Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

(Empowered Autonomous College)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for the T. Y. B.Sc. (under NEP)

Program: B.Sc. BOTANY

Program Code: RJSUBOT

Course codes: RJDSCBOT361, RJDSCBOT362
RJDSCBOTP361 & RJDSCBOTP362

Semester VI

(Revised in alignment with the NEP2020 facilitating the inter-and multidisciplinary learning and multiple entry and exit of the students)
Level 5.5
(CBCS)

To be implemented from 2025-2026

Preamble

The National Education Policy 2020 aims at imparting skill-based learning and caters to the multiple entry and exit facility for the students thus empowering them to acquire knowledge at their pace In the three-year UG program, the student has two exit options. Students also have the option of choosing the Honors program of four years study in a given discipline and later converting it to five-year integrated PG degree program. As an undergraduate student, he/she learns the core subject (Major), subject complementing the core subject (Minor), a course from other discipline (OEC or GEC) Vocational and Skill Enhancement course from the Major (VSEC). The remaining verticals under NEP 2020 are IKS (Indian Knowledge System), AEC (Ability Enhancement Course), VEC (Value Education Course) and with progressive three years of UG, student also completes at different levels OJT (On Job Training), FP (Field Projects), CEP (Community Engagement Program) , RP (Research Project) which helps him/her in understanding their roots, application of the knowledge for the benefit of self and the society. Vertical CC (Co-curricular activities and activities related to yoga and human well-being) helps in preparing youth with good character and interpersonal relationships.

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Credit Structure for B. Sc. Semester VI Major Subject: Botany as per NEP 2020 Implemented from the academic year 2025-2026 Level 5.5

Courses	Credits	Total Credits	Course Titles
Discipline Specific Course (DSC) **Theory I: Plant Physiology and Biochemistry**	4	12	RJDSCBOT361
Discipline Specific Course (DSC) **Theory II: Genetics and Biostatistics**	4		RJDSCBOT362
DSC Practical I: **(Plant Physiology and Biochemistry)**	2		RJDSCBOTP361
DSC Practical II: **(Genetics and Biostatistics)**	2		RJDSCBOTP362
Discipline Specific Elective (DSE) I **Theory: Economic Botany**	2	4	RJDSEBOT361
Discipline Specific Elective (DSE) I **Practical: Economic Botany**	2		RJDSEBOTP361
Discipline Specific Elective (DSE) II **Theory: Microbiology and Plant Pathology**	2	4	RJDSEBOT362
Discipline Specific Elective (DSE) II **Practical: Microbiology and Plant Pathology**	2		RJDSEBOTP362
Vocational Skill Course (VSC) **Practical: Plant Anatomy**	2	2	RJVSCBOTP361
On Job Training (OJT)	4	4	RJOJTBOT361
Total Credits	22	22	

***As per University Grid**

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

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCBOT361	**Paper Title: Plant Physiology and Biochemistry**			**(60 Hours)**
	I	Enzymes	4	
	II	Nitrogen metabolism		
	III	Vegetative growth		
	IV	Photomorphogenesis		

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCBOT362	**Paper Title: Genetics and Biostatistics**			**(60 Hours)**
	I	Genetic mapping in Eukaryotes	4	
	II	Chromosomal mutations		
	III	Gene mutations		
	IV	Biostatistics		

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCBOTP361	**Practical Title: Plant Physiology and Biochemistry**			**(60 Hours)**
			2	

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCBOTP362	**Practical Title: Genetics and Biostatistics**			**(60 Hours)**
			2	

Elective Course 1

Course Code	Unit	Topic Headings	Credits	Duration
RJDSEBOT361	**Paper Title: Economic Botany**			**(30 Hours)**
	I	Fibers and Fiber yielding plants	2	
	II	Minor Cereals and Small grains		
	III	Essential Oil		
	IV	Spices and other flavoring materials		

Course Code	Unit	Topic Headings	Credits	Duration
RJDSEBOTP361	**Practical Title: Economic Botany**			**(60 Hours)**
	I		2	

Elective Course 2

Course Code	Unit	Topic Headings	Credits	Duration
RJDSEBOT362	**Paper Title: Microbiology and Plant Pathology**			**(30 hours)**
	I	Types of microbes, Culturing of microbes	2	
	II	Role of microbes in fermentation		
	III	Plant pathology terms, plant diseases caused by fungi, bacteria and virus one example each		
	IV	Prevention and control measures for plant diseases		

