooker (only for prescribed families), Merits and demerits.		
3	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: a) Capparidaceae b) Umbelliferae c) Cucurbitaceae d) Rubiaceae e) Solanaceae f) Commelinaceae g) Graminae		

T.Y.B.Sc Botany Syllabus Semester V & VI

UNIT III		15	
ANATOMY – I			
1	Anomalous secondary growth in the Stems of <i>Bignonia</i> , <i>Salvadora</i> , <i>Achyranthes</i> , <i>Aristolochia</i> , <i>Dracaena</i> . Storage roots of Beet, Radish.		
2	Root- stems transition.		
3	Types of Stomata – Anomocytic, Anisocytic, Diacytic, Paracytic, and Gramineaceous.		
UNIT IV		15	
PALYNOLOGY			
1	Pollen Morphology.		
2	Pollen viability – storage.		
3	Germination and growth of pollen.		
4	Application of Palynology in honey industry, coal and oil exploration, Aerobiology and pollen allergies, forensic science.		
		L	Cr
Paper-III: FORMS AND FUNCTIONS – III		Paper Code: RJSUBOT503	
		60	2.5
UNIT I		15	
CYTOLOGY AND MOLECULAR BIOLOGY			
1	Structure and functions of nucleus.		
2	Structure and functions of vacuole.		
3	Structure and functions of giant chromosomes.		
4	The genetic code: Characteristics of the genetic code.		
5	Transcription and Translation in Prokaryotes and Eukaryotes.		
UNIT II		15	
PHYSIOLOGY			
1	Mineral Nutrition in plants		
2	Transpiration and stomatal movement		
3	Solute transport: Transport of ions across cell membranes, active and passive transport, carriers, channels and pumps.		
4	Translocation of solutes: Composition of phloem sap, girdling experiment, pressure flow model, phloem loading and unloading, anatomy of sieve tube elements, mechanisms of sieve tube translocation, Munch's hypothesis.		

T.Y.B.Sc Botany Syllabus Semester V & VI

UNIT III		15	
ENVIRONMENTAL BOTANY			
1	Bioremediation: Principles, factors responsible and microbial population in bioremediation.		
2	Phytoremediation: Metals, Organic pollutants.		
3	Plant succession: Hydrosere and Xerosere –Succession on water and barren land respectively citing different seres leading upto the climax vegetation, mono- and poly- climax theories.		
UNIT IV		15	
PLANT TISSUE CULTURE			
1	Aspects of micropropagation with reference to Floriculture: Detailed study of Orchid cultivation.		
2	Plant cell suspension cultures for the production of secondary metabolites, with special reference to Shikonin production.		
3	Somatic embryogenesis and artificial seeds: General account based on- a) Types and Technique. b) Advantages/Importance.		
4	Protoplast fusion and Somatic hybridization: a) Concept, definition, and various methods of protoplast fusion b) Applications of somatic hybridization in agriculture.		
		L	Cr
Paper-IV: CURRENT TRENDS IN PLANT SCIENCES- II		Paper Code: RJSUBOT504	
		60	2.5
UNIT I		15	
ETHNOBOTANY AND MUSHROOM INDUSTRY			
1	Ethnobotany - Definition, history, sources of data and methods of study.		
2	Traditional medicines as used by tribal in Maharashtra towards: a) Skin ailments: <i>Rubia cordifolia</i> , <i>Santalum album</i> . b) Liver ailments: <i>Phyllanthus</i> , <i>Andrographis</i> . c) Wound healing and ageing: <i>Centella</i> , <i>Typha</i> , <i>Terminalia</i> , <i>Tridax</i> . d) Fever: <i>Vitex negundo</i> , <i>Tinospora cordifolia</i> leaves e) Diabetes: <i>Momordica charantia</i> , <i>Syzygium cumini</i> .		
3	Mushroom industry: i) General account of production of mushrooms with respect to methods of Composting, spawning, casing, harvesting of mushroom. Cultivation of <i>Pleurotus</i> , <i>Agaricus</i> mushroom to be studied in detail. ii) General account of mushrooms: Nutritional value, picking and packaging, economic importance. iii) Entrepreneurship in Mushroom Industry		

UNIT II		15	
BIOTECHNOLOGY - I			
1	Construction of genomic DNA libraries, Chromosome libraries and c- DNA libraries.		
2	Identification of specific cloned sequences in c-DNA libraries and Genomic libraries.		
3	Analysis of genes and gene transcripts – Restriction enzyme, analysis of cloned DNA sequences.		
4	Southern Hybridization.		
UNIT III		15	
INSTRUMENTATION			
1	Microscopy II- Instrumentation, working, principle and applications of SEM and TEM.		
2	Chromatography II: General account of Column chromatography. Principle and bedding material involved in adsorption and partition chromatography, Ion exchange chromatography, molecular sieve chromatography.		
UNIT IV		15	
PHARMACOGNOSY AND MEDICINAL BOTANY			
1	Monographs of drugs with reference to biological sources, geographical distribution, common varieties, macro and microscopic characters, chemical constituents, therapeutic uses, adulterants- <i>Strychnos</i> seeds, Clove buds, <i>Allium sativum</i> , <i>Acorus calamus</i> and <i>Curcuma longa</i> .		
SEMESTER VI		L	Cr
Paper I: PLANT DIVERSITY- III		Paper Code: RJSUBOT601	
		60	2.5
UNIT I		15	
BRYOPHYTA			
1	<i>Marchantia</i> - Systematic position, life cycle and Alternation of generations as per G. M. Smith.		
2	<i>Pellia</i> - Systematic position, life cycle and Alternation of generations as per G. M. Smith.		
UNIT II		15	
PTERIDOPHYTA			
1	Lepidophyta – Outline Classification upto orders as per G. M. Smith.		
2	General characters of Lepidophyta.		
3	<i>Lycopodium</i> - Systematic position, Life cycle, Alternation of generations.		

