Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus

Bachelor of Botany

Submitted by

Board of Studies,

Bachelor of Botany

FYUGP-Scheme I-VIII Semester

Bachelor of Science (Honors/Research)

(Botany- Major)

Four Year (Eight Semester Degree Course)

Teaching and Examination Scheme

B.Sc. Sem-I (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-1** Microorganisms-Viruses, Prokaryotes, Algae and Fungi	BBO1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-1** Microorganisms-Viruses, Prokaryotes, Algae and Fungi	BBO1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-2** Cryptogams-Bryophyta, Palaeobotany & Pteridophyta	BBO1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-2** Cryptogams-Bryophyta, Palaeobotany & Pteridophyta	BBO1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Identification of Angio spermic plants	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

B.Sc. Sem-II (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-3** Spermatophyte-Gymnosperm & Angiosperm Morphology	BBO2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-3** Spermatophyte-Gymnosperm & Angiosperm Morphology	BBO2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-4** Cell Biology & Genetics (Mendelism)	BBO2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-4** Cell Biology & Genetics (Mendelism)	BBO2P04	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Horticulture	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-III (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-5** Algae, Fungi, Lichen &Plant Pathology	BBO3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-5** Algae, Fungi, Lichen &Plant Pathology	BBO3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-6** Fossil Angiosperms &Angiosperm Taxonomy	BBO3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-6** Fossil Angiosperms &Angiosperm Taxonomy	BBO3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

B.Sc. Sem-IV (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-7** Genetics, Plant breeding, Biostatistics & Evolution	BBO4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-7** Genetics, Plant breeding, Biostatistics & Evolution	BBO4P07			2	1	-	-	-	-	25	25	25
3	DSC	**Botany-8** Plant Development, Anatomy& Embryology	BBO4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-8** Plant Development, Anatomy& Embryology	BBO4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)				2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)				2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4P06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

B.Sc. Sem-V (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min.
1	DSC	**Botany-9** Biochemistry & Plant Physiology	BBO5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-9** Biochemistry & Plant Physiology	BBO5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-10** Economic botany, Ethnobotany & Phytogeography.	BBO5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-10** Economic botany, Ethnobotany & Phytogeography.	BBO5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	**Botany-11** Medicinal Plants: Cultivation and Practices	BBO5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	**Botany-11** Medicinal Plants: Cultivation and Practices	BBO5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective **1Botany 12** (Pharmacognosy and Phytochemistry / Forestry)	BBO5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective **1Botany 12** (Pharmacognosy and Phytochemistry / Forestry)	BBO5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				**13**	**-**	**18**	**22**	**-**	**520**	**130**	**--**	**150**	**300**	**-**

B.Sc. Sem-VI (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-13** Ecology & Laboratory Instrumentation	BBO6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-13** Ecology & Laboratory Instrumentation	BBO6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-14** Biotechnology& Molecular Biology	BBO6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-14** Biotechnology& Molecular Biology	BBO6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	**Botany-15** Seed Technology & Plant Nursery	BBO6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	**Botany-15** Seed Technology & Plant Nursery	BBO6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	**Elective-2 Botany 16** Molecular biology & Bioinformatics / LaboratoryTechniques	BBO6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	**Elective-2 Botany 16** Molecular biology & Bioinformatics / LaboratoryTechniques	BBO6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	**22**		**440**	**110**		**225**	**325**	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem-VII (Honors) (Botany - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-17** Microbiology, Algae and Fungi	BBO7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-17** Microbiology, Algae and Fungi	BBO7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-18** Bryophytes and Pteridophytes	BBO7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-18** Bryophytes and Pteridophytes	BBO7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	**Botany-** 19 Palaeobotany and Gymnosperms	BBO7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	**Botany-** 19 Palaeobotany and Gymnosperms	BBO7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	**Botany-20** Cytology and Genetics	BBO7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	**Botany-20** Cytology and Genetics	BBO7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3 **Botany 21** (Plant Identification & Herbarium Technique / Ethnobotany)	BBO7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3 **Botany 21** (Plant Identification & Herbarium Technique / Ethnobotany)	BBO7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BBO7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BBO7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**125**	**225**	

B.Sc. Sem-VIII (Honors) (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-23** Plant Physiology and Biochemistry.	BBO8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-23** Plant Physiology and Biochemistry.	BBO8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-24** Plant Development and Reproductive Biology	BBO8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-24** Plant Development and Reproductive Biology	BBO8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	**Botany-25** Cell and Molecular Biology-I	BBO8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	**Botany-25** Cell and Molecular Biology-I	BBO8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	**Botany-26** Angiosperms-I and Ethnobotany	BBO8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	**Botany-26** Angiosperms-I and Ethnobotany	BBO8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4 **Botany-27** (Biodiversity and Environment / Plant Biochemistry)	BBO8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4 **Botany-27** (Biodiversity and Environment / Plant Biochemistry)	BBO8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem-VII (Research) (Botany - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	**Botany-17** Microbiology, Algae and Fungi	BBO7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-17** Microbiology, Algae and Fungi	BBO7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-** 18 Palaeobotany and Gymnosperms	BBO7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-** 18 Palaeobotany and Gymnosperms	BBO7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	**Botany-19** Cytology and Genetics	BBO7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	**Botany-19** Cytology and Genetics	BBO7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3 **Botany 20** (Plant Identification & Herbarium Technique / Ethnobotany)	BBO7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3 **Botany 20** (Plant Identification & Herbarium Technique / Ethnobotany)	BBO7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BBO7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BBO7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

'R' in the subject code indicates 'Research'.