Course Code	Unit	Topic Headings	Credits	Duration
RJDSEBOTP362	**Practical Title: Microbiology and Plant Pathology**			**(60 hours)**
			2	

Course Code	Unit	Topic Headings	Credits	Duration
RJVSCBOTP361	**Practical Title: Plant Anatomy**			**(60 hours)**
	I		2	

Course Code	Unit	Topic Headings	Credits	Duration
RJOJTBOTP361	**Paper Title: On Job Training (OJT)**			**(120 hours)**
			4	

COURSE OUTCOMES (COs) B. Sc. BOTANY

SEMESTER	:	VI Discipline Specific Course
TITLE OF THE SUBJECT/COURSE	:	**PLANT PHYSIOLOGY AND BIOCHEMISTRY**
COURSE CODE	:	RJDSCBOT361
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students will learn the basis of naming and classifying enzymes, their mode of action, characterization of enzymes and inhibition
2	Students would learn about the various biochemical processes in nitrogen metabolism
3	Students will learn about the mechanism of vegetative and reproductive growth in plants. The role of PGRs in growth.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Classify enzymes, explain the mode of action and factors affecting the activity of enzymes. They would be able to identify the type of enzyme inhibitors and how inhibition can be overcome.	1	BT Level III, IV Apply draw conclusions
CO2	Explain the role of nitrogen in plants and how it is made available to the plant through various enzymes in nitrogen metabolism.	1, 3	BT level III, IV and V
CO3	Understand and analyze the underlying mechanism of vegetative and reproductive growth. Appreciate the role of PGRs and their physiological applications. Students would be able to explain the role of light in morphogenesis	1,3	BT level III, IV and V

B.Sc. BOTANY SEMESTER VI Botany Syllabus

Course Code	Title	Credits
RJDSCBOT361	**Plant Physiology and Biochemistry**	**4** **60 hours**
Unit I: **Enzymes** ➢ Nomenclature, Classification ➢ Mode of action, Enzyme Kinetics		

➢ Competitive, non-competitive and uncompetitive inhibitors	
Unit II: Nitrogen Metabolism ➢ Nitrogen cycle, root nodule formation, leg hemoglobin ➢ Nitrogenase activity, assimilation of nitrates (NR, NiR activity), ➢ Assimilation of ammonia (amination and transamination)	
Unit III: Vegetative Growth ➢ Phases of growth, factors affecting growth ➢ Physiological effects and commercial applications of auxins, cytokinins, gibberellins and abscisic acid.	
Unit IV: Photomorphogenesis ➢ The Photochemical and biochemical properties of phytochrome ➢ Phytochrome enabled adaptations in plants due to light conditions.	

Suggested References

1. Buchanan B B and Gruissem W (2015) Biochemistry and Molecular Biology of Plants. Willy Blackwell ASPB USA.
2. Taiz L ., Zeiger E., Moller I M. and Murph A (2015) Plant Physiology and Development . Sinaer Associates Inc. USA 6th edition.
3. Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., & Amon, A. (2021). *Molecular cell biology* (Vol. 1). New York: WH Freeman.
4. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2005). *Lehninger principles of biochemistry*. Macmillan.
5. Raven, P. H., Evert, R. F., & Eichhorn, S. E. (2005). *Biology of plants*. Macmillan.

COURSE OUTCOMES (COs) B. Sc. BOTANY

SEMESTER	:	VI Discipline Specific Course
TITLE OF THE SUBJECT/COURSE	:	**Plant Physiology and Biochemistry (Practical)**
COURSE CODE	:	RJDSCBOTP361
CREDITS	:	02
DURATION	:	60 hours

LEARNING OBJECTIVES	
1	To plan experiments, prepare buffer adjust pH using pH meter, learn how to characterize an enzyme

2	Learn to estimate total nitrogen, nitrate content on the given plant material, set up an assay for measuring nitrate reductase activity
3	Learn to propagate cuttings by application of appropriate PGR

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Set up experiments for enzyme assays, standardize pH meter, prepare buffers, adjust pH, calculate Michaelis constant for the enzyme, analyze and interpret the results.	1	BT Level III, IV Apply draw conclusions
CO2	Extract enzyme from the plant material and carry out assay, analyze and interpret the results.	1, 3	BT level III, IV and V
CO3	Apply the techniques of plant propagation and optimize concentration of rooting hormone for horticultural crops.	1,3	BT level III, IV and V

LIST OF PRACTICALS

Course Code	Practical	Credits
RJDSCBOTP361	**Plant Physiology and Biochemistry**	**2**
❖ Effect of pH on the activity of the enzyme amylase. ❖ Study of enzyme peroxidase from the given plant material – o-dianisidine ❖ Estimation of Nitrate nitrogen content in the given plant extract – phenol disulphonic acid ❖ Determination of antioxidant potential of a given plant material using DPPH assay. ❖ Estimation of *in vivo* nitrate reductase activity from the given plant material – NEDD Reagent ❖ Effect of IBA on rooting of plant cuttings for vegetative propagation.		