T.Y.B.Sc Botany Syllabus Semester V & VI

4	Calamophyta – Outline Classification upto orders as per G. M. Smith.		
5	General characters of Calamophyta		
6	<i>Equisetum</i> : Systematic position, Life cycle, Alternation of generations.		
UNIT III		15	
BRYOPHYTES AND PTERIDOPHYTES: APPLIED ASPECTS			
1	Ecology of Bryophytes.		
2	Economic importance of Bryophytes.		
3	Bryophytes as ecological indicators. Evolution of Sporophyte and Gametophyte in Bryophytes.		
4	Economic importance of Pteridophytes.		
5	Diversity and distribution of Indian Pteridophytes.		
6	Types of sori and evolution of sori.		
UNIT IV		15	
GYMNOSPERMS			
1	<i>Biota (Thuja)</i> - Systematic position as per Coulter and Chamberlain, Life cycle, Alternation of generations.		
2	<i>Gnetum</i> -Systematic position as per Coulter and Chamberlain, Life cycle, Alternation of generations.		
3	<i>Ephedra</i> -Systematic position as per Coulter and Chamberlain, Life cycle, Alternation of generations.		
		L	Cr
Paper II: PLANT DIVERSITY - IV		Paper Code: RJSUBOT602	
		60	2.5
UNIT I		15	
ANGIOSPERMS- II			
1	Major Botanical gardens of India – Indian Botanical Garden, Howrah; National Botanical Research Institute's Garden (NBRI), Lucknow; Lloyd Botanical Garden, Darjeeling; Lalbaugh or Mysore State Botanical Garden, Bangalore.		
2	Botanical survey of India and regional plants of India.		
3	Study of following plant families: a) Rhamnaceae b) Combretaceae c) Asclepiadaceae d) Labiatae e) Euphorbiaceae		

T.Y.B.Sc Botany Syllabus Semester V & VI

	f) Cannaceae		
4	Hutchinson's classification – merits and demerits.		
UNIT II		15	
ANATOMY – II			
1	Ecological anatomy: a) Hydrophytes – submerged, floating rooted. b) Hygrophytes - <i>Typha</i> c) Mesophytes. d) Sciophytes. e) Halophytes. f) Epiphytes. g) Xerophytes.		
UNIT III		15	
EMBRYOLOGY			
1	Microsporogenesis		
2	Megasporogenesis - Development of monosporic type, examples of all embryo sacs.		
3	Types of ovules.		
4	Double fertilization.		
5	Development of embryo – <i>Capsella</i> .		
UNIT IV		15	
BIOSTATISTICS II			
1	Testing of hypothesis- student's <i>t</i> -test (paired and unpaired). Theory and Problems based on these.		
2	Regression- Theory and Graphical method only.		
3	ANOVA (one way).		

T.Y.B.Sc Botany Syllabus Semester V & VI

		L	Cr
PAPER III: FORM AND FUNCTION - III		Paper Code: RJSUBOT603	
		60	2.5
UNIT I		15	
PLANT BIOCHEMISTRY			
1	Structure of biomolecules: Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids).		
2	Enzymes: Nomenclature, classification, mode of action, Enzyme kinetics, Michaelis - Menten equation, competitive non-competitive and uncompetitive inhibitors.		
UNIT II		15	
PLANT PHYSIOLOGY- II			
1	Nitrogen metabolism: Nitrogen cycle, root nodule formation, and leg haemoglobin, nitrogenase activity, assimilation of nitrates, (NR, NiR activity), assimilation of ammonia, (amination and transamination reactions), nitrogen assimilation and carbohydrate utilisation.		
2	Vegetative growth- Phases of growth, Factors affecting growth, Physiological effects and commercial applications of Auxins, Gibberellins, Cytokinins and Absciscic acid.		
UNIT III		15	
GENETICS			
1	Genetic mapping in eukaryotes: discovery of genetic linkage, gene recombination, construction of genetic maps, three-point crosses and mapping chromosomes, problems based on the same.		
2	Gene mutations: definition, types of mutations, causes of mutations, Spontaneous and Induced mutations and The Ames test.		
3	Metabolic disorders – enzymatic and non-enzymatic: Gene control of enzyme structure Garrod's hypothesis of inborn errors of metabolism, Phenylketonuria, albinism, sickle cell anaemia.		
UNIT IV		15	
BIOINFORMATICS			
1	Protein structure analysis and application.		
2	Multiple sequence analysis and phylogenetic analysis.		

