Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Botany (Sem. V & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of B. Sc. in Botany (Fifth and Sixth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2023 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

Near Samarth Colony, Jalgaon - 425 002. (Maharashtra, India) | Ph. : +91 257 - 2237363, 2234281 | e-mail : mjcollege@kces.in | Website : mjcollege.kces.in
समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

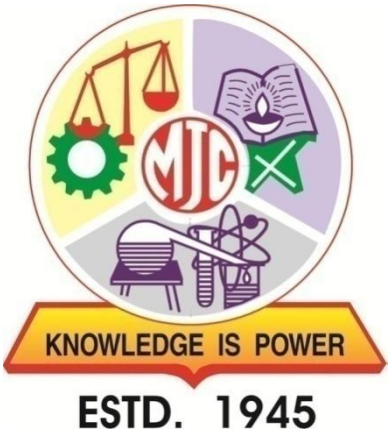
Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon-425001



STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (T.Y. B.Sc. Botany)

Under Choice Based Credit System (CBCS)

and

as per NEP-2020 Guidelines

[w.e.f. Academic Year: 2025-26]

Preface

Botany, (the study of plants)*viz*., including research, environmental management, agriculture, Horticulture, pharmaceuticals, and biotechnology, playing a crucial role in sustainable practices and plant-based solutions. Botanistsstudy the interactions between plants and their environment, including climate change impacts and ecosystem dynamics. Botanists contribute to the development of sustainable agricultural practices that minimize environmental impact and promote food security. Medicinal Botany explore the medicinal properties of plants, identifying compounds with therapeutic potential for treating various diseases. Ecology and Phytogeography involved in restoring degraded ecosystems, such as forests and wetlands, by planting native plant species and managing vegetation.

Botany students can seek employmeny opportunity in various industries including Education, Research and Development, Agriculture, Biotechnology, Ecology, etc. Some popular Botany jobs include Botanist, Plant Taxonomist, Ecologist, Agronomist, Horticulturist etc.Botany is a vast branch of Biology and it covers numerous specializations that are used in various industries. For instance, Genetics, Biotechnology, Horticulture, Agronomy, Forestry, Plant Ecology, etc.,

Hence, Board of Studies in Botany in its meeting held on 22/03/200 5resolved to accept therevised syllabus for T. Y. B. Sc. (Botany) based on Choice Based Credit System (CBCS) ofUGC, NEP-2020 and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognize the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. BotanyHonours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PSO No.	PSO
1	T.Y. B.Sc. (Botany) graduates will have basic and applied knowledge of Plant Science.
2	Acquire academic excellence with an aptitude for higher studies, research and to meet competitive exams.
3	A student completing the course is able to understand different branches of Botany such as Plant systematics, evolution & ecology, physiology, interactions of plant with microbes and insects, morphology, reproduction, genetics and molecular biology of various life-forms.
4	Build life skills in Techniques in Botany, Medicinal Botany and Pharmacognosy, Plant Biotechnology, Anatomy and Embryology, value-added and skill enhancement courses.
5	After successful completion of the program, students will acquire laboratory, natural field and transferable skills which will help them to boost their career.
6	Students can apply their knowledge in public as well as private sector and build successful career.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours **Or** Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	**UG Certificate**
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum. Cr.	**8**	**8**	**8**	**6**	**---**	**10**	**4**	**44**	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	UG Diploma
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-2(2P)	AEC-4(2T) (MIL)	CC-4(2T) ۞FP(2)	22	
	Cum. Cr.	**12**	**---**	**10**	**---**	**4**	**6**	**4**	**8**	**44**	
	Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.										

***** Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

۞ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum. Cr.	**24**	**8**	**---**	**---**	**---**	**8**	**---**	**4**	**44**	
	Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	**28**	**8**	**4**	**---**	**---**	**---**	**4**	**44**	
	Four Year UG Honors Degree in Major and Minor with 176 credits									

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	**20**	**8**	**4**	**---**	**---**	**---**	**12**	**44**	
	Four Year UG Honours with Research Degree in Major and Minor with 176 credits									

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **OE/GE**- Open/Generic elective, **VSC**- Vocational Skill Course, **SEC**- Skill Enhancement Course, **VSEC**- Vocation and Skill Enhancement Course, **AEC**- Ability Enhancement Course, **IKS**- Indian Knowledge System,

VEC- Value Education Course, **T**- Theory, **P**- Practical,**CC**-Co-curricular **RM**- Research Methodology, **OJT**- On Job Training, **FP**- Field Project, **Int**- Internship, **RP**- Research Project, **CEP**- Community Extension Programme, **ENG**- English, **CI**- Constitution of India, **MIL**- Modern Indian Laguage

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of T.Y. B.Sc. BOTANY

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester V, Level – 5.5											
DSC-11	DSC	BOT-DSC-351	Diversity of lower cryptogams	2	2	---	2	20	---	30	---
DSC-12	DSC	BOT-DSC-352	Angiosperm Taxonomy	2	2	---	2	20	---	30	---
DSC-13	DSC	BOT-DSC-353	Cytogenetics, Plant Breeding and Evolution	2	2	---	2	20	---	30	---
DSC-14	DSC	BOT-DSC-354	Practical on BOT-DSC-351 and BOT-DSC-353	2	---	4	4	---	20	---	30
DSC-15	DSC	BOT-DSC-355	Practical on BOT-DSC-352	2	---	4	4	---	20	---	30
DSE-1A	DSE	BOT-DSE-351A	Medico Botany & Pharmacognosy	2	2	---	2	20	---	30	---
DSE-1B	DSE	BOT-DSE-351B	Pharmacognosy (NPTEL)*	2	2	---	2	20	---	30	---
DSE-2A	DSE	BOT-DSE-352A	Practical on BOT-DSE-351A	2	---	4	4	---	20	---	30
DSE-2B	DSE	BOT-DSE-352B	Practical on BOT-DSE-351B	2	---	4	4	---	20	---	30
VSC-1	VSC	BOT-VSC-351	Techniques in Botany	2	2	---	2	20	---	30	---
VSC-2	VSC	BOT-VSC-352	Practical on BOT-VSC-351	2	---	4	4	---	20	---	30
OJT/Int	OJT	BOT-OJT-351	On Job Training/ Internship	4	---	8	8	---	40	---	60
Semester VI, Level – 5.5											
DSC-16	DSC	BOT-DSC-361	Diversity of Higher Cryptogams	2	2	---	2	20	---	30	---
DSC-17	DSC	BOT-DSC-362	Gymnosperms and Palaeobotany	2	2	---	2	20	---	30	---
DSC-18	DSC	BOT-DSC-363	Plant Anatomy	2	2	---	2	20	---	30	---
DSC-19	DSC	BOT-DSC-364	Molecular Biology	2	2	---	2	20	---	30	---
DSC-20	DSC/IKS	BOT-DSC-365	IKS In Ethnobotany	2	2	---	2	20	---	30	---
DSC-21	DSC	BOT-DSC-366	Practical on BOT-DSC-361	2	---	4	4	---	20	---	30
DSC-22	DSC	BOT-DSC-367	Practical on BOT-DSC-362 and BOT-DSC-363	2	---	4	4	---	20	---	30
DSE-3A	DSE	BOT-DSE-361A	Plant Metabolism	2	2	---	2	20	---	30	---
DSE-3B	DSE	BOT-DSE-361B	Plant Physiology (NPTEL)*	2	2	---	2	20	---	30	---
DSE-4A	DSE	BOT-DSE-362A	Practicalon BOT-DSE-361A	2	---	4	4	---	20	---	30
DSE-4B	DSE	BOT-DSE-362B	Practical on BOT-DSE-361B	2	---	4	4	---	20	---	30
VSC-3	VSC	BOT-VSC-361	Plant Biotechnology	2	2	---	2	20	---	30	---
VSC-4	VSC	BOT-VSC-362	Practicalon BOT-VSC-361	2	---	4	4	---	20	---	30

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
  - External examination will be of 1½ hours duration
  - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
  - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
  - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments
iv. Case studies/Case lets
v. Participatory & Industry-Integrated Learning/Field visits
vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT.The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations.The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation conditionis required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-V

T.Y. B.Sc. Botany (Major)
Semester-V
BOT-DSC-351: Diversity of lower cryptogams

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To study salient features of cryptogamic plants. ▪ To make students aware about the status of cryptogams as a group in plant kingdom. ▪ To study the life cycles of selected genera. ▪ To study economic and ecological importance of cryptogamic plants	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Classify algae, fungi based on their characteristics and structures. ▪ Develop critical understanding on morphology, anatomy and reproduction of Algae and Fungi. ▪ Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of algae, fungi. ▪ Increase the awareness and appreciation of human friendly algae, fungi, and their economic importance.	
Unit	**Contents**	**Hours**
Unit I	**An Introduction to Algae** ▪ Definition and general characters ▪ Habit and habitat ▪ Organization of thallus ▪ Similarities, differences with fungi and Bryophytes ▪ Reproduction ▪ Life cycle patterns: Haplontic, Diplontic and Diplohaplontic ▪ Useful and harmful aspect of **algae.** ▪ Contribution of following **Phycologists** ▪ Prof. M. O. P. Iyengar ▪ Prof. T. V. Deshikachary ▪ Outline classification of Algae according to **F. E. Fritsch (1945)** Up to classes with suitable examples	**7**
Unit II	**Study of Life cycle of Algae** ▪ Study of Life cycle of ***Chara***: (with emphasis on systematic position, Occurrence, Morphology, Reproduction and Alternation of generation) ▪ Study of Life cycle of ***Sargassum***: (with emphasis on systematic position, Occurrence, Morphology, Reproduction and Alternation of generation)	**8**
Unit III	**An Introduction to fungi** ▪ Definition and General Characters ▪ Habit and habitat ▪ Structure of thallus ▪ Reproduction ▪ Outline classification of fungi according to **Ainsworth (1973)** up to classes with suitable examples. ▪ Role of Fungi in:	**7**