COURSE OUTCOMES (COs) B. Sc. BOTANY

SEMESTER	:	VI Discipline Specific Course
TITLE OF THE SUBJECT/COURSE	:	**Genetics and Biostatistics**
COURSE CODE	:	**RJDSCBOT362**
CREDITS	:	4
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students would learn about the concept of linkage and crossing over. They would learn about the construction of genetic map.
2	Students would learn about types of chromosomal mutations and gene mutations.
3	Students would learn about statistical tools in data analysis

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Construct a genetic map using data from a three-point test cross	1	BT Level III, IV Apply draw conclusions
CO2	Understand and explain the chromosomal anomalies and interpret data	1, 5	BT level III, IV and V Apply, analyze and evaluate
CO3	Understand the various types of gene mutations and the factors responsible for induced mutations	1,5	BT level III, IV and V Apply, analyze and evaluate
CO4	Statistically analyze and interpret primary and secondary data. They would be able to construct a hypothesis and test it tools which are essential for research.	1,5	BT level III, IV and V Apply, analyze and evaluate

B Sc. BOTANY SEMESTER VI Botany Syllabus

Course Code	Title	Credits
RJDSCBOT362	Genetics and Biostatistics	4 60 hours
Unit I: Genetic Mapping In Eukaryotes ➢ Discovery of Genetic Linkage ➢ Construction of Genetic Maps		
Unit II: Chromosomal Mutations ➢ Types of Chromosomal mutations ➢ Variations in chromosome number: Euploidy and Aneuploidy ➢ Varions in chromosome structure: Deletion, Duplication, Inversion, Translocation		
Unit III: Gene Mutations ➢ Mutations defined, types of mutations ➢ Causes of mutations: Spontaneous mutations, base pair substitutions, additions and deletions ➢ Induced mutations: Effect of UV and DNA repair, Chemical mutagens : base analogues, one example of base modifying agent and intercalating agents.		
Unit IV: Biostatistics ➢ Central Tendency, Variance ➢ Hypothesis Testing, Chi Square Test ➢ Students t Test Paired and unpaired		

Suggested References

1. Genetics by Peter J Russel Fifth edition. The Benjamin/Cummings Publishing Company Inc.
2. Gardner E J., Simmons M J., Snustad D P (1991). Principles of Genetics.8th Edition John Wiley &Sons, India.
3. George W Burns, P J Bottino 1989.The science of Genetics. Macmillan Publishers
4. Danniel W W (1987) Biostatistics. New York, John Wiley and Sons.

COURSE OUTCOMES (COs) B. Sc. BOTANY

SEMESTER	:	VI MAJOR CORE SUBJECT
TITLE OF THE SUBJECT/COURSE	:	**Genetics and Biostatistics (Practical)**
COURSE CODE	:	**RJDSCBOTP362**
CREDITS	:	2
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students would learn problem solving techniques
2	Learn statistical tools essential for research

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Analyze karyotypes and draw relevant conclusions	1	BT Level III, IV Apply draw conclusions
CO2	Statistically analyze data and draw conclusions	1, 5	BT level III, IV and V Apply, analyze and evaluate

Course Code	Practical	Credits
RJDSCBOTP362	**Genetics and Biostatistics**	**2**
❖ Construction of chromosome maps using the given data (at least 10 problems) ❖ Preparation of Idiogram using the photomicrographs of metaphase to study various chromosomal anomalies in human (syndromes) ❖ Calculation of central tendency ❖ Standard deviation ❖ Chi square test ❖ Student 't' test Paired ❖ Student 't' test unpaired test		

Teaching Learning Process

The teaching learning process in the learning outcomes-based curriculum framework in the subject of Botany is designed to develop the cognitive skills of every learner. The post graduate courses offer the requisite skills for professions and jobs in Botany. All courses have practicals as an integral part which promotes the learner to acquire the requisite skills for employment by experiential learning.