T.Y.B.Sc Botany Syllabus Semester V & VI

		L	Cr
Paper IV: Current Trends in Plant Sciences II		Paper Code: RJSUBOT604	
		60	2.5
UNIT I		15	
PLANT BIOTECHNOLOGY - II			
1	DNA sequence analysis – Maxam – Gilbert Method and Sanger's method		
2	Polymerase Chain reaction (PCR) - Technique, Applications, DNA typing.		
3	DNA barcoding: Basic features, nuclear genome sequence, chloroplast genome sequence, <i>rbcL</i> gene sequence, <i>matK</i> gene sequence, present status of barcoding in plants.		
UNIT II		15	
PLANT GEOGRAPHY			
1	Phytogeographical regions of India.		
2	BIODIVERSITY : Definition, diversity of flora found in various forest types of India, Levels of biodiversity, Importance and status of biodiversity, Loss of biodiversity, Conservation of biodiversity, Genetic diversity- Molecular characteristics.		
UNIT III		15	
ECONOMIC BOTANY			
1	Essential Oils: Extraction, perfumes, perfume oils, oil of Rose, Patchouli, Champaca, grass oils: <i>Citronella</i> , Vetiver.		
2	Fatty oils: Drying oil (linseed and Soyabean oil), semidrying oils (Cotton seed, Sesame oil) and non-drying oils (Olive oil and Peanut oil).		
3	Vegetable Fats: Coconut and Palm oil.		
UNIT IV		15	
POST HARVEST TECHNOLOGY			
1	Storage of Plant Produce- Preservation of Fruits and Vegetables.		
2	Drying (Dehydration)- (Natural conditions – Sun drying; Artificial drying- hot air drying, Vacuum drying, Osmotically dried fruits, Crystallized or Candied fruits, Fruit Leather, Freeze Drying).		
3	Freezing (Cold air blast system, Liquid immersion method, Plate freezers, Cryogenic Freezing, Freeze drying).		
4	Canning. Pickling (in brine, in vinegar, Indian pickles). Sugar Concentrates (Jams, Jellies), Fruit juices.		
5	Food preservatives, Use of antioxidants in preservation		

T.Y.B.Sc Botany Syllabus Semester V & VI

Semester V (PRACTICALS)		L	Cr
Practical I PLANT DIVERSITY- III		Paper Code: RJSUBOTP501	2.5
	Microbiology		
1	Study of aeromicrobiota by petri plate exposed method Fungal culture; Bacterial culture.		
2	Determination of Minimum Inhibitory Concentration (MIC) of sucrose against selected microorganism.		
3	Study of antimicrobial activity by the disc diffusion method		
	Algae		
1	Study of stages in the life cycle of the following Algae from fresh / preserved material and permanent slides: a) <i>Polysiphonia</i> b) <i>Vaucheria</i>		
	Fungi		
1	Study of stages in the life cycle of the following Fungi from fresh / preserved material and permanent slides: a) <i>Agaricus</i> b) <i>Puccinia</i> c) <i>Alternaria</i>		
	Plant Pathology		
	Study of the following fungal diseases: a) White rust b) Tikka disease in Groundnut c) Citrus canker d) Insect Pest disease- Aphids		
Practical II : PLANT DIVERSITY- IV		Paper Code: RJSUBOTP502	2.5
	Paleobotany		
	Study of the following form genera with the help of permanent slides/ photomicrographs: a) <i>Calamites</i> b) <i>Lepidodendron</i> c) <i>Lyginopteris</i> d) <i>Pentoxylon</i>		
	Angiosperms		
1	Morphology of Fruits- Simple, Aggregate and Composite.		
2	Study of one plant from each of the following Angiosperm families: a) Capparidaceae b) Umbelliferae c) Cucurbitaceae d) Rubiaceae e) Solanaceae f) Commelinaceae		

T.Y.B.Sc Botany Syllabus Semester V & VI

	g) Graminae		
3	Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families.		
4	Identifying the genus and species of a plant with the help of Flora.		
	Anatomy I		
1	Study of anomalous secondary growth in the stems of the following plants using double staining technique: a) <i>Bignonia</i> b) <i>Salvadora</i> c) <i>Achyranthes</i> d) <i>Aristolochia</i> e) <i>Dracaena</i>		
2	Study of anomalous secondary growth in the roots of- a) Beet b) Radish		
3	Types of Stomata - a) Anomocytic b) Anisocytic c) Diacytic d) Paracytic e) Graminaceous		
	Palynology		
1	Study of pollen morphology (NPC Analysis) of the following by Chitale's Method: a) <i>Hibiscus</i> b) <i>Datura</i> c) <i>Ocimum</i> d) <i>Crinum</i> e) <i>Pancratium</i> f) <i>Canna</i>		
2	Determination of pollen viability.		
3	Pollen analysis from honey sample – unifloral and multifloral honey.		
4	Effect of varying concentration of sucrose on <i>In vitro</i> Pollen germination.		
Practical III - Form and Function - II		Paper Code: RJSUBOTP503	2.5
	CYTOLOGY AND MOLECULAR BIOLOGY		
1	Smear preparation from <i>Tradescantia</i> buds.		
2	Sequence Analysis- Maxam-Gilbert Method		

T.Y.B.Sc Botany Syllabus Semester V & VI

	<u>PHYSIOLOGY</u>		
1	Estimation of Phosphate phosphorus (Plant acid extract).		
2	Estimation of Iron (Plant acid extract).		
	<u>ENVIRONMENTAL BOTANY</u>		
1	Estimation of the following in given water sample: a) Dissolved oxygen demand b) Biological oxygen demand c) Total Hardness d) Salinity and Chlorinity		
2	Plant Tissue culture II:		
	1. Preparation of stock solutions for preparation of MS medium.		
	2. Identification – Multiple shoot culture, hairy root culture, somatic embryogenesis.		
Practical IV-<u>CURRENT TRENDS IN PLANT SCIENCES - II</u>		Paper Code: RJSUBOTP504	2.5
	<u>ETHNOBOTANY AND MUSHROOM CULTIVATION</u>		
1	Study of plants mentioned in theory for Ethnobotany.		
2	Mushroom cultivation		
3	Identification of various stages involved in mushroom cultivation – spawn, pin head stage, mature/ harvest stage of <i>Agaricus</i> , <i>Pleurotus</i> .		
	<u>BIOTECHNOLOGY- I</u>		
1	Growth curve of <i>E. coli</i> .		
2	Plasmid DNA isolation and Separation of DNA using AGE.		
3	Restriction mapping (problems), Southern blotting.		
	<u>INSTRUMENTATION</u>		
1	Experiment based on ion exchange chromatography for demonstration.		
2	Experiment based on separation of dyes/ plant pigments using silica gel column.		
	<u>PHARMACOGNOSY</u>		
1	Macroscopic/ Microscopic characters and Chemical tests for active constituents of the following plants: a) <i>Allium sativum</i> b) <i>Acorus calamus</i> c) <i>Curcuma longa</i> d) <i>Strychnos nux-vomica</i> e) <i>Eugenia caryophyllata</i>		
	SEMESTER VI (PRACTICALS)		