B.Sc. Sem-VIII (Research) (Botany- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	**Botany-22** Plant Physiology and Biochemistry Ethnobotany.	BBO8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	**Botany-22** Plant Physiology and Biochemistry Ethnobotany.	BBO8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	**Botany-23** Plant Development, Reproductive Biology and Angiosperms-I	BBO8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	**Botany-23** Plant Development, Reproductive Biology and Angiosperms-I	BBO8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	**Botany-24** Cell and Molecular Biology-I	BBO8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	**Botany-24** Cell and Molecular Biology-I	BBO8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4 **Botany-25** (Biodiversity and Environment / Plant Biochemistry)	BBO8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 4 **Botany-25** (Biodiversity and Environment / Plant Biochemistry)	BBO8P25R	-	-	2	1	-	-	-	-	-	50	25
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2 +1)	-	-	-	-	175	175	175
Total				09	-	22	**20**		**360**	**90**		**225**	**325**	

'R' in the subject code indicates 'Research'.

Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Botany)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Identification of Angiospermic plants	Botany	**BVS1P01**
II	**VSC**	Horticulture	Botany	**BVS2P03**
III	**VSC**	Plant pathology and Disease management	Botany	**BVS3P05**
V	**VSC**	Plant propagation and tissue culture	Botany	**BVS5P07**
VI	**VSC**			**BVS6P08**

Basket for ELECTIVE (DSE) Category Courses (Botany)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Pharmacognosy and Phytochemistry B. Forestry	BBO5T12
VI	Elective 2	A. Molecular biology & Bioinformatics B. LaboratoryTechniques	BBO6T16
VII (Honors)	Elective 3	A. Plant Identification & Herbarium Technique B. Ethnobotany	BBO7T21
VIII (Honors)	Elective 4	A. Biodiversity and Environment B. Plant Biochemistry	BBO8T27
VII (Research)	Elective 3	A. Plant Identification & Herbarium Technique B. Ethnobotany	BBO7T20R
VIII (Research)	Elective 4	A. Biodiversity and Environment B. Plant Biochemistry	BBO7T25R

Model Question Paper Format

Time:-3Hrs. Max.Marks:80

Note:-1.All questions are compulsory.
2. Each question carries equal marks.

Q. 1. Write on:-

(A) Unit-I 8Marks
(B) Unit-I 8Marks

OR

Write Short Notes on:-

(C) Unit-I 4Marks
(D) Unit-I 4Marks
(E) Unit-I 4Marks
(F) Unit-I 4Marks

Q. 2. Write on:-

(A) Unit-II 8Marks
(B) Unit-II 8Marks

OR

Write Short Notes on:-

(A) Unit-II 4Marks
(B) Unit-II 4Marks
(C) Unit-II 4Marks
(D) Unit-II 4Marks

Q. 3. Write on:-

(A) Unit-III 8Marks
(B) Unit-III 8Marks

OR

Write Short Notes on:-

(A) Unit-III 4Marks
(B) Unit-III 4Marks
(C) Unit-III 4Marks
(D) Unit-III 4Marks

Q. 4. Write on:-

(A) Unit-IV 8Marks
(B) Unit-IV 8Marks

OR

Write Short Notes on:-

(A) Unit-IV 4Marks
(B) Unit-IV 4Marks
(C) Unit-IV 4Marks
(D) Unit-IV 4Marks

Q. 5. Write in Three to Four Lines Diagrams are not necessary.

(A) Unit-I 2Marks
(B) Unit-I 2Marks
(C) Unit-II 2Marks
(D) Unit-II 2Marks
(E) Unit-III 2Marks
(F) Unit-III 2Marks
(G) Unit-IV 2Marks
(H) Unit-IV 2Marks

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY

FOUR YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY (Honours/Research)

(Courses effective from Academic Year 2023-24)

SYLLABUS OF COURSES TO BE OFFERED

Major Courses (Discipline Specific Core), Minor Courses, Elective Courses (Discipline Specific Elective), Generic Elective (GE)/Open Elective (OE)

CHOICE BASED CREDIT SYSTEM (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. Major/Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Major/Core course. Department/Subject Specific Core (DSC) is a single discipline course of study or specific subject course of study, which should be pursued by a student as a mandatory requirement of his /her program of study.

2. Minor Course: A course offered in a discipline/subject be treated as minor by another discipline/subject. Students are expected to gain in depth multi-/interdisciplinary understanding through theoretical and practical experiences, as well as an adequate knowledge base through the choice of minor subject and discipline. The student choosing to discipline specific core (DSC) have to choose minors from faculty/discipline unrelated to the major but something that complements the major.

3. Elective Course: A course which can be chosen from a pool of courses, and which is very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope, or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course. There shall be a pool /basket of DSEs from which a student has to choose a course of study.