An interesting combination of teaching learning processes is adopted in which the teacher and learners are actively involved.

Some of the salient teaching learning processes are-

- Class lectures
- Presentations
- Group Discussion, workshops
- Peer teaching and learning
- Flipped classroom, project-based learning, quiz, seminars, exhibitions, posters
- Practical experimental design planning, analysis, interpretation, application of knowledge gained, field projects, mini projects.
- Technology enabled self-learning.
- Internships, On job training
- Project work, scientific writing,

The effective teaching strategies would address the requirements of learners to learn at their own pace. The teaching pedagogy adopted to ensure inculcate higher order skills in the learner. The entire program is also designed to foster human values and environmental consciousness for an equable society. The teaching learning processes adopted would aim at participatory pedagogy.

Scheme of Examinations

1. Internal examination 40 marks by
   MCQ/Assignment/Project/Survey/Presentation/Seminar
2. One External (Semester End Examination) of 60 marks. Duration 2 hour.
3. Two Practical Examination at the end of Semester consisting of 50 marks each with minimum 20 marks for passing.
4. Minimum marks for passing Semester End Theory and Practical Exam are 40 %.
5. Students must appear Semester End Examination to be able to complete total credits for a given Semester.
6. For any KT examinations, there shall be Examination on Demand and students must register for the same.
7. 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.
8. In case of loss of journal, a candidate must produce a certificate from the Head of the Department /Institute that the practical 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 (if any) will not be granted.
9. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

Evaluation and Assessment

(Based on the centralized guidelines given by EC under NEP2020)

Evaluation (Theory): Total marks per course - 100

Internal Examination- 40 marks

External- Semester End Examination – 60 marks

Question paper covering all units and topics.

Two Practicals, Evaluation of Practical per Semester - 50 marks

There will be continuous evaluation for Practical's : 20 marks

Key to set effective Question paper

Question	KNOWLEDGE	UNDERSTANDING	APPLICATION and ANALYSIS	TOTAL MARKS- Per unit
Unit 1	05	04	03	12
Unit 2	05	04	03	12
Unit 3	05	04	03	12
Unit 4	05	04	03	12
Short notes from topics covering all the units	05	04	03	12
-TOTAL- Per objective	25	20	15	60
% WEIGHTAGE	42%	33%	25%	100%

Mapping of the course to Local/ Regional/National/International relevance

The diversity existing in the Plant kingdom is unparallel ranging from single cell to the tallest tree living on this planet. Plants represent the unique organism which fulfills the energy needs of all other organisms. With their unique metabolic capacity can carry out biosynthesis of complex biomolecules at ambient temperature and pressure without polluting the surroundings, in fact help in obviating climate change. All courses contribute towards SDG 4 i.e. Quality Education.

Class	Course Name	Course Code	Local relevance	Regional relevance	National relevance	International relevance
T Y B Sc Botany DSC	Plant Physiology and Biochemistry	RJDSCBOT361	✓	✓	✓	✓
T Y B Sc Botany DSC	Genetics and Biostatistics	RJDSCBOT362	✓	✓	✓	✓
T Y B Sc Botany DSC Practicals	Plant Physiology and Biochemistry Genetics and Biostatistics	RJDSCBOTP361 RJDSCBOTP362	✓	✓	✓	✓

Mapping of the course to Employability/ Entrepreneurship/Skill development

The courses in Botany have been designed to impart one or more skills to make students employable.

Class	Course Name	Course Code	Topic focusing on Employability/ Entrepreneurship/skill development	Employability/Entrepreneurship/ Skill development	Specific activity
T Y B Sc Botany DSC	Plant Physiology and Biochemistry Genetics and Biostatistics	RJDSCBOT361 RJDSCBOT362	Domain knowledge, teaching skills	Presentation skills	Seminars
T Y B Sc Botany DSC Practicals	Plant Physiology and Biochemistry Genetics and Biostatistics	RJDSCBOTP361&362	Domain knowledge, teaching skills	Analytical skills	All Practicals

Integration of Cross cutting Issues

Class	Course Code	Cross Cutting Issues
T Y B Sc Botany Major Discipline specific course	RJDSCBOT361 RJDSCBOT362 RJDSCBOTP361 RJDSCBOTP362	Ethics, Environment and Sustainability UNSDG 4, 13,15 NEP2020 Interdisciplinary