T.Y.B.Sc Botany Syllabus Semester V & VI

Practical I - PLANT DIVERSITY- III		Paper Code: RJSUBOTP601		2.5
	<u>Bryophyta</u>			
1	Study of stages in the life cycle of the following Bryophyta from fresh / preserved material and permanent slides a) <i>Marchantia</i> b) <i>Pellia</i>			
	Pteridophyta			
1	Study of stages in the life cycles of the following Pteridophytes from fresh / preserved material and permanent slides :- a) <i>Lycopodium</i> b) <i>Equisetum</i>			
	Bryophytes and Pteridophytes: Applied aspects			
1	Economic importance of Bryophytes.			
2	Economic importance of Pteridophytes.			
3	Types of sporophytes in Bryophytes (from Permanent slides).			
4	Types of sori and soral arrangement in Pteridophytes.			
	Gymnosperms			
1	Study of stages in the life cycles of the following Gymnosperms from fresh / preserved material and permanent slides: a) <i>Thuja/ Biota</i> b) <i>Gnetum</i> c) <i>Ephedra</i>			
Practical - II : PLANT DIVERSITY- IV		Paper Code: RJSUBOTP602		2.5
	Angiosperms			
1	Study of one plant from each of the following Angiosperm families: a) Rhamnaceae b) Combretaceae c) Asclepiadaceae d) Labiatae e) Euphorbiaceae f) Cannaceae			
2	Morphological peculiarities and economic importance of the members of the above-mentioned Angiosperm families.			
3	Identify the genus and species with the help of flora.			

T.Y.B.Sc Botany Syllabus Semester V & VI

	Anatomy		
1	Study of Ecological Anatomy of : a) Hydrophytes: <i>Hydrilla</i> stem, <i>Nymphaea</i> petiole, <i>Eichhornia</i> offset b) Epiphytes: Orchid c) Sciophytes: <i>Peperomia</i> leaf d) Xerophytes: <i>Nerium</i> leaf, <i>Opuntia</i> phylloclade e) Halophytes: <i>Avicennia</i> leaf and pneumatophore, <i>Sesuvium</i> / <i>Sueda</i> leaf f) Mesophytes: <i>Vinca</i> leaf		
	Embryology		
1	Study of various stages of Microsporogenesis, Megasporogenesis and Embryo Development with the help of permanent slides / photomicrographs.		
2	Mounting of Monocot (Maize) and Dicot (Castor and Gram) embryo.		
3	<i>In vivo</i> growth of pollen tube in <i>Portulaca</i> / <i>Vinca</i> .		
	Biostatistics II		
1	<i>t</i> -test (paired and unpaired).		
2	Problems based on regression analysis.		
3	ANOVA.		
Practical- III FORM AND FUNCTION –III		Paper Code: RJSUBOTP603	2.5
	PLANT BIOCHEMISTRY		
1	Estimation of proteins by Biuret method.		
2	Effect of pH on the activity of amylase.		
3	Effect of substrate variation on the activity of amylase.		
	PLANT PHYSIOLOGY		
1	Determination of alpha-amino nitrogen.		
2	Effect of GA on seed germination.		
3	Estimation of reducing sugars by DNSA method.		
	GENETICS		
1	Problems based on three-point crosses, construction of chromosome maps.		
2	Identification of types of mutations from given DNA sequences.		
3	Study of mitosis using pre-treated root tips of <i>Allium</i> .		
	Bioinformatics		

T.Y.B.Sc Botany Syllabus Semester V & VI

1	Protein structure analysis and application		
2	Multiple sequence analysis and phylogenetic analysis		
Practical- IV : CURRENT TRENDS IN PLANT SCIENCES- II		Paper Code: RJSUBOTP604	
	PLANT BIOTECHNOLOGY II		
1	DNA sequencing - Maxam-Gilbert Method.		
2	DNA barcoding of plant material by using suitable data.		
	Plant Geography		
1	Study of Phytogeographical regions of India.		
2	Preparation of vegetation map using Garmin's GPS Instrument.		
3	Problems based on Simpson's diversity Index.		
	Economic Botany		
1	Demonstration: Extraction of essential oil using Clevenger.		
2	Thin layer chromatography of essential oil of Patchouli and <i>Citronella</i> .		
3	Saponification value of Palm oil.		
	Post-Harvest Technology		
1	Preparation of: a) Squash b) Jam c) Jelly d) Pickle.		

T.Y.BSc	Semester V Theory
RJSUBOT501 Paper I Plant Diversity III	<p>Course Outcomes 5.1:</p> <ol style="list-style-type: none"> 1. Microbiology studies – various microbes, media type and composition, staining, colony characters. 2. Pure cultures and Role of microbes in fermentation. 3. Detailed study of algae (<i>Rhodophyta</i> and <i>Xanthophyta</i>) and fungi (Basidiomycetes and Deuteromycetes) 4. Study of Systematic position, Life cycle and Alternation of generations of algae (<i>Polysiphonia</i>, and <i>Vaucheria</i>) and fungi (<i>Agaricus</i>, <i>Puccinia</i> and <i>Alternaria</i>.) 5. Study of plant diseases and Physical, chemical and biological control methods of plant diseases. <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Microbiology studies. ➤ Understanding classical botany and application. ➤ Knowing the cause and control of plant diseases.