4. Generic Elective (GE) or Open Elective (OE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. Generic or open electives shall be a pool / basket of courses which is meant to provide multidisciplinary or interdisciplinary education to students.

5. Vocational Skill Course: Vocational Skill Courses enable people to work that requires technical knowledge along with artistic or practical skills. These courses do not focus on theoretical knowledge, instead, they are primarily designed to provide job centred training for very specific fields.

6. Ability Enhancement Courses (AEC): AEC courses are the courses based upon the content that leads to knowledge enhancement through various area of study. They are Language and Literature, Environmental Science and Sustainable Development courses which will be mandatory for all disciplines. Combination of courses on English, Indian language (Marathi /Hindi/ Sanskrit or other regional languages if offered in that college) and Environment studies can be taken as an example on AEC courses.

7. Professional Ethics, Value Education and Life Skills Courses (EVLSC): Value education courses are common pool of courses offered by different faculties/disciplines and are aimed at personality building embedding ethical, cultural and constitutional values promoting critical thinking and scientific temperament. Value based education is expected to accomplish the development of humanistic, ethical, constitutional and universal human values (UHV) of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values and life skills. Lessons in service and participation in community service programs could also be included as an integral part of the holistic education. Courses on life skills should beadded to increase the employability as well as self-esteem of the students.

8. Co-curricular Courses on Sports, Fine/Applied/Visual Arts and Cultural Activities: Students have to take some courses under co-curricular courses as a part of four-year multidisciplinary degree program.

9. Internship, apprenticeship, Field Projects and Community Engagement Projects: A student may undertake minimum of 4-6 weeks of Project Work either at University Research Centers or at any preapproved external Research Institutions/CSIR Laboratories.

The field-based learning / project should attempt to provide opportunities for students to understand the different socio-economic contexts. It should aim at giving students exposure to development related issues in rural and urban settings. This component will include participation in activities related to National Service Scheme (NSS), national Cadet Corps (NCC), adult education/literacy initiatives and mentoring school students. A minimum of 4-6weeks of summer work, either on university campus in activities related to preservation of environment/ biodiversity or community-based work in the neighbour community (through NSS unit) or field level work with a recognized NGO or regional case studies program at villages may be undertaken as a part of field projects

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY

FOUR YEAR UNDERGRADUATE PROGRAMME

B.Sc. BOTANY (Honours/Research)

(Courses effective from Academic Year 2023-24)

SYLLABUS

Semester I

B. Sc. Semester-I Discipline Specific Core Course (DSC-I)- BOTANY Paper-I (BBO1T01) Microorganisms-Viruses, Prokaryotes, Algae and Fungi			
DSC-I Theory	**Hours: 2 Hours/Week**	**Marks: 80+20=100**	**Credit: 2**
Unit-I			
1. Introduction to microorganisms. 2. Classification of microorganisms (Outline) –Carl Woese's- Domain system (1990). 3. Brief account of Bacteria- Archaebacteria, Mycoplasma, Actinomycetes 4. **Viruses-** General account, structure& multiplication of –T4 Phage (Lytic, Lysogenic) 5. **Bacteria**: General characteristics, cell structure and economic importance. 6. **Cyanobacteria** : *Nostoc* (Morphology, Reproduction and importance in Agriculture)			7 Hrs
Unit-II			
1. General characteristics and Economic importance's of Algae. 2. **Classification of algae**: Lee (2008) up to phylum with examples 3. **Morphology and reproduction of the following**: *Oedogonium, Chara* and *Ectocarpus,*			8 Hrs
Unit-III			
1. **Fungi** General characteristics and Economic importance. 2. **Classification outline:** Alexopolous and Mims, 1996 3. **Life cycle** of *Albugo*, *Rhizopus* and *Agaricus*. 4. **Mycorrhiza:** ectomycorrhiza and endomycorrhiza.			7 Hrs
Unit-IV			
1. **Lichens:** General account, Types of lichens, Internal Structure, Reproduction and Economic importance. 2. **Plant Pathology:** Casual organism, Symptoms, transmission and control measures of Plant diseases- Citrus canker, Red Rot of Sugar cane, Little leaf of Brinjal and Leaf Curl of Papaya.			8 Hrs

DSC-I Practical	Hours: 2 Hours/Week	Marks: 25+25=50	Credit: 1

1. Study of Viruses from models / photographs (TMV and T4 Bacteriophage).
2. Study of gram staining of the given Bacterial culture.
3. Study of ultrastructure of Bacteriophage from TEM photographs.
4. Study of vegetative and reproductive structure of Cyanobacteria: *Nostoc*, *temporary* preparations and from permanent slides.
5. Study of vegetative and reproductive structure of Algae: *Chara, Ectocarpus, and Oedogonium,* temporary preparations and from permanent slides.
6. Study of Fungal genera: *Albugo, Rhizopus, and Agaricus*.
7. Study of Lichen: Thallus structure, Types of lichens.
8. **Plant Pathology** Study of diseases caused by the following: Citrus canker, Red Rot of Sugar cane, Little leaf of Brinjal and Leaf Curl of Papaya.
9. **Mycorrhiza:** ectomycorrhiza and endomycorrhiza (Photographs).
10. Instruments of Micro biology laboratory.