	Agriculture, Industry, Food, Medicine ▪ Contribution of following mycologists Prof. E. J. Buttler and Prof. C. V. Subramanian	
Unit IV	▪ Study of Life cycle of ***Albugo***: with reference to systematic position, thallus structure and reproduction. ▪ Study of Life cycle of ***Penicillium***: with reference to systematic position, thallus structure and reproduction. ▪ Definition , General account, significance of Mycorrhiza , Types :Ecto and Endomycorrhiza.	**8**
Study Resources	**References:** ▪ Alexopoulus C. J, Mims C. W. and Blacwel M. I. (1996), Introductory Mycology. John Wiley and Sons Inc. New York, U. S. A. ▪ Bold, H. C. and M. J. M. Wynne (1978), Introduction to the Algae - Structure and Reproduction. Prentice Hall of India Pvt. Ltd. New Delhi. ▪ Chapman, V. J. and D. J. Chapman (1979), The Algae. English Language Book Soc. & Mac Millons, London. ▪ Dube, H. C. (1990), An Introduction to Fungi. Vikas Pub. House Ltd. New Delhi, India. ▪ Ganguli, H. C. and Kar, A. K. (2001), College Botany Vol. I. Books and Allied Press Ltd. Kolkata, India ▪ Kumar H. D. (1988), Introductory Phycology. Affiliated East West Press Ltd. New Delhi ▪ Kumar H. D. and H. N. Singh (1976), A Text Book of Algae. Affiliated East West Press Ltd. New Delhi, India ▪ Pandey, B. P. (1994), A Text Book of Botany - Algae. S. Chand and Co. Ltd. New Delhi, India. ▪ Pandey, S. N., Trivedi, P. S. and S. P. Misra (1995), A Text Book of Algae. Vikas Pub. House Pvt. Ltd. New Delhi, India. ▪ Prescott, G. W. (1969), The Algae: A Review. Thomas Nelson and Press, London, U. K. ▪ Sharma, O. P. (1990), Text Book of Algae. Tata McGraw Hill Pub. Co. Ltd. New Delhi, India. ▪ Sharma, O. P. (1990), Text Book of Fungi. Tata McGraw Hill Pub. Co. Ltd, New Delhi, India. ▪ Singh, Pande and Jain. (2004), Text book of Botany. Diversity of Microbes and Cryptogams. Rastogi Publications, Gangotri, Shivaji Road, Meerut ▪ Smith G. M. (1955), Cryptogamic Botany Vol. I: Algae and Fungi. McGraw Hill Book Co. New York, U. S. A. ▪ Vashishta, B. R. (2012), Botany for Degree Students - Algae. S. Chand and Co. Ltd. New Delhi, India. ▪ Pandey, B. P. (1995), A Text Book of Botany Bryophyta. S. Chand and Co. Ltd. New Delhi, India. ▪ Parihar, N. S. (1972), An Introduction to Embryophyta. Vol.1 Bryophyta, Central Book Depot, Hydrabad, India.	

T.Y. B.Sc. Botany (Major)
Semester-V
BOT-DSC-352: Angiosperm Taxonomy

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To classify plant systematics and recognize the importance of herbarium and Virtual herbarium ▪ To evaluate the Important herbaria and botanical gardens ▪ To Assess terms and concepts related to Phylogenetic Systematics ▪ To Generalize the characters of the families according to Bentham & Hooker's system of classification	
Course Outcomes	After successful completion of this course, students are expected to: ▪ From this paper student will get the importance of herbarium, systematics and classification ▪ They will learn the terms and concepts related to phyllogenetic studies. ▪ They will be able to generalize the characters of families as per Bentham and Hookers system of classification.	
Unit	**Contents**	**Hours**
Unit I	**Unit-I: Study of origin of Angiosperms** ▪ Definition, Distinguishing Characters of Angiosperms ▪ Taxonomy: Aims of taxonomy ▪ The origin of Angiosperms: w. r. t. i. Age of Angiosperms ii. Probable ancestors of angiosperms: Theories of Angiosperm's origin (Gnetales, Benetitales and Pteridospermales)	**7**
Unit II	**Unit-II: Systems of Classification** ▪ Study of Systems of Classification w. r. t. outline, merits and demerits of - Hutchinson's system of classification ▪ Engler and Prantl's system of classification ▪ Principles of Angiosperm Phylogeny Group (APGIV) classification. (Brief account)	**6**
Unit III	**Unit-III: Significance of Plant systematic and Botanical Nomenclature** ▪ Importance of Herbarium ▪ Virtual herbarium ▪ Flora, Monographs, Journals ▪ Principles and rules (ICN) ▪ Typification, author citation, ▪ Rejection of names	**6**
Unit IV	**Unit-IV: Study of Angiosperm Families** ▪ *Sensu*Bentham and Hooker's system of classification, ▪ Study of following families w. r. t. geographical distribution, systematic position, morphological characters (vegetative and floral), salient features, floral formula and economic importance of the following families: Annonaceae; Cruciferae; Compositae (Asteraceae); Labiatae; Asclepiadaceae; Nyctaginaceae; Liliaceae; Orchidaceae; Musaceae. ▪ Biological importance of Asclepidaceae, Orchidaceaeand	**11**

	Asteraceae	
Study Resources	▪ Singh, (2012), *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi.3rdedition. ▪ Jeffrey, C. (1982), An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge. ▪ Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002), Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition. ▪ Radford, A.E. (1986), Fundamentals of *Plant Systematics*. Harper and Row, New York. ▪ Sambamurty A.V.S.S. (2005), Taxonomy of Angiosperms. I. K. International Pvt. Ltd., New Delhi. ▪ Singh, V., Pande, P. C. & Jain, D. K. (2008), Taxonomy and Economic Botany. Rastogi Publications, Meerut. ▪ Pandey, B. P. (2009), A Textbook of Botany Angiosperms. S. Chand and Company	

T.Y. B.Sc. BOTANY (Major)
Semester-V
BOT-DSC-353: Cytogenetics, Plant Breeding and Evolution

Total Hours: 30 **Credits: 2**

Course Objectives	▪ Understand the principles of Mendelian genetics, chromosomal organization, and inheritance patterns. ▪ Analyze chromosomal aberrations, cytoplasmic inheritance, and their genetic implications. ▪ Explore plant breeding techniques, including hybridization and selection methods, for crop improvement. ▪ Examine the theories of evolution and their applications in understanding species diversity and adaptation. ▪ Investigate behavioral evolution and the neural basis of learning, memory, and social communication.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Explains the mechanisms of inheritance, chromosomal organization, and genetic variations. ▪ Analyzes and interprets the effects of chromosomal aberrations and cytoplasmic inheritance in real-world scenarios. ▪ Applies plant breeding techniques, such as hybridization and selection methods, to solve agricultural challenges and improve crop productivity. ▪ Evaluates evolutionary theories and applies them to understand species adaptation and diversity. ▪ Integrates concepts of behavioral evolution to explain neural, social, and reproductive strategies in organisms.	
Unit	**Contents**	**Hours**
Unit I	**Mendelian Genetics and Chromosomal Organization** ▪ History, Definition, Concept, heredity, variation, Genetical terminology, branches and applications of Genetics. ▪ Monohybrid Cross, Dihybrid Cross, Laws of Mendel, Back cross, Test Cross. ▪ Incomplete Dominance, Codominance, Multiple Alleles. ▪ Chromatin structure and organization: Chromosome structure and DNA packaging; euchromatin and heterochromatin. ▪ Organization of plastid and mitochondrial genomes. ▪ Special Chromosomes: Structure, occurrence and behaviour of polytene, lampbrush, B and sex chromosomes.	**6**
Unit II	**Alterations of Chromosome and Cytoplasmic Inheritance** ▪ Euploidy, Aneuploidy-Concept and Types, Aneuploidy in Plants, Polyploidy in Plants, Applications of Polyploidy. ▪ Cytology and genetic effects of Deletion, Duplication Inversion and Translocation with examples. ▪ Cytoplasmic inheritance Definition and concept, Chloroplast-Varigation in Four O'clock plants, Mitochondria- Petite mutants in yeast.	**4**

Unit III	**Plant Breeding** ▪ Introduction, Scope, Importance and Objectives. ▪ Plant Introduction and Acclimatization. ▪ Methods and Practices of Plant Breeding: mass selection, pure line selection and clonal selection, advantages and disadvantages, achievements ▪ Hybridization: Definition and Concept, Steps in Hybridization. ▪ Breeding Methods -Pedigree method, Bulk method, Singleseed descent method and Backcross method. ▪ Heterosis and Hybrid Vigour. ▪ Introduction to male sterility.	**10**
Unit IV	**Evolution** ▪ Definition, Inorganic, Chemical and Molecular Evolution. ▪ Concept of origin of species, organic and biological evolution. ▪ Postulates of Lamark (Lamark's and Pre-Darwinian theories). ▪ Theory of Natural Selection (Darwinism). ▪ Post Darwinism (Modern Synthetic Theory). ▪ Mutation theory. ▪ Introduction to Hardy Weinberg Principles. ▪ Brain, Behaviour and Evolution:Neural basis of learning, memory, cognition, sleep and arousal; Development of behavior; Social communication; Social dominance.	**10**
Study Resources	▪ Gardner E. J., Simmons M. J., Snustad, D. P. (2008). Principles of Genetics, 8th Ed. Wiley, India. ▪ Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics, 5th Ed., John Wiley & Sons Inc., India. ▪ Klug, W. S., Cummings, M. R., Spencer, C., Palladino, M. (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings. ▪ Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th Ed., W. H. Freeman and Co., U.S.A. ▪ Pierce, B. A. (2011). Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning. ▪ Singh, B. D. (2005). Plant Breeding: Principles and Methods, 7th Ed., Kalyani Publishers. ▪ Chaudhari, H. K. (1984). Elementary Principles of Plant Breeding, 2nd Ed., Oxford - IBH. ▪ Verma P.S and Agarwal V.K (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.	

T.Y. B.Sc. Botany (Major)
Semester-V
BOT-DSC-354: Practical on BOT-DSC-351 and BOT-DSC-353

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To accustom students with Algae, Fungi . ▪ Develop proficiency in cytological techniques for preparing fixatives, stains, and observing chromosomes. ▪ Understand and identify stages of mitosis and meiosis using plant materials. ▪ Analyze chromosome morphology and chromatin organization through practical demonstrations. ▪ Apply genetic principles to study inheritance patterns using monohybrid and dihybrid crosses. ▪ Acquire practical knowledge of hybridization, selfing, and crossing techniques in crop plants.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the fundamental concepts related to algae, fungi and bryophytes ▪ Examine morphology and range of thallus structure in algae ▪ Evaluate the significance of fungi and its different types ▪ Demonstrates the ability to prepare and use fixatives and stains for cytological studies. ▪ Identifies and explains the stages of mitosis and meiosis in suitable plant materials. ▪ Analyzes chromosomal morphology and chromatin structure, including euchromatin and heterochromatin. ▪ Applies genetic concepts to solve problems related to monohybrid and dihybrid crosses. ▪ Performs hybridization, selfing, and crossing techniques effectively in self- and cross-pollinated crops.	
Sr. No.	**Contents**	**Hours**
1-2	**Study of range of thallus structure in algae with the help of materials or Permanent slides (any one from the examples):** a) **Unicellular thallus**: *Chlamydomonas, Chlorella* b) **Colonial thallus**: *Pandorina*, *Eudorina*, *Volvox*, *Hydrodictyon* c) **Filamentous thallus**: *Pithophora*, *Chaetophora*, *Coleochaetae*, *Stigeoclonium*, *Drapanaldia*, *Fritscheilla*and *Oedogonium*	**8**
3	Study of range of thallus structure in algae with the help of materials or Permanent slides (any one from the examples): a) **Siphonaceous thallus**: *Vaucheria*, *Caulerpa* b) **Pseudoparenchymatous thallus:** (Uniaxial/Multiaxial) thallus: *Batrachospermum*, *Polysiphonia* c) P**arenchymatous thallus**: *Ulva*, *Enteromorpha*	**4**
4	Study of life cycle of ***Chara* .**	**4**
5	Study of life cycle of ***Sarassum.***	**4**
6	Study of life cycle of ***Albugo.***	**4**

7	Study of life cycle of ***Penicillium.***	**4**
8	Cytological techniques-preparation of Fixatives, preparation of stains (Aceto carmine and Aceto-orcein).	**4**
9-10	Study of various stages of mitosis from suitable plant material.	**8**
11-12	Study of various stages of meiosis from suitable plant material.	**8**
13	Preparation of salivary gland chromosomes in Chironomous larvae.	**4**
14	Morphological study and selfing techniques in self pollinated crops.	**4**
15	Morphological study and crossing techniques in cross pollinated crops.	**4**
Study Resources	▪ Vanderpoorten, A. and Goffinet, B. (2009), Introduction to Bryophytes. Cambridge University Press, Cambridge ▪ Kumar, H.D. (1999), Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. ▪ Tortora, G.J., Funke, B.R., Case, C.L. (2010), Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. ▪ Sethi, I.K. and Walia, S.K. (2011), Text book of Fungi & Their Allies, MacMillan 4. Publishers Pvt. Ltd., Delhi. ▪ Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996), Introductory Mycology, John Wiley and Sons (Asia), Singapore. ▪ Klug, W. S., Cummings, M. R., Spencer, C., Palladino, M. (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings. ▪ Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th Ed., W. H. Freeman and Co., U.S.A. ▪ Pierce, B. A. (2011). Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning. ▪ Singh, B. D. (2005). Plant Breeding: Principles and Methods, 7th Ed., Kalyani Publishers. ▪ Chaudhari, H. K. (1984). Elementary Principles of Plant Breeding, 2nd Ed., Oxford - IBH.	