T.Y.BSc	Semester V Theory
RJSUBOT502 Paper II Plant diversity- IV	<p>Course Outcomes 5.2:</p> <ol style="list-style-type: none"> 1. Exploring palaeobotany with studies of <i>Calamites</i>, <i>Lepidodendron</i>, <i>Lyginopteris</i>, <i>Pentoxylon</i> and contributions of Birbal Sahni (Birbal Sahni Institute of Paleobotany, Lucknow.) 2. Detailed study of Morphology of flower, Complete classification of Bentham and Hooker: Merits and demerits, system of classification for flowering plants up to family of Capparidaceae, Umbelliferae, Cucurbitaceae, Rubiaceae, Solanaceae, Commelinaceae and Graminae. 3. Study of anomalous secondary growth in the stems, root- stem transition and types of stomata. 4. Study of pollen morphology, viability, germination and growth of pollen and application of Palynology. <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Understanding the past environment with the help of palaeobotany. ➤ Learning of Bentham and Hooker classification. ➤ Knowing the anomalous secondary growth reinforcement of tall plants ➤ Understanding the pollen specificity.

T.Y.B.Sc Botany Syllabus Semester V & VI

T.Y.BSc	Semester V Theory
RJSUBOT503 Paper-III Forms and functions – III	<p>Course Outcomes 5.3:</p> <ol style="list-style-type: none"> 1. Detailed study of nucleus, vacuole and functions of giant chromosomes. 2. Mechanism of Transcription and Translation in Eukaryotes and Characteristics of the genetic code. 3. Understanding Plant- Water relations with Solute transport and Translocation. 4. Study of bioremediation and Phytoremediation. 5. Study of plant succession. 6. Understanding the role of micropropagation in plant cell suspension, secondary metabolites, Somatic embryogenesis, artificial seeds, Protoplast fusion and Somatic hybridization. <p>Learning outcomes: (Research orientation, skill development)</p> <ul style="list-style-type: none"> ➤ Basic concepts of molecular biology. ➤ Understanding solute transport and translocation in plant. ➤ Use of bioremediation and Phytoremediation. ➤ Application of plant tissue culture and micropropagation.

T.Y.Bsc	Semester V theory
RJSUBOT504 Paper-iv Current trends in plant science- II	<p>Course outcomes 5.4:</p> <ol style="list-style-type: none"> 1. Detailed study of ethno botany and traditional medicines. 2. Exploring mushroom cultivation and its nutritional value. 3. Understanding c- DNA libraries, restriction enzyme, analysis of cloned DNA sequences and southern hybridization. 4. Detailed study of instrumentation techniques colorimetry, spectrophotometry (visible, UV and IR), column chromatography, adsorption and partition chromatography, ion exchange chromatography, molecular sieve chromatography 5. Pharmacognosy study of <i>Strychnos</i> seeds, Clove buds, <i>Allium sativum</i>, <i>Acorus calamus</i> and <i>Curcuma longa</i>. <p>Learning outcome: (Skill development and entrepreneurship)</p> <ul style="list-style-type: none"> ➤ Understanding ethno botany and traditional medicines. ➤ Motivation of Entrepreneurship in mushroom cultivation. ➤ Basic concept of molecular biology. ➤ Learning analytical techniques. ➤ Pharmacognosy study.

T.Y.B.Sc Botany Syllabus Semester V & VI

T.Y.BSc	Semester V Practical Skill development
RJSUBOTP501 Practical I Plant Diversity III	<p>Course Outcomes 5.1:</p> <ol style="list-style-type: none"> 1. Detailed study of Aeromicrobiota, Minimum Inhibitory Concentration (MIC) and antimicrobial activity. 2. Study of stages in the life cycle algae (<i>Polysiphonia</i>, and <i>Vaucheria</i>) and fungi (<i>Agaricus</i>, <i>Puccinia</i> and <i>Alternaria</i>). 3. Detailed study of the fungal diseases (White rust, Tikka disease in Groundnut and Citrus canker). <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Microbiology study. ➤ Understanding classical botany and its application. ➤ Detailed study of causative agent of plant diseases.

T.Y.BSc	Semester V Practical Skill development, experiential learning, planning.
RJSUBOTP502 Practical II PLANT DIVERSITY- IV	<p>Course Outcomes 5.2:</p> <ol style="list-style-type: none"> 1. Study of palaeobotany with studies of <i>Calamites</i>, <i>Lepidodendron</i>, <i>Lyginopteris</i> and, <i>Pentoxylon</i>. 2. Detailed study of <i>Capparidaceae</i>, <i>Umbelliferae</i>, <i>Cucurbitaceae</i>, <i>Rubiaceae</i>, <i>Solanaceae</i>, <i>Commelinaceae</i> and <i>Graminae</i>. 3. Identifying the genus and species of a plant with the help of Flora. 4. Study of anomalous secondary growth with double staining in the stems (<i>Bignonia</i>, <i>Salvadora</i>, <i>Achyranthes</i>, <i>Aristolochia</i> and <i>Dracaena</i>) and roots of beet and radish. 5. Study of types of stomata. 6. Study of pollen morphology (NPC analysis), viability and effect of varying concentration of sucrose on <i>In vitro</i> pollen germination and pollen analysis from honey sample. <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Understanding the past environment with the help of palaeobotany. ➤ Learning of Angiosperm's taxonomy. ➤ Learning of double staining technique. ➤ Understanding the pollen specificity and NPC analysis.