Suggested activity:

Seminar, Quiz, debate, Assignments, collection of diseased plant parts –studying symptoms and identification of pathogen, collection and study of Algae available in local area, Field work, Study Projects, Models etc. are Part of Curriculum for all units in all papers

B.Sc - SEMESTER –I BOTANY PRACTICAL

PAPER –I

Microorganisms-Viruses, Prokaryotes, Algae and Fungi

Time: 3hrs. **Max. Marks: 25**

1. Perform Gram staining of the given Bacterial culture **/** Identify giving reasons the given C**yanobacteria (A)**. **5 Marks**
2. Identify giving reasons the given **Algae (B)** **5 Marks**
3. Identify giving reasons the given Fungi **(C)** **5 Marks**
4. **Spotting:** **5 Marks**
   D. One of the instruments of Micro biology laboratory.
   E. Whole specimen or a permanent slide of Algae.
   F. Whole specimen or a permanent slide of Fungi.
   G. Whole specimen or a permanent slide of Plant disease studied.
   H. Whole specimen or a permanent slide of Lichens, Mycorrhiza.
5. Record and excursion report(submission is compulsory) **5 Marks**

Suggested readings

1. Barsanti, L. and Gualtieri, P. (2014). Algae: Anatomy, Biochemistry and Biotechnology, 2 nd Edition. CRC/ Taylor & Francis,
2. NY. Lee, R.E. (2018). Phycology, Fifth Edition. Cambridge University Press, Cambridge.
3. Marjorie, Kelly and Cowan, Heidi Smith. (2017). Microbiology: A Systems Approach. McGraw Hill New York, 5th edition.
4. Pandey, S.N and Trivedi, P.S. (2015). A text book of Botany Vol.I Vikas publishing House Pvt/ Ltd, New Delhi
5. Mehrotra, R.S. and K.R. Aneja. (1999). An Introduction to Mycology. New Age International Publisher.
6. Pelczar M.J., Chan E.C.S and Kreig N.R. (1997). Microbiology. Tata MacGraw Hill.
7. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGrawHill, Delhi, India.
8. Robert Edward Lee. (2018). Phycology. Cambridge University Press, U.K. 5th edition.
9. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
10. Sharma, O. P. (2011). Algae. Tata McGraw Hill Education Private Limited, U.K. 1st edition.
11. Tortora, G.J., Funke, B.R., Case, C.L. (2011). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 13th edition

12. Aneja, K.R. (1993): Experimental in Microbiology, Plant Pathology & Tissue Culture, Wiswa Prakashan, New Delhi.
13. Bold H. C. and M. J. Wynne (1978): Introduction of Algae: Structure and Reproduction (Prentice Hall of India Pvt. Ltd.)
14. Sharma, P. D. [1991]: The Fungi (Rastogi & Co. Meerut)
15. Sharma, P.D. [1993] Microbiology and plant pathology (Rastogi & Co)
16. Smith, GM. [1971] Cryptogamic Botany, Vol 1 Algae and Fungi(TMI)
17. Smith, K. M. [1992]: Plant Viruses 6th Ed (university Book Stall New Delhi)
18. Sunder Rajan, S. (2001): Tools and Techniques of Microbiology, Anmol Publ New Delhi
19. Vasistha, B. R. (1990): Algae (S. Chand & Co. New Delhi)
20. Vasistha, B. R. (1990): Fungi (S. Chand & Co. New Delhi)
21. Woese CR, Fox GE (November 1977). "Phylogenetic structure of the prokaryotic domain: the primary kingdoms". Proceedings of the National Academy of Sciences of the United States of America. 74 (11): 5088 0. Bibcode:1977PNAS...74.5088W. doi:10.1073/pnas.74.11.5088. PMC 432104. PMID 270744
22. Agrios, G.N. (1980) Plant Pathology, academic Press, INC, New York.
23. Ainsworth, G.C. and A.S.Sussman (eds). The Fungi, An advance Treatise Vol.I, II, III & IV Academic Press, New York.
24. Alexopoulos C.J., Mims C.W. and Blackwell M. 2002. Introductory Mycology (4thed.). John Wiley and Sons (Asia), Singapore.
25. Alexopoulos, C.J., Mims and Black well (1996) 4th ed. John Wiley and Sons, Inc. Wiley, New York
26. Gangulee H.C. and Kar A.K. 2011. College Botany (Vol. II).New Central Book Agency. Calcutta.
27. Gupta, V.K. and M.K.Behl (1994) Indian Plant Viruses and Mycoplasma Kalyani Publishers, 1/1, Rejinder Nagar, Ludhiana.
28. Rangaswamy, G. and A.Mahadevan (1999) Diseases of Crop Plant in India, Prentice Hall
29. Bergey's Manual of Systematic Bacteriology, 2nd ed., vol. 1-3, Springer Verlag, New York, NY.
30. Pandey, B.P. (2014). Modern Practical Botany Vol. I. S. Chand and Company Ltd. Ramnagar, New Delhi.
31. Purohit, S.D., Kundra, G. K. and Singhvi, A. (2013). Practical Botany (part I). Apex Publishing House Durga Nursery Road Udaipur, Rajasthan.
32. Sambamurty, A.V.S.S. (2006). A text book of Algae. I.K International Publishing House,Pvt. Ltd.
33. Dube, R.C. and D.K. Maheshwari (2000) Practical Microbiology -S.Chand & Co. Ltd.