T.Y. B.Sc. Botany (Major)
Semester-V
BOT-DSC-355: Practical on BOT-DSC-352

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To know the technique of studying family in morphological terms ▪ To get the knowledge of describic common plants in respective families ▪ To get the idea to make artificial key for plants ▪ To study the plants in their natural habitat.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Know the technique of studying family in morphological terms ▪ Get the knowledge of describic common plants in respective families ▪ Get the idea to make artificial key for plants ▪ Learn the plants in their natural habitat.	
Sr. No.	**Contents**	**Hours**
1	Method to describe an Angiospermic plant in morphological terms	**4**
2-11	Study of any 09 plant families with respect to systematic position, morphological characters (vegetative and floral), floral formula and floral diagram (sensu Bentham and Hookers system)	**40**
12-13	Identification of genus and species (any suitable) by using local, regional, state and national flora	**8**
14	Preparation of Artificial Key (Dichotomous), Indented Key and Bracketed Key	**4**
15	Field visit Note : i) Excursion tour is compulsory ii) Submission of photograph of any ten plants and tour report at the time of practical examination	**4**
Study Resources	▪ Singh, (2012), *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi.3rdedition. ▪ Jeffrey, C. (1982), An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge. ▪ Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002), Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition. ▪ Radford, A.E. (1986), Fundamentals of *Plant Systematics*. Harper and Row, New York. ▪ Sambamurty A.V.S.S. (2005), Taxonomy of Angiosperms. I. K. International Pvt. Ltd., New Delhi. ▪ Singh, V., Pande, P. C. & Jain, D. K. (2008), Taxonomy and Economic Botany. Rastogi Publications, Meerut. ▪ Pandey, B. P. (2009), A Textbook of Botany Angiosperms. S. Chand and Company	

T.Y. B.Sc. Botany (Elective)
Semester-V
BOT-DSE-351A: Medico Botany and Pharmacognosy

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To know history, scope and importance of Medicobotany and Pharmacognosy. ▪ To study classification, cultivation, collection and processing of plant drugs. ▪ To study morphology, botanical and chemical characterization and analytical methods of crude drugs. ▪ To prepare Ayurvedic recipes. ▪ To make student aware about biopiracy and legislation about medicinal Plants.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand Scope and importance of Medico Botany and Pharmacognosy. ▪ Analyze the different types of plant drug processing. ▪ Examine the chemical and analytical characterization of crud drugs.	
Unit	**Contents**	**Hours**
Unit I	**Classification of Plant Drugs** ▪ Taxonomical, morphological, chemical, therapeutic and alphabetical ▪ Chemical nature of crude drug ▪ Concept of therapeutic active chemical constituents ▪ Cultural practices for seed / vegetative / clonally propagated medicinal plants (Locally available any five plants)	**7**
Unit II	**Collection and processing of crude drugs** ▪ Collection (Any five plants) a) Root b) Stem and bark c) Leaf d) Flower e) Fruits and Seeds f) Gums and resins ▪ Processing (Any five plants) a) Harvesting b) Drying c) Garbling/Dressing, d) Packing e. Storage ▪ Drug aduleration and types of adulterants	**8**
Unit III	**Preparation of following Ayurveda medicines with respect to Botanical source, part used and method of preparation:** ▪ Triphala churn ▪ Kumari asav ▪ Arjunarishtha (Aristha)	**7**
Unit IV	**Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs** ▪ Root drug: *Asparagus racemosus* (Shatavari) ▪ Stem bark drug: *Teminalia arjuna* (Arjun sadada) ▪ Leaf drug: *Adathoda zeylanica* (Adulsa) ▪ Fruit drug: *Aegle marmelos* (Bel)	**8**

	▪ Entire plant: *Ocimum sanctum* (Tulasi)	
Study Resources	▪ Jeffery, B. and Harborn. (1998), Photochemical Methods: A guide to Modern Techniques of Plant analysis. Springer Netherlands. eBook ISBN 978-94-009-5921-7. ▪ Khandelwal, K.R. (2008), Practical Pharmacognocy, Pragati Books Pvt. Ltd. 50. ISBN13: 9788185790305 ▪ Kokate, C.K. Purohit A.P. and Gokhale S.B. (2021), Pharmacognocy (degree), Nirali Prakashan. ISBN 9788196396152 ▪ Iyengar MA. (1995), Study of crude drugs, 8th ed., Manipal power press, Manipal, India. ▪ Iyengar, M.A. (2017), Pharmacognocy Lab. Pharma Med Press; 1st edition. ISBN-10 : 9386819449 ▪ Rangari, V.D. (2017), A Textbook of Pharmacognocy and Photochemistry. Vol-I and II ▪ CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016), Aush Gyanya: Handbook of Medicinal and Aromatic Plant Cultivation. ▪ Evans, W.C. (2009), Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd. ▪ Sharma, R. (2013), Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.	

T.Y. B.Sc. Botany (Elective)
Semester-V
BOT-DSE-351B: Pharmacognosy
(*NPTELCourse Code:102105342)

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To know history, scope and importance of Pharmacognosy. ▪ To study classification, cultivation, collection and processing of plant drugs. ▪ To study morphology, botanical and chemical characterization and analytical methods of crude drugs. ▪ To prepare Ayurvedic recipes. ▪ To make student aware about biopiracy and legislation about medicinal Plants.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Know about important of system of medicine. ▪ Develop critical understanding of chemical nature of crude drug ▪ Develop practical approach of cultivation of plant drug ▪ Demonstrate proficiency in the experimental techniques and methods of appropriate analysis and processing of crude drug. ▪ Increase the awareness on preparation of Ayurvedic medicine.	
Unit	**Contents**	**Hours**
Unit I	▪ Medicinal and aromatic plants. ▪ Origin and Evolution of plant specialized metabolism. ▪ Eliciting specialized metabolism in plant cell and organ culture. ▪ Different strategies of metabolic engineering. Genetic transformation for manipulation of plant specialized metabolism. Introduction to alkaloids. ▪ Engineering tropane alkaloid pathways in plants.	**7**
Unit II	▪ Engineering morphine and purine alkaloid pathways. Biosynthesis and genetic manipulation of indole alkaloid pathways. Metabolic reprogramming for non-natural indole alkaloids in plants. ▪ Discovery of new alkaloid pathways in plants (strychnine and colchicine). ▪ Terpenoid metabolism and pathway manipulation.	**8**
Unit III	▪ Genetic manipulation of carotenoid pathway. Emission biology of terpenoid floral volatiles. ▪ Biotechnological intervention for production of complex terpenes viz. hyperforin and taxol. ▪ Biochemistry of phenylpropanoid/benzenoid metabolism. Pathway manipulation for reduction of lignin content and composition.	**7**
Unit IV	▪ Biochemistry and cell biology of anthocyanin formation in flowers. ▪ Manipulation of anthocyanin pathways and creation of blue rose. ▪ Biochemistry of tea polyphenols. Biosynthesis of phenolic alcohols and esters. ▪ Pathway manipulation for production of phenolic esters.	**8**

	▪ Metabolic engineering for vanillin biosynthesis. Genetic engineering of shikonin pathway. Molecular pharming for human somatotropin production in transplastomic plants.	
Study Resources	**References:** ▪ Jeffery, B. and Harborn. Photochemical Methods: A guide to Modern Techniques of Plant analysis. Springer, 1998. ▪ Khandelwal, K.R. Practical Pharmacognocy, Pragati Books Pvt. Ltd. ▪ Kokate, C.K. Purohit A.P. and GokhaleS.B. Pharmacognocy (degree), NiraliPrakashan. ▪ Iyengar, M.A. Study of Crude drugs, Manipal Power Press, Manipal. ▪ Iyengar, M.A. Pharmacognocy Lab. Manipal Power Press, Manipal. ▪ Rangari, V.D. A Textbook of Pharmacognocy and Photochemistry. Vol-I and II ▪ Daniel, M. Chemotaxonomy – ▪ Wallis, T.E. Textbook of Pharmacognocy. J.A, Churchill Ltd. London ▪ Trease& Evans', Pharmacognosy ▪ Buchanan et al. Biochemistry & Molecular Biology of Plants ▪ Walton& Brown, Chemicals from Plants ▪ Bosher&Tobins, Plant Biochemistry	

T.Y. B.Sc. Botany (Elective)
Semester-V
BOT-DSE-352A: Practical on BOT-DSE-351A

Total Hours: 60 **Credits: 2**

Course Objectives	• To demonstration and practice cultural practices for seed / vegetative / clonally propagated medicinal plants • To study of harvesting, drying and storage of various locally available medicinal plants • To study of drying, grading and harvesting of medicinal and aromatic plants.	
Course Outcomes	After successful completion of this course, students are expected to: • Cultural practices for seed / vegetative / clonally propagated medicinal plants • Prepare of various Ayurveda medicines • Distribution, botanical characterization of drug constituents • Drying grading and harvesting of medicinal and aromatic plants.	
Sr. No.	**Content**	**Hours**
1.	Harvesting, drying, storage of Stevia	**4**
2.	Harvesting, drying, storage of Kalmegh	**4**
3.	Harvesting, drying, storage of Satavar	**4**
4.	Harvesting and distillation of Mints and Basil	**4**
5.	Preparation of following Ayurveda medicines with respect to Botanical source, part used and method of preparation: ▪ Triphala churn ▪ Kumari asav	**4**
6.	Preparation of following Ayurveda medicines with respect to Botanical source, part used and method of preparation: ▪ Arjunarishtha (Aristha)	**4**
7 and 8	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: ▪ Root drug: Asparagus racemosus (Shatavari) ▪ Stem bark drug: Teminalia arjuna (Arjun sadada)	**8**
9 and 10	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: ▪ Leaf drug: Adathoda zeylanica (Adulsa) ▪ Fruit drug: Aegle marmelos (Bel)	**8**
11.	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: ▪ Entire plant: Ocimum sanctum (Tulasi)	**4**
12.	Study of drying, grading and harvesting of medicinal plants.	**4**
13.	Study of drying, grading and harvesting of aromatic plants.	**4**
14.	Extraction of alkaloids from Belladona	**4**
15.	Extraction of Withanaloids from Ashwagandha	**4**
Study Resources	▪ AYUSH (www.indianmedicine.nic.in), About the systems—An overview of Ayurveda, ▪ CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow	