T.Y.B.Sc Botany Syllabus Semester V & VI

T.Y.BSc	Semester V Practical Skill based training
RJSUBOTP503 Practical III FORMS AND FUNCTIONS – III	<p>Course Outcomes 5.3:</p> <ol style="list-style-type: none"> 1. Study of meiosis in <i>Tradescantia</i> buds. 2. Predicting the sequence of amino acids in the polypeptide. 3. Estimation of Phosphate phosphorus and Iron from plant acid extract. 4. Estimation of Dissolved oxygen demand, biological oxygen demand, Total Hardness and Salinity and Chlorinity in given water sample. 5. Understanding plant tissue culture and preparation of stock solutions for preparation of MS medium. <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Understanding the stages of meiosis and sequencing of amino acids. ➤ Assessment of Phosphate phosphorus and Iron content in plants. ➤ Assessment of water quality.

T.Y.BSc	Semester V Practical
RJSUBOTP504 Practical IV Current trends in plant science- II	<p>Course Outcomes 5.4: Tribal knowledge, ethics, entrepreneurship, research orientation</p> <ol style="list-style-type: none"> 1. Study of plants for Ethnobotany. 2. Mushroom cultivation. 3. Analysis of Growth curve of <i>E. coli</i>. 4. Plasmid DNA isolation and separation of DNA using AGE and understanding restriction mapping (problems), southern blotting. 5. Analysis of sample on Beer Lambert's Law. 6. Study of macroscopic/ microscopic characters and Chemical tests for active constituents of <i>Allium sativum</i>, <i>Acorus calamus</i>, <i>Curcuma longa</i>, <i>Strychnos nux-vomica</i> and <i>Eugenia caryophyllata</i>. <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Understanding ethno botany and traditional medicines. (Understanding and application of traditional knowledge and scientific understanding). ➤ Motivation of Entrepreneurship in mushroom cultivation. ➤ Determination of generation time of <i>E. coli</i>. ➤ Learning analytical techniques ➤ Pharmacognosy study of macroscopic/ microscopic characters of the above-mentioned plants.

T.Y.BSc	Semester VI Theory
RJSUBOT601 Paper 1 Plant Diversity III	<p>Course Outcomes 6.1:</p> <ol style="list-style-type: none"> 1. Detailed study of Bryophyta (<i>Marchantia</i>, <i>Pellia</i>, <i>Sphagnum</i>) and <i>Pteridophyta</i> (<i>Lepidophyta</i>, <i>Lycopodium</i>, <i>Calamophyta</i>, <i>Equisetum</i>, <i>Pterophyta</i> and <i>Marsilea</i>). 2. Study of Bryophytes in aspect of ecology, economic importance, ecological indicators and evolution of sporophyte and gametophyte. 3. Study of Pteridophytes economic importance, diversity and distribution, types of sori and evolution of sori. 4. Detailed study of gymnosperms (<i>Thuja</i>, <i>Gnetum</i> and <i>Ephedra</i>) and its economic importance. <p>Learning outcomes:</p> <ul style="list-style-type: none"> ➤ Understanding Bryophytes and Pteridophytes and their applications. ➤ Recognising the benefits of gymnosperms.

T.Y.BSc	Semester VI Theory
RJSUBOT602 Paper 2 Plant diversity- IV	<p>Course Outcomes 6.2:</p> <ol style="list-style-type: none"> 1. Study of major botanical gardens of India, botanical survey of India and regional plants of India. 2. Detailed study of angiosperm families (<i>Rhamnaceae</i>, <i>Combretaceae</i>, <i>Asclepiadaceae</i>, <i>Labiatae</i>, <i>Euphorbiaceae</i> and <i>Cannaceae</i>) and Hutchinson's classification. 3. Anatomical study of hydrophytes, hygrophytes, mesophytes, sciophytes, halophytes, epiphytes and xerophytes. 4. Development study of Microsporogenesis and Megasporogenesis and embryo. 5. Analysis of data by Student's <i>t</i>-test, Regression and ANOVA (one way). <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Introduction of Indian regional flora. ➤ Detailed study of some angiosperms families. ➤ Study of plant adaptations in different environment. ➤ Plant development study. ➤ Bio-statistical analysis of data.

T.Y.B.Sc Botany Syllabus Semester V & VI

T.Y.BSc	Semester VI Theory
RJSUBOT603 Paper-III forms and functions – III	Course Outcomes 6.3 : <ol style="list-style-type: none"> 1. Study of biomolecules: Carbohydrates (sugars, starch, cellulose, pectin, lipids (fatty acids and glycerol), proteins (amino acids). 2. Detailed study of enzymes and it's mechanism. 3. Detailed study of plant nitrogen metabolism, vegetative growth and commercial applications PGR. 4. Understanding eukaryotes genetic mapping, gene mutations, metabolic disorders – enzymatic and non-enzymatic. 5. Study of bioinformatics application (BLAST, protein structure analysis and application, multiple sequence analysis and phylogenetic analysis. Learning outcomes: <ul style="list-style-type: none"> ➤ Understanding macromolecules and enzymes application. ➤ Some concept learning of plant physiology and molecular biology. ➤ Bioinformatics application. Computational biology