B. Sc. Semester-I

Discipline Specific Core Course (DSC-II)- BOTANY Paper-II (BBO1T02)

Paleobotany, Bryophyta and Pteridophyta

DSC-II Theory	Hours: 2 Hours/Week	Marks: 80+20=100	Credit: 2

Unit-I	
1. Palaeobotany: Concept and Importance. Geological Time Scale. 2. Contributions of Birbal Sahni 3. Types of fossils: Impression, Compression, Petrifaction, Cast, Mold and Amber. 4. Fossil plants: *Glossopteris* (Leaf, Scutum).	7 Hrs
Unit-II	
1. Bryophytes – Bryophytes as amphibians of kingdom Plantae, General characteristics of Hepaticopsida, Anthocerotopsida and Bryopsida, alternation of generation and classification (Proskauer 1957) of Bryophytes. 2. Distribution, morphology, anatomy, reproductive structures and life-cycles of *Riccia* and *Funaria* 3. Economic Importance of Bryophytes.	8 Hrs
Unit-III	
1.Pteridophytes- General characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida 2.Classification (Smith 1955) and Economic importance 3.Alternation of generation in Pteridophytes (Homosporic and Heterosporic) 4.Stelar system in Pteridophytes	7 Hrs
Unit-IV	
1. Fossil Pteridophyte : Rhynia 2. Morphology, anatomy, reproductive structures and life-cycle in Selaginella, and Pteris 3. Heterospory and Seed habit.	8 Hrs
Note- 1. Developmental details not to be included. 2. Short Excursion tour/visit is expected to study Bryophytes and Pteridophytes or fossils in natural habitat.	

DSC-II Practical	Hours: Hours/Week	Marks: 25+25=50	Credit: 1

1. Study of Fossil types
2. Study of fossil plants- Rhynia, Glsossopteris.
3. Study of morphology, classification, reproductive structures and life-cycle of Riccia and Funaria
4. Study of morphology, classification, anatomy, reproductive structures and lifecycle of Selaginella, and Pteris

B.Sc - SEMESTER –I BOTANY PRACTICAL

PAPER –II

Palaeobotany, Bryophytes and Pteridophytes

Time: 3hrs. **Max. Marks: 25**

Q. 1) Identify & give characters of the given Bryophytic material [A] and make a temporary Mount 05

Q. 2) Identify & give characters of the given Pteridophytic material [B]and make temporary Mount. 05

Q. 3) Describe the given fossil Type [C] 05

Q. 4) Spotting: 05

D- Bryophyte

E- Pteridophyte (Morphology)

F- Pteridophyte (Reproductive)

G- *Glossopteris*

H- Types of Stele

Q. 5) Practical Record & Excursion Report 05

Suggested reading

1. Agashe SN 1995. Paleobotany- Plants of the past, their evolution, paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
2. Prasad KN 1999. An Introduction to Paleobotany. APH Publication.
3. Siddiqui KA 2002. Elements of Paleobotany. Kitab Mahal Allahabad.
4. Parihar NS 1995. Essential of Paleobotany. Central Book, Allahabad.
5. Gangulee HC, Kar AK and Santra SC 2018. College Botany Vol II. New central Book Agency Ltd London.
6. Singh V, Pande PC and Jain DK 2007. Diversity of Microbes and Cryptograms. Rastogi Publication.
7. Hait G, Bhattacharya K and Ghosh AK 2017. A Textbook of Botany Vol I. New central Book Agency Ltd London.
8. Bhattacharya K, Hait G, and Ghosh AK 2015. A Textbook of Botany Vol II. New central Book Agency Ltd London.
9. Rashid A 2016. An Introduction to Archegoniate Plants. Vikas Publishing House.
10. Thakur AK and Bassi SK 2007. Diversity of Microbes and Cryptograms. S. Chand Publication, New Delhi.
11. Rashid A 2018. An Introduction to Bryophyta. Vikas Publishing House.
12. Satish Kumar 2015. Diversity of Algae, Lichen and Bryophytes. Pragati Publication.
13. Sharma OP 2017. Bryophyta. Tata McGraw Hill Publishing Co. New Delhi.
14. Vashishtha BR 2016. Bryophyta. S. Chand Publication, New Delhi.

15. Parihar NS 1997. The biology and Morphology of Bryophytes. Central Book Depot, allahabad.
16. Smith GM 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata McGraw Hill Publishing, New Delhi.
17. Vanderpoorten A and Goffinet B 2009. Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.
18. Sharma OP 1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi.
19. Sharma OP 2012. Pteridophyta. Tata McGraw Hill Publishing Co. New Delhi.
20. Sporne KR 1970. The Morphology of Pteridophytes. Hutchinson University Library London.
21. Dhaka TS and Lalit Singh 2017. Elementary Pteridophyta. Pragati Prakashan.
22. Rashid A 2018. An Introduction to Pteridophyta. Vikas Publication House Pvt. Ltd.
23. Parihar NS 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allahabad.
24. Parihar NS 1976. An Introduction to Pteridophytes, Central Book Depot, Allahabad.
25. Vashishtha BR 1992. Pteridophyta. S. Chand and Co. New Delhi.
26. Sundara Rajan 2000. Practical Manual of Pteridophyta. Anmol Publication Pvt. Ltd. New Delhi.
27. Santra SC 2015. Practical Botany Vol I NCBA London.