	(2016), Aush Gyanya: Handbook of Medicinal and Aromatic Plant Cultivation. ▪ Evans, W.C. (2009), Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd. ▪ Jain, S.K. and Jain, Vartika. (eds.) (2017), Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi ▪ Kapoor, L. D. (2001), Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press. ▪ Thakur, R. S., H. S. Puri, and Husain, A. (1989), Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

T.Y. B.Sc. Botany (Elective)
Semester-V
BOT-DSE-352B: Practical on BOT-DSE-351B

Total Hours: 60 **Credits: 4**

Course Objectives	▪ To know practical approach about collection and processing of crud drug ▪ To study classification, morphological characterization of various plant material. ▪ To study phytochemical analysis of crude drugs. ▪ To prepare Ayurvedic recipes. ▪ To make student aware about biopiracy and legislation about medicinal Plants.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Know about important of system of medicine. ▪ Develop critical understanding of chemical nature of crude drug ▪ Develop practical approach of cultivation of plant drug ▪ Demonstrate proficiency in the experimental techniques and methods of appropriate analysis and processing of crude drug. ▪ Increase the awareness on preparation of Ayurvedic medicine.	
Sr. No.	**Contents**	**Hours**
1	Collection of crud drug from various parts of plant from locally available plant material	**4**
2	Processing of crud drug a) Harvesting b) Drying c) Garbling/Dressing, d) Packing e. Storage	**4**
3	Microscopic and Macroscopic characters for recognizing Botanical source, External Morphology, Epidermal features like trichomes, stomata types, stomatal number, and stomatal index of following. a. Adulsa (*Adathodazeylanica*) b. *Ocimum sanctum* (Tulasi)	**4**
4	Drug adulteration types and checking of drug adulteration from available material	**4**
5	Preliminary photochemical screening for the powder drug of following a. Rhizome- Adruk (Zizngiber officinalis) b Leaf – Adulsa (Adathodazeylanica)	**4**
6	Preliminary photochemical screening for the powder drug of following c. Stem- *Tinosporacordifolia* (Gulvel) dEntire plant: *Ocimum sanctum* (Tulasi)	**4**
7	Preliminary photochemical screening for the powder drug of following Stem bark- *Teminaliaarjuna (Arjun sadada)* f.Root drug: *Asparagus racemosus* (Shatavari)	**4**
8	Preparation of following Ayurvedic medicines with respect to Botanical source, part used and method of preparation: Triphalachurna SukhsarakVatti (triphala+sonamukhi+Jire+Ajwon)	**4**
9	Preparation of following Ayurvedic medicines with respect to Botanical source, part used and method of preparation: Arjunarishtha (Aristha) MakaTelam (*Eclipta alba*)	**4**
10	Preparation of following Ayurvedic medicines with respect to Botanical source, part used and method of preparation: Kumariasav	**4**

11	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: Root drug: *Asparagus racemosus* (Shatavari) Rhizome: *Zingiberofficinale* (Adrak)	**4**
12	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: Stem bark drug: *Teminaliaarjuna* (Arjun sadada) Stem drug:*Tinosporacordifolia* (Gulvel)	**4**
13	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: Leaf drug: *Adathodazeylanica* (Adulsa) Fruit drug: *Terminalia bellerica* (Behada)	**4**
14	Botanical source, distribution, botanical characterization of drug constituents and uses of the following drugs: Entire plant: *Ocimum sanctum* (Tulasi)	**4**
15	Biopiracy of medicinal plants from India Drug legislation and patenting	**4**
Study Resources	1. Jeffery, B. and Harborn. Photochemical Methods: A guide to Modern Techniques of Plant analysis. Springer, 1998. 2. Khandelwal, K.R. Practical Pharmacognocy, Pragati Books Pvt. Ltd. 3. 4. 5. 6. 7. 8. 3.Kokate, C.K. Purohit A.P. and GokhaleS.B. Pharmacognocy (degree), NiraliPrakashan. 4. Iyengar, M.A. Study of Crude drugs, Manipal Power Press, Manipal. 5. Iyengar, M.A. Pharmacognocy Lab. Manipal Power Press, Manipal. 6. Rangari, V.D. A Textbook of Pharmacognocy and Photochemistry. Vol-I and II 7. Daniel, M. Chemotaxonomy – 8.Wallis, T.E. Textbook of Pharmacognocy. J.A, Churchill Ltd. London	

T.Y. B.Sc. Botany (Vocational)
Semester-V
BOT-VSC-351: Techniques in Botany

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To know about microscopic technique in Botany. ▪ To study the centrifugation technique in Botany ▪ To study the spectroscopic technique in Botany ▪ To study Chromatographictechniques in Botany.	
Course Outcomes	▪ After successful completion of this course, students are expected to: ▪ Well versed with the microscopic technique. ▪ Understand the centrifugation technique in Botany ▪ Learn Spectroscopic technique in Botany ▪ Aquire the knowledge of Chromatographic techniques.	
Unit	**Contents**	**Hours**
Unit I	**Microscopy** Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; fluorescence microscopy: Transmission and Scanning electron microscopy. Micrometry: - metric units, principles and techniques. Properties of light-wavelengths and resolving power of microscope.	**8**
Unit II	**Centrifugation techniques: -** Principles and working of centrifuge RPM, rotors and its types, types of centrifuge (high speed centrifuge,ultra-centrifuge and gradient centrifuge)	**7**
Unit III	**Spectroscopic techniques: -** Relation of wavelength and energy, principles and working of visible spectrophotometer, U.V. spectrophotometer, I.R. spectrophotometer and applications in biology	**7**
Unit IV	**Chromatography** Introduction – Definition and principle of chromatographyTypes(Any 2) a) Paper chromatography -Unidirectional - Ascending and descending, b) Two dimensional, c) Thin layer chromatography -Plate and column. d) Procedure for preparation of paper chromatogram and thin layerChromatogram RF Value	**8**
Study Resources	• Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition. • Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A. • Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A.,Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rdedition. • Starrier, R.Y. Ingrahaan, J.L., Whalis, M.L. and P.andPainter (1993) • GeneralMicrobiology (5th Ed) The Macmillan Press Ltd, London, U.K. • Prasad andPrasad . Outline of microtechniques. Emkay publication Delhi (1975). • L. R. Patki, B. L. Bhalchandra, I. H. Jeevaji forwarded by Dr. (Mrs) V.	

	M. Sapkal. An introduction to microtechniques. S. Chand & co. ltd. New Delhi. • V. K. Sharma.(1991) – Techniques in microscopy and cell Biology, Tata Mc GrawHillPublishing Co. Ltd. New Delhi. • UpadhayaNath "Biophysical chemistry" Himalaya Publication, Mumbai. • Sadasivan, Manicum "Biochemical analysis" New age Publication, New Delhi.	

T.Y. B.Sc. Botany (Vocational)
Semester-V
BOT-VSC-352:Practical on BOT-VSC-351

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To study Preparation of permanent slides ▪ To know the isolation of chlorophyll by centrifugation ▪ To study estimation of protein by Lowry's methods. ▪ To study separation sugar and amino acid by paper chromatography	
Course Outcomes	▪ After successful completion of this course, students are expected to: ▪ Well versed with the permanent slides preparation. ▪ Understand chlorophyll isolation by centrifugation ▪ Learn protein estimation by Lowry's methods ▪ Aquire the knowledge of separation of sugar and amino acid by paper chromatography	
Sr. No.	**Contents**	**Hours**
1-2	To amino acid by paper chromatography.	**8**
3-4	To separate sugars by paper chromatography	**8**
5-6	Isolation and estimation of Chlorophyll through centrifugation and spectrophotometry.	**8**
7-8	To separate chloroplast pigments by TL chromatography	**8**
9-10	Measurment of biological material by mycrometry	**8**
11	Preparation of permanent slides (double staining).	**4**
12	Study of different microscopic techniques using photographs/micrographs	**4**
13	Demonstration of principle and working of spectrophotometer, centrifuge, microscope	**4**
14-15	To study amino acid by circular paper chromatography.	**8**
Study Resources	▪ Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition. ▪ Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A. ▪ Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A.,Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rdedition. ▪ Starrier, R.Y. Ingrahaan, J.L., Whalis, M.L. and P.andPainter (1993) ▪ GeneralMicrobiology (5th Ed) The Macmillan Press Ltd, London, U.K. ▪ Prasad andPrasad . Outline of microtechniques. Emkay publication Delhi (1975). ▪ L. R. Patki, B. L. Bhalchandra, I. H. Jeevaji forwarded by Dr. (Mrs) V. M. Sapkal. An introduction to microtechniques. S. Chand & co. ltd. New Delhi. ▪ UpadhayaNath "Biophysical chemistry" Himalaya Publication, Mumbai. ▪ Sadasivan, Manicum "Biochemical analysis" New age Publication, New Delhi.	

T.Y. B.Sc. Botany (On Job Training)
Semester-V
OJT-BOT-351: Internship/On Job Training

Hours: 120 **Credits: 4**

Course objectives	• To provide the students with actual work experience • To make aware prescribe standards and guidelines at work • To develop the employability of participating student • To avail an opportunities to eventually acquire job experiences
Course outcomes	After successful completion of this course, students are expected to: • Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and proceduralsystems • Acquaintthe knowledge related to working hours, work protocols and guidelines • Understand the roles and responsibilities of employee as well as team work • Justify job experiences that match theirpotentials, skills, and competencies

Internship

An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills.

On the job training

On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc.

Internship / OJT Process:

1. **Pre-Approval**: Students should seek approval from the college before starting the Internship / OJT. This ensures that the Internship / OJT aligns with the curriculum and meets the necessary criteria.
2. **Mentor and Supervisor**: Each student should have an assigned mentor at the organization/industry where they are interning. Additionally, anInternship / OJT supervisor from the college will be appointed to guide and monitor the progress.
3. **Regular Reporting:** Students should maintain regular communication with their supervisor and mentor, providing progress reports and seeking feedback.
4. **Professional Conduct**: Students must adhere to professional conduct throughout the Internship / OJT, including punctuality, respect for colleagues, and adherence to the organization's/industry's policies and guidelines.
5. **Student Diary**: Students should maintain a diary to document their experiences, challenges faced, and lessons learned during the Internship / OJT.
6. **Final Report**: At the end of the Internship / OJT, students should submit a comprehensive final report, summarizing their accomplishments, contributions, and key takeaways.
7. **Evaluation**: The Internship / OJT is worth 4 credits (equivalent to 100 marks), and the evaluation will be divided into two categories: one by the mentor and the other by the Internship / OJT supervisor. The mentor's evaluation (internal examination) will carry 40 marks, and it will be based on the student's performance during the Internship / OJT. External examination will be conducted by mentor and supervisor which will be based on the student's diary, the final report prepared by the student, and their performance in the final viva voce, and will carry60 marks. The total marks obtained by the students in both evaluations will be added together for the purpose of final evaluation. The evaluation of the students will be conducted by the mentor using the evaluation sheet provided by the college.