T.Y.BSc	Semester VI theory
RJSUBOT604 Paper-IV Current trends in plant science- II	Course Outcomes 6.4: <ol style="list-style-type: none"> 1. Detailed study of DNA sequence analysis, Polymerase Chain reaction and DNA barcoding. 2. Study of biodiversity and Phytogeographical regions of India. 3. Detailed study of Essential Oils, Fatty oils and Vegetable Fats. 4. Study of post-harvest technology (storage, drying, freezing, canning and food preservatives). Learning outcomes: <ul style="list-style-type: none"> ➤ Concept of molecular biology of DNA. ➤ Knowing biodiversity and Phytogeographical regions of India. ➤ Understanding the application of oils and fats and post-harvest technology. (Entrepreneurship)

T.Y.BSc	Semester VI Practical Skill
RJSUBOTP601 Practical I Plant Diversity III	<p>Course Outcomes 6.1:</p> <ol style="list-style-type: none"> 1. Slide preparation/ permanent slides study of <i>Bryophyta</i> (<i>Marchantia</i>, <i>Pellia</i> and <i>Sphagnum</i>) and <i>Pteridophyta</i> (<i>Lycopodium</i> and <i>Equisetum</i>). 2. Study of types of sporophytes in Bryophytes and sori and soral arrangement in Pteridophytes. 3. Detailed study of gymnosperms (<i>Thuja</i>, <i>Gnetum</i> and <i>Ephedra</i>) and its economic importance. <p>Learning outcome:</p> <ul style="list-style-type: none"> ➤ Understanding the detailed morphology of Bryophyta and Pteridophyta. To understand their role in plant succession. ➤ Recognising the benefits of gymnosperms.

T.Y.BSc	Semester VI Practical: Skill enhancement, experiential learning, Application in field studies
RJSUBOTP602 Practical II PLANT DIVERSITY- IV	<p>Course Outcomes 6.2:</p> <ol style="list-style-type: none"> 1. Study of angiosperm families (<i>Rhamnaceae</i>, <i>Combretaceae</i>, <i>Asclepiadaceae</i>, <i>Labiatae</i>, <i>Euphorbiaceae</i> and <i>Cannaceae</i>) 2. Identify the genus and species with the help of flora. 3. Anatomical sectional study of hydrophytes, mesophytes, sciophytes, halophytes, epiphytes and xerophytes. 4. Study of various stages of Microsporogenesis and Megasporogenesis, embryo and <i>In vivo</i> growth of pollen tube 5. Analysis of data given by Student's <i>T</i>-Test, Regression and ANOVA (one way). <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Detailed study of some angiosperm families. ➤ Anatomical study of plant adaptations in different environment. ➤ Study of plant development stages. ➤ Bio-statistical analysis of data.

T.Y.B.Sc Botany Syllabus Semester V & VI

T.Y.BSc	Semester VI Practical: Skill development, research orientation, experimental design
RJSUBOTP603 Practical III FORMS AND FUNCTIONS – III	<p>Course Outcome 6.3:</p> <ol style="list-style-type: none"> 1. Estimation of proteins from sample. 2. Study the effect of temperature, pH and substrate variation on the activity of amylase. 3. Estimation of alpha-amino nitrogen, reducing sugars and Effect of GA on seed germination. 4. Analysis of problems based on three-point crosses, construction of chromosome maps. 5. Identification of types of mutations from given DNA sequences. 6. Study of mitosis using pre-treated root tips of <i>Allium</i>. <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Understanding enzymology application. ➤ Nutritional value finding ➤ Mapping of gene and construction of chromosome maps. ➤ Mutation effect study.

T.Y.BSc	Semester VI Practical : Entrepreneurship
RJSUBOTP604 Practical IV Current trends in plant science- II	<p>Course Outcomes 6.4:</p> <ol style="list-style-type: none"> 1. DNA sequencing and barcoding of plant material 2. Study of Phytogeographical regions of India, vegetation map using Garmin's GPS Instrument. 3. Analysis of problems based on Simpson's diversity Index. 4. Distillate extraction of essential oil using Clevenger and application of thin layer chromatography. 5. Estimation of saponification value of palm oil. 6. Preparation of Squash, Jam, Jelly and Pickle. <p>Learning outcomes :</p> <ul style="list-style-type: none"> ➤ Molecular identification of plant material. ➤ Tree census study. ➤ Distillate application in perfumery. ➤ Entrepreneurship in post-harvest technology.

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Scheme of Examinations

1. Two Internals of 20 marks each. Duration 30min for each.
2. One External (Semester End Examination) of 60 marks. Duration 2 hours.
3. One Practical at the end of Semester consisting of Practical I 50 marks, Practical II 50 marks, Practical III 30 marks and Practical IV 50 marks but passing combined out of 200.
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. Student must appear at least one of the two Internal Tests to be eligible for the Semester End Examination.
6. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
7. Two short field excursions for habitat studies are compulsory. Field report submission is mandatory
8. Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15students.
9. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of T.Y.B.Sc. Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of T.Y.B.Sc. Botany as per the minimum requirements.
10. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practical's for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.
11. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

Evaluation and Assessment

Evaluation (Theory): Total marks per course - 100.