B. Sc. Semester-I

VSC Botany (BVS1P01)

Identification of Higher plants

VSC Practical	Hours: 4 Hours/Week	Marks: 50+50=100	Credit: 2

Unit-I	
1. Study of Morphological features of vegetative parts of plant. a) Morphology of different types of Roots and its Modifications with examples. b) Morphology of Stem and its Modifications with examples. c) Morphology of Leaf and its Modifications with locally available plants. d) Study of phyllotaxy and venation pattern and epidermal features of different leaves with locally available suitable examples.	15 Hrs
Unit-II	
2. Study of Morphological features of reproductive parts of plant. a) Study of Inflorescence- i) Cymose, 2) Racemose, 3) Special types b) Structure of typical flower and its variations.	15 Hrs
Unit-III	
3. Study of Morphological features of reproductive parts of plant. a) Study of family specific characteristics features of plants, b) Study of accessory whorls of flower-Calyx and Corolla with Modifications c) Study of essential whorls of flower – Androecium and Gynoecium with modifications. d) Study of fruits- Simple, aggregate and composite with suitable examples.	15 Hrs
Unit-IV	
4. Taxonomic description of various locally available different taxa representing various members of dicot and monocot groups (minimum 7 from Dicot and 3 from monocot) and preparation of Key (for any two families by using available Flora) 5. Identification of plant by – a) Flora (10 Plants). b) By using different online applications (Minimum two apps) c) Visit to different taxonomic digital data base.	15 Hrs

B.Sc - SEMESTER –I BOTANY PRACTICAL

VSC Botany (BVS1P01)

Identification of Higher plants

Time: 5 Hrs **Total Marks: 50**

Q1. Describe the given plant material in technical language and identify the family.	10
Q2. Describe the morphology of different leaf	10
Q3. Prepare a family key of given plants	10
Q4. Identify the given plant species using Flora	05
Q5. Spotting 1. (Vegetative Morphology - 3) 2. (Types of Inflorescence - 2)	05
Q6. Viva-voce & Practical Record	10

Suggested Reading

1. Flora of British India By T. Cooke
2. Flora of Nagpur District By Dr. N. R. Ugemuge.
3. Practical Botany Vol. II, Bendre & Kumar
4. Flora of Maharashtra State By- Sharma, Karthikeyan, Singh.
5. Various other flora available from different websites.

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
C. Components of Environment: Atmosphere (Structure and composition),hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto- cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.
C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr **P.U. Meshram, Allied Publishers, New Delhi.**
8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)

SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	TOTAL	**30 HRS**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, Motilal Banarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution ofCivil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books.

Semester II

B. Sc. Semester-II Discipline Specific Core Course (DSC-3)- BOTANY Paper-3 (BBO2T03) Spermatophyte: Gymnosperms and Angiosperm Morphology			
DSC-III Theory	**Hours: 2 Hours/Week**	**Marks: 80+20=100**	**Credit: 2**
Unit-I			
Gymosperms: 1. **Gymnosperms:** General characteristics, Classification (Stewart, 1982) and Economic Importance 2. **Fossil Gymnosperms:** *Cycadeoidea* (Morphology and Reproductive structure) 3. **Life cycle of:** *Cycas* (Morphology, Anatomy and Reproductive structures)			7 Hrs
Unit-II			
Vegetative Morphology: 1. **Root:** Tap root and adventitious root, modification of root for storage and respiration. 2. **Stem:** Branching (Monopodial and Sympodial), Modification of stem (Runner, Suckers Rhizome, Tuber, Bulb) 3. **Leaf:** Typical leaf, Types (Simple and Compound), Types of phyllotaxy, Venation, Modification of leaf (Tendril, Phyllode)			8 Hrs
Unit-III			
Reproductive Morphology: 1. **Inflorescence:** Definition, Racemose, Cymose and Special types. 2. **Flower:** Structure of Typical flower, insertion of floral whorls, Variation in thalamus (Androphore, Gynophore and Gynandrophore) 3. **Calyx and Corolla:** Cohesion, Forms of corolla and Aestivation. 4. **Androecium:** Parts, Cohesion, Adhesion and Fixation.			7 Hrs
Unit-IV			
Carpel and Fruit: 1. **Gynoecium:** Parts, Cohesion, Adhesion and Placentation. 2. **Fruit:** Definition, Pericarp, Types of fruits: Simple (Dehiscent, Schizocarpic, Dry Indehiscent, Fleshy Indehiscent); Aggregate (Etaerio) fruits, Composite Fruits			8 Hrs

(Sorosis and Syconus).	