Internal Evaluation Criteria for Students by the Mentor:

1. **Quality of Work** (10 marks): How well did the student perform their assigned tasks during the Internship / OJT? Evaluate the accuracy, thoroughness, and attention to detail in their work.
2. **Initiative and Proactiveness**(10 marks): Did the student show initiative in taking on additional responsibilities or tasks beyond their assigned role? Did they demonstrate a proactive attitude towards problem-solving?
3. **Communication Skills** (10 marks): Assess the student's ability to communicate effectively with colleagues, superiors, and clients (if applicable). Consider both written and verbal communication.
4. **Problem-Solving SkillsandTime Management** (10 marks): Evaluate the student's ability to analyze problems, propose solutions, and implement effective strategies to overcome challenges.How well did the student manage their time during the Internship / OJT? Were they able to meet project deadlines and handle multiple tasks efficiently?

External Evaluation Criteria for Students by the Supervisor and Mentor:

1. **Student Diary** (15 marks): Review the student's diary to understand their reflections, insights gained, and self-assessment of their performance during the Internship / OJT.
2. **Final Report** (15 marks): Evaluate the quality and comprehensiveness of the student's final report, including the clarity of their achievements and contributions.
3. **Presentation of Student in Viva Voce** (30 marks): Evaluate the responses given by the student to the questions asked by the faculty in the Viva Voce.

Evaluation Criteria for Final Viva Voce:

1. Presentation Skills
2. Knowledge of the Internship / OJT Project
3. Practical Application and Work Experience
4. Problem-Solving and Critical Thinking
5. Communication and Professionalism

SEMESTER-VI

T.Y. B.Sc. Botany (Major)
Semester-VI
BOT-DSC-361: Diversity of Higher Cryptogams

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To understand the diversity Bryophytes and Pteridophytes ▪ To know about morphological, anatomical and developmental patterns in the bryophytes, pteridophytes ▪ To know the systematic, morphology and structure, of Bryophytes and Pteridophytes ▪ To understand the life cycle pattern of Bryophytes and Pteridophytes ▪ To know the economic importance of Bryophytes and Pteridophytes	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the diversity Bryophytes and Pteridophytes ▪ Know about morphological, anatomical and developmental patterns in the bryophytes, pteridophytes ▪ Know the systematic, morphology and structure, of Bryophytes and Pteridophytes ▪ Understand the life cycle pattern of Bryophytes and Pteridophytes ▪ Know the economic importance of Bryophytes and Pteridophytes	
Unit	**Contents**	**Hours**
Unit I	**Bryophytes** ▪ Introduction, Habit and habitat and General characteristics of Bryophytes. ▪ Alternation of generations. ▪ Classification of Bryophytes according to G. M. Smith (1955) up to classes with reasons, giving at least two examples from each class. ▪ Economic and ecological importance of Bryophytes.	**5**
Unit II	▪ Study of Life Cycle of Bryophytes: ***Marchantia*** and ***Anthoceros*** with respect to-Taxonomic position,Morphology,Anatomy, Reproduction,Gametophytes and sporophytes	**10**
Unit III	**Pteridophytes:** ▪ Introduction, definition and general characteristics of Pteridophytes. ▪ Habit and Habitat. ▪ Classification of Pteridophytes according to K. R. Sporneup to classes with reasons, giving at least two examples from each class. ▪ Economic importance of Pteridophytes. ▪ Stele and its types	**5**
Unit IV	▪ Study of Life Cycle of Pteridophytes: ***Psilotum*** and ***Equisetum*** with respect to-Taxonomic position,Morphology, Anatomy, Reproduction,Sporophytes and Gametophytes	**10**
Study Resources	▪ Gangulee, H.C. and Kar, A.K. (2001). College Botany Vol. II. Books and Allied Press Ltd. Kolkata. ▪ Pandey, S.N. and Trivedi, P.S. (1997). A Text Book of Botany Vol. II, Vikas Publishing House (P.) Ltd. New Delhi.	

	▪ Parihar, N.S. (1977). Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad. ▪ Parihar, N.S. (1984). An Introduction to Embryophyta Vol. I Bryophyta. Central Book Depot, Allahabad ▪ Rashid, A. (1996). An Introduction to Bryophyta. Vikas Publishing House Ltd. New Delhi. ▪ Rashid, A. (1996). An Introduction to Pteridophyta. Vikas Publishing House Ltd ▪ Saxena, A.K. and Sarbhai, R.M. (1992). A Text Book of Botany Vol. II Embryophyta. 8. RatanPrakashanMandir, Agra. ▪ Smith, G.M. (1995). Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes). ▪ Mc Graw-Hill Book Company, New york and London. ▪ Sporne, K.R. (1995). The Morphology of Pteridophyta. The Hutchinson University Library, London, U.K. ▪ Vashistha, B.R. (1997). Botany For Degree Students-Bryophyta. S. Chand and company (P.) Ltd. New Delhi. ▪ Vashistha, P.C. (1984). Pteridophytes. S. Chand and company (P.) Ltd. New Delhi	

T.Y. B.Sc. Botany (Major)
Semester-VI
BOT-DSC-362: Gymnosperms and Palaeobotany

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To study Gymnosperms with respect to distinguishing characters, comparison with Angiosperms, and classification. ▪ To study the life cycles of *Pinu*s and *Gnetum* ▪ To study the scope of Paleobotany, types of fossils and geological time scale. ▪ To study the various fossil genera representing different fossil groups.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Classify Gymnosperms on their characteristics and structures. ▪ Develop critical understanding on morphology, anatomy and reproduction of *Pinu*s and *Gnetum* ▪ Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Paleobotany. ▪ Increase the awareness and appreciation of *Pinu*s and *Gnetum*, Paleobotany and their economic importance.	
Unit	**Contents**	**Hours**
Unit I	**GYMNOSPERMS** ▪ Introduction ▪ Distinguishing features of the group ▪ Comparison of Gymnosperms with Angiosperms ▪ Economic importance of Gymnosperms ▪ Classification of Gymnosperms by K. R. Sporne up to orders	**4**
Unit II	**Life cycle of *Pinus* with respect to** ▪ Distribution in India ▪ Systematic position ▪ External morphology ▪ Internal morphology a) Primary structure of root, stem and leaf ▪ Reproductive structure a) Male cone b) Structure & development of Male gametophyte c) Female cone d) Structure & development of Female gametophyte ▪ Pollination andFertilization ▪ Structure of embryo and polyembryony ▪ Seed structure and germination ▪ Alternation of generation	**9**
Unit III	**Life cycle of *Gnetum* with respect to** ▪ Distribution in India ▪ Systematic position ▪ External morphology ▪ Internal morphology a) Primary structure of root, stem and leaf b) Anomalous Secondary growth in Gnetumula ▪ Reproductive structure a) Male cone b) Structure and development of Male gametophyte c) Female cone d) Structure and development of Female gametophyte ▪ Pollination and Fertilization ▪ Structure of embryo and polyembryony	**9**

	▪ Seed structure and germination ▪ Alternation of generation ▪ Resemblance with Angiosperms	
Unit IV	**Palaeobotany** ▪ Introduction, definition and scope ▪ Contribution of BirbalSahani in Palaeobotany ▪ Definition of Fossil ▪ Fossilization process, Conditions favorable for fossilization ▪ Geological time scale. Eras, Periods, Epochs and major plant groups Types of fossils: Impression, Compression, Petrifaction, Cast, Coal ball, Amber ▪ Study of the following fossil groups w. r. t. morphology and structure of - Psilopsida: *Rhynia,* Lycopsida: *Lepidostrobus* (Cone) and Sphenopsida: *Annularia* (Leaf)	**8**
Study Resources	**GYMNOSPERMS** ▪ Datta, S. C. (1966). Introduction to Gymnosperms. Asia Pub. House, New Delhi, India. ▪ Datta, S. C. (1998). Systematic Botany, 4th Ed. New Age International Pvt. Ltd. New Delhi, India. ▪ Gangulee, H. C. and Kar, A. K. (1998). College botany Vol. II. New central book agency (P) Ltd. Kolkata, India. ▪ Chopra, G. L. (1962). Introduction to Gymnosperms. Asia Pub. House, New Delhi. India. ▪ Vashishta, P. C. (1983). Botany for degree students: Gymnosperms. S. Chand & Co. New Delhi, India. ▪ Sporne, K. R. (1967). Morphology of Gymnosperms. Hutchinson university library London,U. K. ▪ Pandey, B. P. (1982). College botany Vol. II. S. Chand & Co. New Delhi, India. **PALEOBOTANY** ▪ Delevoryas, T. (1962). Morphology and Evolution of fossil plants. Holt Reihart& Winston, New York. ▪ Surange, K. R. (1966). Indian fossil Pteridophytes. CSIR New Delhi, India. ▪ Stewart, Wilson. N. (1983). Paleobotany and evolution of plants. Cambridge University Press. ▪ Arnold, Chester, R. (1972). An introduction to Paleobotany. McGraw Hill Publ. Co. Ltd., New York. ▪ Andrews Henry N. (1961). Studies in Paleobotany. John Wiley & Sons, USA. ▪ Dick, M. W. and Edwards D. (1983). Contribution to Paleobotany. The white friars press ltd. Tonbridge. ▪ Shukla, Ashok C. &Shital P. Misra (1975). Essentials of Paleobotany. Vikas Publ. House, New Delhi, India. ▪ Chapman, Meyen S. V. and Hall, Fundamentals of Paleobotany. Cambridge University Press, Cambridge, London, U. K. ▪ Norman, F. Hughes (1976). Paleobotany of Angiosperms origin. Cambridge University Press, Cambridge, London, U. K. ▪ 10. Mishra, S. R. (2010). Text Books of Paleobotany. Discovery Publication House Pvt. Ltd.	