CIA- 40 marks

CIA 1: Written test -20 marks

CIA 2: Written Test / Assignment / Field Trip/mini project/ & Report -20 marks

Semester End Examination – 60 marks

Question paper covering all units

Evaluation of Practicals 100 marks (50 marks for each practical RJSUBOTP501, RJSUBOTP502, RJSUBOTP503, RJSUBOTP504, RJSUBOTP601, RJSUBOTP602, RJSUBOTP603 & RJSUBOTP604)

Course Semester End Examination in Semester V and VI Paper I, II, III and IV (RJSUBOT501, RJSUBOT502, RJSUBOT503, RJSUBOT504, RJSUBOT601, RJSUBOT602, RJSUBOT603 & RJSUBOT604)

Question	Knowledge	Understanding	Application and analyses	Total marks-Per unit
Unit 1	06	03	03	12
Unit 2	06	03	03	12
Unit 3	06	03	03	12
Unit 4	06	03	03	12
Short notes from topics covering all the units	06	03	03	12
-TOTAL-Per objective	30	15	15	60
% WEIGHTAGE	50	25	25	100%

Evaluation of Practicals 200 marks/Semester

SEMESTER V: (50 marks for each practical RJSUBOTP501, RJSUBOTP502, RJSUBOTP503 & RJSUBOTP504)

SEMESTER VI: RJSUBOTP601, RJSUBOTP602, RJSUBOT603 & RJSUBOTP604)

Continuous Evaluation of practical components which require adequate duration for completion of the task, observation and interpretation: 25%

Course end Practical Evaluation of skills of students in terms of skill, analysis, interpretation and conclusion.

ASSESSMENT OF BOTANY FIELD TRIP REPORT

Dept. of Botany Course Code _____ Date _____ Roll No _____

Name of student: _____ UID No _____ Marks _____ / 20

Place of visit _____

Assessment Grid: Place one tick in each appropriate row. Overall mark should reflect the positions of ticks in the individual rows

(20)	Field Trip and Report	80-100% 17-20 Marks	60-80% 13-16 Marks	40-60% 09-12 Marks	20-40% 05-08 Marks
30% (06)	Organization of report	Introduction about the location, vegetation, Botanical Names, Family, Local name, Description using Botanical Term, reporting all the species seen, Handwritten or typed.	Few mistakes,	Many mistakes	Inadequate presentation
		6	5	4	3
50% (10)	Content	Excellent reporting of all the species observed in the field, ecological and morphological data,	Good reporting, species observed in the field but few of them missing in the list	Satisfactory, many species or relevant data missing from the report	Poor, inadequate and insufficient data or just a list of the species without any data.
		10/9	8	6	5
10% (02)	Conclusion	Conclusion based on self observation. Type of forest and vegetation	Good conclusion, comments not independent	Satisfactory, but insufficient	Poor, irrelevant conclusion
	----Marks----	2	2 / 1	1 / 0.5	0.5
5% (01)	References	Proper references, in required format	Proper references but no format	Few references	rrrelevant references
	----Marks----	1	1	0.5	0
5% (01)	Attendance / participation	Attended and participated actively	Attended and participated	Infrequent Participation	No participation
	----Marks----	1	1	0.5	0

Comments:

Name and Signature of Faculty

Mini Project Under graduate level

Dept. of Course Code _____ Date _____

UID No _____ Roll No _____ Marks _____ /20

Name of student -----

Title of Assignment: _____

Assessment Grid: Place one tick in each appropriate row. Overall mark should reflect the positions of ticks in the individual rows. In boxes that have more than one set of marks, cancel out the marks that are not applicable and circle the correct marks.

Project work and report (Parameters)	Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Average
Project work done	10	10 / 9	8 / 7	6 / 5	4 / 3
Report writing and conclusions	10	10 / 9	8 / 7	6 / 5	4 / 3

T.Y.B.Sc Botany Syllabus Semester V & VI**Mapping of the course to employability/ Entrepreneurship/skill development**

Class	Course Name	Course Code	Topic focussing on Employability/ Entrepreneurship/skill development	Employability/ Entrepreneurship/ Skill development	Specific activity
T Y B Sc Botany	Pant Diversity III & IV	RJSUBOT501, RJSUBOT502	Plant Diversity III, IV focuses on identification of plants ranging from microbes to angiosperms including fossils forms, involving details of detailed analysis of internal structure special features of developmental biology. Biostatistical tools for analysis of data	The topics focuses on identification resulting in strain selection, this find opportunities in industries involved in enzymes, antimicrobial agents, plant identification and tree census	Plant identifications use key characters, Palynology identification of pollen grains
T Y B Sc Botany	Forms and Functions III	RJSUBOT503 RJSUBOT603	Thrust areas like cytology, molecular biology, plant physiology, plant Biochemistry, Environmental Botany, Plant tissue culture, genetics and Bioinformatics	Employability in field of the teaching and research. Domain knowledge essential for further progression	Interpretation of biochemical pathways, Computational skills for biological data analysis
T Y B Sc Botany	Current trends II	RJSUBOT504 RJSUBOT604	Ethnobotany, mushroom industry, biotechnology, post-harvest technology, Pharmacognosy and medicinal botany	Analytical skills; Interpretation Skills; Writing skills; entrepreneurship skills;	Mushroom industries: post-harvest technology to achieve sustainable development goals
T Y B Sc Botany	Practicals-plant diversity III & IV;	RJSUBOTP501, RJSUBOTP502, RJSUBOTP601, RJSUBOTP602	Macroscopical and Microscopical identification of sample from lower to higher forms	Organisational skills, record keeping, interpretation skills	Field trip , techniques
T Y B Sc Botany	Practicals - Forms and Functions III	RJSUBOTP503, RJSUBOTP603	Sampling techniques, quality and quantitative test, water analysis, extraction of plasmid	Skill enhancement, employability as technicians	Training and use of analytical instrument; plant propagation using tissue culture technique; industrial visit
T Y B Sc Botany	Practicals - Current trends II	RJSUBOTP504, RJSUBOTP604	Mushroom cultivation, authentication of plant sample, extraction of essential oils,	Employability in research laboratory, NGOs; analysis of crude drug , natural product development	Workshop on mushroom cultivation; preparation of jam, jellies, etc.