DSC-III Practical	Hours: 2Hours/Week	Marks: 25+25=50	Credit: 1

1. Study of Gymnosperms*:* Fossil gymnosperm *Cycadeoidea and Cycas*
2. Study of different root modifications
3. Study of nature of branching and modification of stem
4. Study of leaf: Types (Simple & Compound), Phyllotaxy, Venation and Modifications.
5. Inflorescence: Types mentioned in theory.
6. Flower: Parts, calyx, corolla, androecium, gynoecium, Insertion of Floral whorls, variation in thalamus.
7. Fruits: Study of different types of fruits

B.Sc - SEMESTER –II BOTANY PRACTICAL

PAPER –III

Spermatophyte: Gymnosperms and Angiosperm Morphology

TIME: FIVE HOURS **MAX. MARKS: 25**

Q. 1: Identify the given **Gymnospermic** material **(A)**. Prepare temporary mount and write identifying characters. 05 M

Q. 2: Describe the given **leaf** material**(B)**. 05 M

Q. 3: Describe the given **flower(C)** 05 M

Q. 4: **Spotting**: 05 M

(D) Gymnosperm **(E)**Fossil gymnosperm **(F)**Modified root/Stem

(G) Inflorescence **(H)** Fruit

Q. 5: Practical Record and Excursion report. 05 M

Suggested Readings:

1. Bhatnagar, S. P. and Moitra A. (1996): Gymnosperms. New Age International Limited, New Delhi.
2. Bierhorst, D. W. [1971]: Morphology of Vascular Plants. Macmillon& Co. N. R.
3. Chamberlain, C. J. (1986) Gymnosperms-Structure and Evolution .CBS Publishers & Distributors.
4. Cronquist A. (1961) Introductory Botany . Harper and Brothers , Publishers, New York.
5. Datta A. C. [1971] A Class-book of Botany, Oxford University Press .
6. Galbraith D (1989) Understanding Biology.John Wiley & Sons Inc.
7. Gangulee H. C. and Kar A. K (1970) College Botany Vol. I & II, New Central Book Agency, Calcutta
8. Moore, R, Clark W. D, Vodopich D. S. (1998) Botany. Second Edition . WCB/McGraw-Hill,
9. Sambamurty A.V.S.S. (2013) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. I K International Publishing House Pvt. Ltd .
10. Saxena A. K. and Sarabhai R. P. (1962) A Textbook of Botany Vol. II.RatanPrakashanMandir, Agra.
11. Sharma, O. P. (2004). Gymnosperms.McMillan India Ltd.
12. Singh M. P, Sharma A K (2002) Textbook of Botany. Anmol Publications Pvt. Ltd.
13. Sporne, K. R. (1965): The Morphology of Gymnosperms. Hutchinson University Library Press,London.
14. Vashishtha, B. R. [1992]: Gymnosperm. S. Chand & Co. New Delhi.
15. Vashistha, P.C (1978) Botany for Degree Students- Gymnosperms Vol. V. S. Chand and Co. New Delhi.
16. Vashistha, P.C, Sinha A. K. and Kumar A (1976) Botany for Degree Students- Gymnosperms S. Chand Publishing.
17. Verma, V. (2010) Botany. Ane Books Pvt. Ltd.

B. Sc. Semester-II

Discipline Specific Core Course (DSC-4)- BOTANY Paper4 (BBO2T04) Cell Biology and Genetics			
DSC-III Theory	**Hours: 2 Hours/Week**	**Marks: 80+20=100**	**Credit: 2**
Unit-I			
1. Definition of cell, brief account of Schleiden and **Schwann** Cell theory. 2. Comparison of prokaryotic and eukaryotic cell 3. Ultra-structure of typical plant cell 4. Ultra-Structure and functions of: a. Cell wall b. Cell membrane (Fluid Mosaic model) c. Endoplasmic reticulum			7 Hrs
Unit-II			
Ultra- Structure and functions of: Continued d. Golgi complex e. Ribosomes f. Mitochondria g. Chloroplast h. Lysosome i. Vacuole j. Peroxisomes and Glyoxysomes			8 Hrs
Unit-III			
Ultra-Structure and functions of: Continued k. Nucleus 5. Morphology of typical eukaryotic chromosome 6. Karyotype and idiogram 7. Molecular organization of chromosome- **Nucleosome model** 8. Sex chromosomes in ***Melandrium album*** (XY-type)			7 Hrs
Unit-IV			
9. Cell cycle 10. Mitosis in plants 11. Meiosis in plants 12. Significance of Mitosis and Meiosis 13. Mendelism: Monohybrid and dihybrid cross, Laws of inheritance – Law of segregation and Law of independent assortment			8 Hrs

DSC-IV Practical	Hours: 2Hours/Week	Marks: 25+25=50	Credit: 1
1. To study the cell organelles with the help of photographs and slides. 2. To study the mitosis with suitable plant materials. 3. To study the meiosis with suitable plant materials. 4. To work out the Numerical problems based on monohybrid and dihybrid ratio. 5. To prove Mendel's law of segregation by applying Chi-square test with the help of coloured beads. 6. To prove Mendel's law of independent assortment by applying Chi-square test with the help of coloured beads. 7. To study the morphology of eukaryotic Chromosome. 8. To demonstrate monohybrid cross by using Pea plant.			
Note: **Botanical excursion and visits is compulsory**			