T.Y. B.Sc. Botany (Major)
Semester-VI
BOT-DSC-363: Plant Anatomy

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To understand the fundamental concepts of plant anatomy and embryology ▪ To analyze and recognize the different organs of plant and secondary growth. ▪ To examine the structure and functions of eco-system. ▪ To evaluate the structural organization of flower and the process of pollination and fertilization.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ The students will be able to understand the fundamental concepts of plant anatomy and Embryology ▪ The students will be able to analyze the different organs of plant and secondary growth. ▪ The students will be able to learn the structure and functions of eco-system. ▪ They will learn to evaluate the structural organization of flower and process of pollination and fertilization.	
Unit	**Contents**	**Hours**
Unit I	**Plant Tissues and Organs** ▪ Root and shoot apical meristems ▪ Simple and complex tissues ▪ Structure of dicot and monocot root stem and leaf.	**4**
Unit II	**Secondary Growth, Adaptive and Protective systems of Flower** ▪ Vascular cambium – structure and function ▪ Seasonal activity ▪ Secondary growth in root and stem, ▪ Wood (heartwood and Soft wood) ▪ Hard wood and soft wood ▪ Epidermis, cuticle, stomata ▪ General account of adaptations in xerophytes and hydrophytes.	**11**
Unit III	**Structural Organization of flower and fertilization** ▪ Structure of anther and pollen ▪ Structure and types of ovules ▪ Types of embryo sacs, ▪ Organization and ultrastructure of mature embryo sac ▪ Pollination mechanisms and adaptations ▪ Double fertilization (Syngamy and triple fusion) ▪ Seed-structure appendages and dispersal mechanisms.	**10**
Unit IV	**Embryo and Endosperm, Apomixis and Polyembryony** ▪ Endosperm types ▪ Structure and functions ▪ Dicot and monocot embryo ▪ Definition, types and Practical applications of apomixis and ▪ Polyembryony – causes ▪ Types of polyembryony	**5**

Study Resources	▪ Bhojwani, S.S. and Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. ▪ Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cum	

T.Y. B.Sc. Botany (Major)
Semester-VI
BOT-DSC-364: Molecular Biology

Total Hours: 30 **Credits: 2**

Course Objectives	▪ Understand the fundamental concepts of molecular biology, including genome structures and key experiments. ▪ Explore DNA replication mechanisms, enzymes involved, and its biological significance. ▪ Analyze transcription processes, RNA types, modifications, and regulatory mechanisms. ▪ Examine translation mechanisms, protein synthesis steps, and translational regulation. ▪ Understand gene regulation mechanisms, including operon models and post-transcriptional modifications.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Explains key molecular biology experiments and genome structures across different organisms. ▪ Describes DNA replication processes, enzyme functions, and topological properties of DNA. ▪ Demonstrates an understanding of transcription mechanisms, RNA processing, and regulatory controls. ▪ Analyzes the role of RNA and ribosomes in translation, including initiation, elongation, and termination. ▪ Applies knowledge of gene regulation, operon models, and post-transcriptional modifications in genetic control.	
Unit	**Contents**	**Hours**
Unit I	**Basic Molecular Biology** ▪ Definition, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment. ▪ Viral genome structure, Bacterial genome structure (concept of nucleoid), Eukaryotic genome structure. ▪ DNA topological properties, Base flipping, Palindrome, Inverted repeats and stem and loop. ▪ DNA Replication: Enzymes involved, process of replication. ▪ Significance of DNA replication.	**8**
Unit II	**Transcription** ▪ Types of RNA: mRNA, tRNA, rRNA; types of promoters; types of RNA polymerase enzymes in eukaryotes; molecular mechanism of transcription. ▪ mRNAprocessing, editingcapping, adenylation, splicing, Exon shuffling, RNA Editing,mRNA transport. ▪ Regulation of Transcription: repressors and inhibitor	**8**
Unit III	**Translation** ▪ Role of m-RNA, t-RNA and Ribosomes and Aminoacyl tRNAsynthetase in translation. ▪ Initiation, elongation, translocation and termination of protein	**8**

	synthesis. ▪ Regulation of translation: Cytoplasmic polyadenylation, UTR sequence elements, RNA binding proteins, ribosomal regulation, non-sense mediated RNA decay,5` decapping.	
Unit IV	**Gene Regulation** ▪ Post Transcriptional regulation and intron splicing. ▪ Lac Operon. ▪ Trptophan Operon.	**6**
Study Resources	▪ Berg J. M., Tymoczko J. L., Gatto Jr. G. J., Stryer L. (2015), Biochemistry, 8thEdn,W. H. Freemanand Company, New York. ▪ Krebs J. E., Goldstein E. S., Kilpatrick S. T. (2018), Lewin's Genes XII, Jones and Barlett Learning. ▪ Lewin B (2013) Gene XI, Pearson Prentice Hall, Pearson Education, Inc., NT, USA. ▪ Lodish, H. Berk, A.., Zipursky, S.L., Matsudaria, P., Baltimore, D., and Darnell, J. Malacinski GM(2003) Essentials of Molecular Biology, 4th edn., Jones &Batiett, London. (ISBN: 0-7637-2133-6). ▪ Lodish Harvey, Berk Arnold, Zipursky S Lawrence, Matsudaira Paul, Baltimore David, and Darnell James (2000) Molecular Cell Biology. Media connected,W. H. Freeman and Company, New York. ▪ Verma P. S., Agarwal V.K.(2014) Cytology, S. Chand and Company Pvt. Ltd. ▪ Watson J D, Baker J A, Bell S P, Gann A, Lewin M, Losick R (2004) Molecular biology of gene, 7th edition. cold spring harbor, New York	

T.Y. B.Sc. Botany (Major with IKS)
Semester-VI
BOT-DSC-365: IKS In Ethnobotany

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To make students understand the importance of plants and their relationship with human being ▪ To acknowledge them about how plants are a part of culture and traditions ▪ How traditional medicine can cure various diseases	
Course Outcomes	▪ After successful completion of this course, students are expected to: ▪ Understand the importance of plants and their relationship with human being ▪ Know how plants are a part of culture and traditions ▪ Know the importance of traditional medicine and how it can cure various diseases.	
Unit	**Contents**	**Hours**
Unit I	**Ethnobotany and Folk Medicine** ▪ Ethnobotany and Folk medicines. ▪ Ethnobotany in India: Methods to study ethnobotany ▪ Scope and Importance of Ethnobotany ▪ Ethnobotany as an interdisciplinary science ▪ Ethnomedicine, ethnoecology, ethnic communities of India.	**7**
Unit II	**Plants used by the tribals** ▪ Food plants ▪ Intoxicants and beverages ▪ Plants in mythology ▪ Taboos and totems in relation to plants, folklore, folktales ▪ Wildlife protection in tribal plants	**8**
Unit III	**Medico-Ethnobotanical sources in India:** ▪ Significance of following plants in ethnobotanical practices along with Botanical name, family and uses of - *Azadirechtaindica, Ocimum sanctum, Tinosporacordifolia, Gloriosasuperba* ▪ Sacred Grooves (Devrai in Maharashtra)	**8**
Unit IV	**Ethnobotany and Legal Aspects** ▪ Biopiracy. Intellectual Property Rights and Traditional knowledge ▪ Role of peoples biodiversity register (PBR) ▪ Role of ethnic groups in conservation of plant genetic resources ▪ Endangered taxa and forest management	**7**
Study Resources	▪ S. K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995. ▪ S. K. Jain (ed.) Glimpses of Indian Ethnobotany, Oxford and I B H, New Delhi- 1981. ▪ S. K. Jain (ed). 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India. ▪ S. K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.	

	▪ Colton C. M.1997. Ethnobotany- Principles and Applications. John Willey and sons- Chichester. ▪ Rajiv K. Sinha- Ethnobotany The Renaissance of Traditional Herbal medicine.	

T.Y. B.Sc. Botany (Major)
Semester-VI
BOT-DSC-366:Practical on BOT-DSC-361

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To understand the diversity Bryophytes and Pteridophytes ▪ To know about morphological, anatomical and developmental patterns in the bryophytes, pteridophytes ▪ To know the systematic, morphology and structure, of Bryophytes and Pteridophytes ▪ To understand the life cycle pattern of Bryophytes and Pteridophytes ▪ To know the steles and their types	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the diversity Bryophytes and Pteridophytes ▪ Know about morphological, anatomical and developmental patterns in the bryophytes, pteridophytes ▪ Know the systematic, morphology and structure, of Bryophytes and Pteridophytes ▪ Understand the life cycle pattern of Bryophytes and Pteridophytes ▪ Know the the steles and their types	
Sr. No.	**Contents**	**Hours**
1	Study of examination of bryophyte specimens to understand their morphology including thallus and leaves	**4**
2	Study of examination of bryophyte specimens to understand their morphology including reproductive organs	**4**
3-4	Study of life cycle of Marchantia w. r. t. a) Systematic Position b) External morphology: Mounting of rhizoids & scales c) Internal morphology: i) T. S. of Thallus ii) V. S. of thallus through gemma cup (P.S) d) V. S. of antheridiophore (P. S.) e) V. S. of archegoniophore (P. S.) f) V. S. of sporophyte (P. S.)	**8**
5-6	Study of life cycle of Anthoceros w. r. t. a) Systematic Position b) External morphology: Mounting of rhizoids c) Internal morphology: i) T. S. of Thallus, d) T. S. of thallus through antheridia (P. S.) e) T.S. of thallus through archegonia (P. S.) f) L. S. of sporophyte (P. S.)	**8**
7	Study the general morphology of ferns, clubmosses, and horsetails.	**4**
8-9	Study of life cycle of Psilotum w. r. t. a) Systematic Position b) External morphology c) Internal morphology i) T. S. of stem ii) T. S. of rhizome (P. S.) d) T. S. of synangium (P. S.)	**8**
10-11	Study of life cycle of Equisetum w. r. t. a) Systematic Position b) External morphology c) Internal morphology i) T. S. of stem ii) T. S. of rhizome (P. S.) d) T. S. of Strobulii and Sporangium (P. S.)	**8**
12-13	Study of stele from permanent slides: Actinostele, Plectostele, Amphiphloicsiphonostele, Eustele, Atactostele	**8**
14-15	Study Tour	**8**

Study Resources	▪ Gangulee, H.C. and Kar, A.K. (2001). College Botany Vol. II. Books and Allied Press Ltd. Kolkata. ▪ Pandey, S.N. and Trivedi, P.S. (1997). A Text Book of Botany Vol. II, Vikas Publishing House (P.) Ltd. New Delhi. ▪ Parihar, N.S. (1977). Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad. ▪ Parihar, N.S. (1984). An Introduction to Embryophyta Vol. I Bryophyta. Central Book Depot, Allahabad ▪ Rashid, A. (1996). An Introduction to Bryophyta. Vikas Publishing House Ltd. New Delhi. ▪ Rashid, A. (1996). An Introduction to Pteridophyta. Vikas Publishing House Ltd ▪ Saxena, A.K. and Sarbhai, R.M. (1992). A Text Book of Botany Vol. II Embryophyta. 8. RatanPrakashanMandir, Agra. ▪ Smith, G.M. (1995). Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes). ▪ Mc Graw-Hill Book Company, New york and London. ▪ Sporne, K.R. (1995). The Morphology of Pteridophyta. The Hutchinson University Library, London, U.K. ▪ Vashistha, B.R. (1997). Botany For Degree Students-Bryophyta. S. Chand and company (P.) Ltd. New Delhi. ▪ Vashistha, P.C. (1984). Pteridophytes. S. Chand and company (P.) Ltd. New Delhi	

T.Y. B.Sc. Botany (Major)
Semester-VI
BOT-DSC-367: Practical on BOT-DSC-362 and BOT-DSC-363

Total Hours: 60 **Credits: 2**

Course Objectives	▪ Understand the systematic position, external and internal morphology of *Pinus* and *Gnetum*, including cone and ovule structures. ▪ Study fossil representatives of different plant groups to understand plant evolution. ▪ To understand the fundamental concepts of plant anatomy and embryology ▪ To analyze and recognize the different organs of plant and secondary growth. ▪ To examine the structure and functions of eco-system. ▪ To evaluate the structural organization of flower and the process of pollination and fertilization	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Identifies and explains the morphological and anatomical features of *Pinus* and *Gnetum*. ▪ Analyzes the structure of male and female cones, microsporophylls, and ovules in gymnosperms. ▪ Demonstrates knowledge of fossil plant groups and their evolutionary significance. ▪ The students will be able to understand the fundamental concepts of plant anatomy and Embryology ▪ The students will be able to analyze the different organs of plant and secondary growth. ▪ The students will be able to learn the structure and functions of eco-system. ▪ They will learn to evaluate the structural organization of flower and process of pollination and fertilization.	
Sr. No.	**Contents**	**Hours**
1-2	**Study of *Pinus* w. r. t.** Systematic Position, External morphology and Internal morphology, T. S. of stem and T. S. of Needle **Male cone:** Morphology (Specimen), L. S. of male cone (P. S.), Microsporophyll (Specimen/P. S.), Mounting of pollen grains **Female cone:** Morphology (Specimen), L. S. of female cone (P. S.), Megasporophyll (Specimen/P. S.), V. S. of mature ovule (P. S.)	**8**
3-4	**Study of *Gnetum*w. r. t.** Systematic Position and External morphology Internal morphology: T. S. of stem, T. S. of leaf, Secondary growth in the stem of *G. ula*(P. S.) Morphology of male cone (Specimen), Female cone, Morphology (Specimen),V. S. of mature ovule (P. S.)	**8**
5	Study of different types of fossils.	**4**
6	**Study of the following with the help of slides/specimens** Psilopsida: *Rhynia* Lycopsida: *Lepidostrobus* (Cone) Sphenopsida: *Annularia* (Leaf)	**4**
7	**Stem:** Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus	**4**

	(only Permanent slides).	
8	**Root:** Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).	**4**
9	**Leaf:** Dicot and Monocot leaf (Study through transverse section, Double staining)	**4**
10	**Adaptive anatomy:** Xerophyte (Nerium, Ficus leaf); Hydrophyte (Hydrilla, Eichornia stem).	**4**
11	Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides	**4**
12	Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).	**4**
13	Dissection of embryo/endosperm from developing seeds.	**4**
14-15	Field Visit	**8**
Study Resources	▪ Bhatnagar, S.P. and Moitra, A. (1996), Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India. ▪ Parihar, N.S. (1991), An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad. ▪ 4. Chopra, G. L. (1962). Introduction to Gymnosperms. Asia Pub. House, New Delhi. India. ▪ Vashishta, P. C. (1983). Botany for degree students: Gymnosperms. S. Chand & Co. New Delhi, India. ▪ Sporne, K. R. (1967). Morphology of Gymnosperms. Hutchinson university library London,U. K. ▪ Delevoryas, T. (1962). Morphology and Evolution of fossil plants. Holt Reihart& Winston, New York. ▪ Surange, K. R. (1966). Indian fossil Pteridophytes. CSIR New Delhi, India. ▪ Stewart, Wilson. N. (1983). Paleobotany and evolution of plants. Cambridge University Press. ▪ Arnold, Chester, R. (1972). An introduction to Paleobotany. McGraw Hill Publ. Co. Ltd., New York. ▪ Berg J. M., Tymoczko J. L., Gatto Jr. G. J., Stryer L. (2015), Biochemistry, 8thEdn,W. H. Freemanand Company, New York. ▪ Krebs J. E., Goldstein E. S., Kilpatrick S. T. (2018), Lewin's Genes XII, Jones and Barlett Learning. ▪ Lewin B (2013) Gene XI, Pearson Prentice Hall, Pearson Education, Inc., NT, USA. ▪ Lodish, H. Berk, A.., Zipursky, S.L., Matsudaria, P., Baltimore, D., and Darnell, J. Malacinski GM(2003) Essentials of Molecular Biology, 4th edn., Jones &Batiett, London. (ISBN: 0-7637-2133-6). ▪ Lodish Harvey, Berk Arnold, Zipursky S Lawrence, Matsudaira Paul, Baltimore David, and Darnell James (2000) Molecular Cell Biology. Media connected,W. H. Freeman and Company, New York. ▪ Verma P. S., Agarwal V.K.(2014) Cytology, S. Chand and Company Pvt. Ltd. ▪ Watson J D, Baker J A, Bell S P, Gann A, Lewin M, Losick R (2004) Molecular biology of gene, 7th edition. cold spring harbor, New York	

T.Y. B.Sc. Botany (Elective)
Semester-VI
BOT-DSE-361A: Plant Metabolism

Total Hours: 30 **Credits: 2**

Course Objectives	▪ Understand the fundamental concepts of metabolism, including anabolism, catabolism, and enzyme functions. ▪ Explore the process of photosynthesis, its pigments, and the mechanisms of light and dark reactions. ▪ Analyze different types of respiration, including aerobic and anaerobic pathways, and their biochemical mechanisms. ▪ Examine the process of photorespiration, its sites, mechanisms, and influencing factors. ▪ Understand nitrogen metabolism, including nitrogen fixation, nitrate and ammonia assimilation, and their significance.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Explains the role of enzymes in metabolism, their classification, structure, and mechanisms of action. ▪ Describes the structure of the photosynthetic apparatus, pigment functions, and mechanisms of light and dark reactions. ▪ Demonstrates knowledge of aerobic and anaerobic respiration, including glycolysis, the Krebs cycle, and the electron transport system. ▪ Analyzes the process of photorespiration and factors affecting the efficiency of photosynthesis and respiration. ▪ Applies knowledge of nitrogen metabolism, biological nitrogen fixation, and nutrient assimilation in plant growth.	
Unit	**Contents**	**Hours**
Unit I	**Introduction** ▪ Definition, Plant cell as organic Laboratory, Anabolism and catabolism, ▪ Enzymes: Definition, Structure and properties, Classification of enzymes, Mode of enzyme action: Lock and key Model, Induced fit model	**8**
Unit II	**Photosynthesis** ▪ Definition, photosynthetic apparatus (Structure of Chloroplast) ▪ Role of photosynthetic pigments: Chlorophyll (Chl-a, Chl-b),Carotenoids and Phycobillins ▪ Mechanism of Photosystem I and II ▪ Light Reaction: Cyclic and Non-Cyclic Photophosphorylation ▪ Dark Reaction: C3, C4 and CAM pathway ▪ Photorespiration: Definition, Sites and Mechanism of photorespiration. ▪ Factor affecting the process of photosynthesis.	**10**
Unit III	**Respiration** ▪ Introduction, Definition and Types ▪ Mechanism of Aerobic respiration. – Glycolysis, Kreb's cycle, Electron Transfer System (ETS) ▪ Mechanism of Anaerobic respiration: Alcoholic Fermentation ▪ Factor affecting the process of respiration.	**6**
Unit IV	**Nitrogen metabolism** ▪ Introduction. ▪ Types of Nitrogen fixation.	**6**

	▪ Biological nitrogen fixation. ▪ Nitrate and ammonia assimilation. ▪ Importance	
Study Resources	▪ Kochhar P. L. (1962) Plant Physiology, Atmaram and Sons, Delhi, India ▪ Salisbury, F.B and C.W. Ross (1999): Plant Physiology CBS Publishers and Printers, New Delhi ▪ Harborne, J.B. (1973). Phytochemical Methods. John Wiley and Sons. New York ▪ Mukherjee, S. A.K. Ghosh (1998) Plant Physiology ,Tata McGraw Hill Publishers(P) Ltd., New Delhi ▪ Srivastava H. S., 2004. Plant Physiology and Biochemistry, Rastogi Publications. ▪ Verma S. K. and MohitVerma, 2006. A Text book of Plant Physiology, Biochemistry and Biotechnology, S. Chand and Co. ▪ Jain. V.K. (1977) Fundamentals of plant physiology. S. Chand and Company Ltd. New Delhi, India	

T.Y. B.Sc. Botany (Elective)
Semester-VI
BOT-DSE-361B : Plant Physiology
Course Code: (SWAYAM cec25_ma19)

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To understand the Water Potential and its components, and how they drive the flow of water ▪ To know the importance of mineral nutrition especially the role and deficiency symptoms of essential elements ▪ To understand the translocation in the phloem occurs and its dependency on phloem loading and unloading ▪ To know the discovery, chemical nature and physiological roles of plant growth regulators and some photoreceptors ▪ To know the physiology of flowering with special focus on photoperiodism and vernalization	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the Water Potential and its components, and how they drive the flow of water ▪ Learn the importance of mineral nutrition especially the role and deficiency symptoms of essential elements ▪ Understand the translocation in the phloem occurs and its dependency on phloem loading and unloading ▪ Able to learn the discovery, chemical nature and physiological roles of plant growth regulators and some photoreceptors ▪ Understand the physiology of flowering with special focus on photoperiodism and vernalization	
Unit	**Contents**	**Hours**
Unit I	Water and life, Physical chemical properties of water, Water Potential and its components, Aquaporins, Diffusion, osmosis, absorption (SPAC), Ascent of sap, Transpiration: Its importance and factors affecting transpiration, Mechanism of opening and closing of stomata, Essential macronutrients and micronutrients: Role, deficiency and toxicity, Methods of study and use of nutrient solutions, Chelating agents, Biological membrane: Structure and Function, Chemical properties of soil (pH and soil nutrient status)	**8**
Unit II	Soil as a nutrient reservoir and transport of ions across cell membrane (passive absorption), Active absorption, Mineral nutrient uptake (mechanism), Phloem transport, Phloem loading, Phloem unloading, Source–sink relationship, Auxins—history of discovery, biosysnthesis and mechanism of action, Gibberellins—history of discovery, biosysnthesis and mechanism of action, Cytokinins—history of discovery, biosysnthesis and mechanism of action, Abscisic acid—history of discovery, biosysnthesis and mechanism of action, Ethylene – history of discovery, biosynthesis and role in plant growth and development	**7**
Unit III	Bioassay of Auxins, Cytokinins and Gibberellins, Bioassay of Abscisic acid and Ethylene, Brassinosteroids: discovery, chemical nature, bioassay and	**8**

	physiological roles, Jasmonic acid: discovery, chemical nature, bioassay and physiological roles, Development of flower as a modified shoot, Physiology of flowering, Flowering and photoperiodism (Short-day, Long-day and Day-neutral plants), Seed dormancy (types) and seed germination, Phytochromes—discovery, role and mechanism of action, Cryptochromes: discovery, chemical nature, role in photomorphogenesis, mode of action,Phototropins: discovery, chemical nature, role in photomorphogenesis, mode of action, Low energy responses (LER) and high irradiance responses (HIR)	
Unit IV	Growth: phases and kinetics, Flowering plants: annuals, biennials and perennials, Senescence—mechanism and role, Leaf abscission and senescence, Plant movements, Leaf adaptations to water stress, Morphological and anatomical responses of plants to water, Physiological responses of plants to water stress, Morphological, anatomical and physiological responses of plants to salinity	**7**
Study Resources	▪ Taiz, L., Moller, M., Murphy, A. andZeiger, E. 2022. Plant Physiology and Development (7th Edition). Sinauer Associates, Inc. Publishers, USA. ▪ Taiz, L., Zeiger, E., Moller, M. and Murphy, A. 2014. Plant Physiology and Development (6th Edition). Sinauer Associates, Inc. Publishers, Massachusetts, USA. ▪ Hopkins, W. G. and Huner, N. P. A. 2009. Introduction to Plant Physiology (4th Edition). John Wiley and Sons, Inc. USA. ▪ Mohr Hans, Schoper. P and Gamon A. 2019. Plant Physiology (5th edition). Springer. ▪ Nobel, P. S. 2009. Physiochemical and Environmental Plant Physiology, Fourth Edition. Academic Press. ▪ Pandey, B.P. 2023. Botany For B.Sc. Students Semester V: Paper 1 | Plant Physiology, Metabolism & Biochemistry | Experiments in Physiology, Biochemistry & Molecular Biology - NEP 2020 UP. S .India ,Chand and Company Ltd ▪ Srivastava, L. M. 2002. Plant Growth and Development: Hormones and Environment (1st edition). Academic Press, USA. ▪ Mengel, K., Kirkby, E. A., Kosegarten, H. and Appel, T. 2001. Principles of Plant Nutrition (5th edition). Kluwer Academic Publisher, Dordrecht, The Netherlands. ▪ Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th ed.). Wadsworth Publishing Company, Belmont, California.	