B.Sc - SEMESTER –II BOTANY PRACTICAL

PAPER –IV

Cell Biology and Genetics

TIME: FIVE HOURS **MAX. MARKS: 25**

Q. 1: To prepare semi permanent smear/squash of the given plant material (A), identify stage/ Stages of Cell division. 05 M

Q. 2: to prove Mendels law of inheritance by using colour beads (B) and apply chi square test 06 M

Q. 3: To work out numerical problem based on monohybrid/ dihybrid ratio. 04 M

Q. 4: **Spotting**: 05 M

(D)Cell organelle **(E)** Cell organelle

(F) Mitosis/ Meiosis

(G) Types of cell **(H)** Chromosome morphology

Q. 5: Practical Record and Excursion report. 05 M

Suggested reading:

1. The Science of Genetics, William Hexter; Henry t. Yost Jr, Printice-Hall of India Pvt. Ltd, New-Delhi; 1977.
2. Genetics 2nd Ed., Strickberger M.W.; Mac Millan Publising Co. Inc., New York, 1976.
3. Cell and Molecular Biology, E. De. Robertis and E.M. De. Robertis; 7th Ed. Saunders College/Holt Rinehart and Winston, Philadelphia, 1980.
4. Fundamental of Genetics, 6th Ed. B.D. Singh; MedTech Science Press, Scientific International Pvt. Ltd., New Delhi, 2023.
5. Cytology and Genetics, V.R. Dnyansagar; Tata Mc Graw Hill, 1986.
6. Genetics, C. Sarin; Tata Mc Graw Hill, 1985.
7. Principles of Genetics, Gardner E.J.; Simmons M.S. and D. Peter Snustad, Wiley India Pvt. Ltd., New Delhi, 2006.
8. Cell Biology, Gerald Karp; 7th Ed., Wiley India Pvt. Ltd., New Delhi, 2013.
9. Introduction to Cytogenetics, Ganesh Prasad, Kalyani Publishers, New-Delhi, 1998.
10. Cell Biology, C.B. Powar, Himalaya Publishing House, Mumbai, 2010.

B. Sc. Semester-II VSC Botany (BVS2P03) Horticulture			
VSEC Practical	**Hours: 4 Hours/Week**	**Marks: 50+50=100**	**Credit: 2**
Unit-I			
1. Visit to a garden/orchard/vegetable farm. 2. Identification of major fruit crops of our country. 3. Identification of major vegetable crops of our country. 4. Identification of major flower crops of our country.			15 Hrs.
Unit-II			
1. Identification of ornamental plants for avenues and lawn- grasses, hedges, edges plants of our country 2. Identification of indoor and outdoor foliage ornamentals, cacti-succulents and bulbous plants. • Understanding interior environments. • Plants for different light conditions. • Deciding the location of the indoor plant, managing colour, Using mirrors, Plants in baskets, Miniature gardens 3. Dealing with indoor plants- Potting Media, Container selection, managing plant nutrition, pruning indoor plants, Factors for growing indoor plants			15 Hrs.
Unit-III			
1. Propagation of horticultural crops through seeds 2. Propagation through asexual methods-cuttings, layering, runners, suckers, grafting, and budding. 3. Preparation of pot for planting, cleaning, media preparation and filling.			15 Hrs.
Unit-IV			
1. Identification of different fertilizers-NPK 2. Identification of organic manures-FYM, vermicompost, cakes, bone meal. 3. Preparation of model of a low-cost storage structure for horticultural produce			15 Hrs.

B.Sc. Semester-II BOTANY

PRACTICALEXAMINATION

VSEC-3 Botany (BVS2P03)

Subject: Horticulture

Time: 5 hrs. **Max. Marks: 50**

Q.1. Identify Given five Fruit material and state its importance.	05
Q.2. Identify Given five Vegetable materials and state its importance.	05
Q.3. Identify given four flowers crops of our country.	10
Q.4. Describe various Potting Media, Container selection for indoor plants,	05
Q.5. Prepare a pot for planting by cleaning, media preparation and filling.	05
Q.6. Spotting:	10
Identify given 05 fertilizer samples and comment on it.	
Q.7. Viva-voce	05
Q.8. Practical Record and field visit report.	05

Suggested Reading

1. Fundamentals of Horticulture Dr. G. S. K. Swamy, Dr. J. Auxcilia
2. Principles of Horticulture Fifth edition C.R. Adams, K.M. Bamford and M.P. Early Butterworth-Heinemann is an imprint of Elsevier
3. Fundamentals of Horticulture A Laboratory Manual Dr. Divya Slathia, Dr. Amit Saurabh, Dr. Yogendra Singh & Dr. Shalini Singh Dr. Khem Singh Gill, Akal College of agriculture, Eternal University, Baru Sahib, Sirmour 173101, Himachal Pradesh, India.
4. Fundamentals of Horticulture (Practical Manual) S.K. Pandey, C.S. Pandey Department of Horticulture College of Agriculture Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur 482004 (MP)
5. Practical manual of Basic Agriculture CBSE First Edition

SEM 2 : CONSTITUION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity

- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

1. It is possible to create a map of the intellectual growth of a culture usingastronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phasetransitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the pastdramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	**8**
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	**8**
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	**7**
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	**7**
	TOTAL	**30 HRS**

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao.Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan,Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin% 20of%20Astronomy.pdf