T.Y. B.Sc. Botany (Elective)
Semester-VI
BOT-DSE-362A:Practical on BOT-DSE-361A

Total Hours: 60 **Credits: 2**

Course Objectives	▪ Understand enzyme activity by studying the effect of pH and enzyme concentration on catalase. ▪ Analyze the influence of light intensity and bicarbonate concentration on oxygen evolution during photosynthesis. ▪ Learn biochemical separation techniques such as paper chromatography for amino acid analysis. ▪ Investigate physiological processes like starch storage, CO_2 necessity for photosynthesis, and respiratory quotient. ▪ Apply quantitative methods for analyzing osmotic potential, stomatal characteristics, respiration rates, amino acids, and soluble proteins.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Demonstrates the effect of pH and enzyme concentration on catalase activity. ▪ Explains the role of light intensity and bicarbonate in photosynthetic oxygen evolution. ▪ Performs biochemical separation techniques, such as paper chromatography, for amino acid analysis. ▪ Analyzes physiological processes like starch storage, CO_2 in photosynthesis, and respiration rates in different plant parts. ▪ Applies spectrophotometric methods to estimate amino acids, soluble proteins, and osmotic potential in plant cells.	
Sr. No.	**Contents**	**Hours**
1& 2	Study the activity of catalase and study the effect of pH and enzyme concentration.	**4**
3 & 4	To study the effect of light intensity and bicarbonate concentration on O_2evolution in photosynthesis.	**4**
5 & 6	Separation of amino acids by paper chromatography.	**4**
7	To demonstrate the presence of starch in chloroplast	**4**
8	CO_2 essential forPhotosynthesis	**4**
9	R.Q. (RespiratoryQuotient)	**4**
10	Kuhne's Tubeexperiment	**4**
11	Determination of osmotic potential of plant cell sap by plasmolysis method	**4**
12	Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.	**4**
13	Comparison of the rate of respiration in any two parts of a plant.	**4**
14	Estimation of total free amino acids by spectrophotometry	**4**
15	Estimation of soluble proteins by Lowery et. al. method.	**4**

Study Resources	▪ Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy 2015. Plant Physiology and Development (Sixth Edition) Sinauer Associates, Inc Publishers Sunderland, Massachusetts U.S.A. ▪ Epstein, E., and Bloom, A. J. (2005) Mineral Nutrition of Plants: Principles and Perspectives, 2nd ed. SinauerAssociates, Sunderland, MA. ▪ Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA. ▪ V. K. Jain (2017) Fundamentals of Plant Physiology S. Chand Publications.	

T.Y. B.Sc. Botany (Elective)
Semester-VI
BOT-DSE-362B: Practical on BOT-DSE-361B

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To learn about Qualitative assessment of microelements in plant ash ▪ To study the Effect of hormone on germinating seeds. ▪ To learn about nitrate estimation. ▪ To study the isolation and culturing of Rhizobium.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand about Qualitative assessment of microelements in plant ash ▪ Aquire knowledge of growth hormone effect on seed germination ▪ Well veredwith nitrate estimation. ▪ Aquanted with isolation and culturing of Rhizobium .	
Sr. No.	**Contents**	**Hours**
1	Study of Diffusaion Pressure Deficiet by potato tuber	**4**
2-3	Separation of amino acids from germinating seeds by ascending paper chromatography..	**8**
4-5	Effect of hormone on germinating seeds	**8**
6	Hydroponics technique	**4**
7	Study of deficiency symptoms of nutrients	**4**
9-11	Bioassay of some plant hormones	**12**
12	Demonstration Practicals: Exo and Endo Leaf curling experiment, Ringing Girdle Experiment, Phloem loading, Phloem unloading	**4**
13	Study of isolation of root nodule from leguminous plant	**4**
14-15	Demonstration Practicals: Deficiency symptoms of Macro and Micro elements	**8**
Study Resources	▪ Haiborne, T.C. (1981) Phytochemical Methods : A Guide To Modem Techniques of Plant Analysis. Chapman and Hall, London, U.K. ▪ Hopkins, W.G (1985) Introduction to Plant Physiology; John Wiley and Sons. Incl. New York, U.S.A. ▪ Jain, V.K. (1997) Fundamentals of Plant Physiology. Atrnaram& Sons, New Delhi India ▪ Lincoln, Taiz and EduardonZeiger (2010) Plant Physiology SinauerAssociates,Inc. ▪ Mukherjee, S and A.K. Ghose (1996). Plant Physiology, Vikas Publishing House, New Delhi, India. ▪ Mukharji, S. and Ghosh, A.K. (2012), Plant Physiology, New Central Book Agency (P) Ltd. Kolkata, 700009. ▪ Pandey, S.K and B.L.Sinba (.994) Plant Physiology, Vikas Publishing House, New Delhi, India. ▪ Sarabhai, B.P. (1995), Elements of Plant Physiology, Amol Publications, New Delhi, India. ▪ Verma, V. (1984) Introduction to Plant Physiology. Emkey Publications, New Delhi, India.	

T.Y. B.Sc. Botany (Vocational)
Semester-VI
BOT-VSC-361: Plant Biotechnology

Total Hours: 30 **Credits: 2**

Course Objectives	▪ Understand the fundamental principles, history, and laboratory techniques of plant tissue culture. ▪ Learn various plant tissue culture techniques, including micropropagation, callus culture, and suspension culture. ▪ Explore somatic embryogenesis, anther and pollen culture, and organ culture techniques. ▪ Understand protoplast culture, somatic hybridization, and cybridization for plant improvement. ▪ Examine genetic engineering methods, gene transfer techniques, and the development of transgenic plants.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Explains the fundamental principles, laboratory setup, and sterilization techniques of plant tissue culture. ▪ Demonstrates knowledge of micropropagation, callus culture, and suspension culture, including their applications and limitations. ▪ Analyzes the processes of somatic embryogenesis, organ culture, and their significance in plant biotechnology. ▪ Describes the isolation, fusion, and applications of protoplast culture and somatic hybridization. ▪ Applies knowledge of genetic engineering techniques and the development of transgenic plants for agricultural advancements.	
Unit	**Contents**	**Hours**
Unit I	**Concepts of Plant Tissue Culture** ▪ Brief history of plant tissue culture. Fundamental principles of in vitro plant cultures. ▪ Basic techniques of plant tissue culture- Plant Tissue Culture Laboratory Organization, Tools and Instruments for Plant Tissue Culture, Sterilization Techniques, Surface sterilization of explants, ▪ Components of plant tissue culture media- preparation and its functions, use of plant growth regulators	**6**
Unit II	**Techniques of Plant Tissue Culture-I** ▪ **Micropropagation:**Concept of differentiation, Dedifferentiation and redifferentiation, Different Stages of Micropropagation, Applications of Micropropagation, Microprapagation - Advantages over conventional methods. ▪ **Callus Culture:**Introduction, Types of callus, Factors affecting, protocol, Morphology & internal structure of callus, Maintenance of callus, Applications and limitations ▪ **Suspension Culture:** Introduction, principle, types, synchronization; applications and limitations ▪ **Protoplast:** Isolation, culture and fusion, Somatic hybridization and cybridization, applications and limitations	**10**

Unit III	**Techniques of Plant Tissue Culture-II** ▪ **Somatic embryogenesis:** Introduction, types of embryogenesis (direct and indirect), Stages of somatic embryogenesis. Induction, development and maturation of Somatic Embryogenesis. Factors affecting somatic embryogenesis Advantages and disadvantages of Somatic Embryogenesis. ▪ **Anther and Pollen Culture:** Introduction, principle, factors affecting. Ovary, ovule, embryo and endosperm culture; Applications and limitations. ▪ **Organ Culture Technique:** Introduction, principle, root tip culture, leaf culture, shoot tip & meristem culture. ▪ **Protoplast Culture:** Isolation, culture and fusion, Somatic hybridization and cybridization, applications and limitations ▪ **Applications of Plant Tissue Culture**	**10**
Unit IV	**Genetic Engineering and Transgenic Plants** ▪ Introduction to Genetic Engineering and Transgenic Plants Methods of gene transfer in plants Tumor formation in plants by A. tumefaciens, application of A. tumefaciens in plant genetic engineering. ▪ Examples and introduction of transgenic plants- BT Cotton, Herbicide Resistant Plant- Glyphosate Resistant, Salt Tolerant, Stress Tolerant Crops, FLAVR SAVR Tomato and Golden Rice.	**4**
Study Resources	1. An Introduction to Plant Tissue Culture M K Razdan; Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi. 2. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi. 3. Introduction to Plant Biotechnology- H S Chawla; Oxford & IBH publishing Co.Pvt.Ltd., New Delhi. 4. Plant Cell and Tissue Culture. - S. Narayanaswam, Tata McGraw-Hill Publishing Company Limited., 2004 5. Plant cell, Tissue and Organ Culture - Fundamental Methods, O. L. Gamborg, G. C. Philips; Narosa Publishing House, New Delhi. 6. Plant Tissue Culture - Basic and Applications- T. B. Jha, and B. Ghosh, University Press; 2007	

T.Y. B.Sc. Botany (Vocational)
Semester-VI
BOT-VSC-362: Practical on BOT-VSC-361

Total Hours: 60 **Credits: 2**

Course Objectives	▪ Equip students with practical skills in plant tissue culture techniques. ▪ Train students in aseptic handling and laboratory preparation. ▪ Introduce molecular techniques like DNA isolation, gel electrophoresis, and PCR. ▪ Provide exposure to real-world applications through laboratory visits.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Demonstrate proficiency in plant tissue culture techniques. ▪ Maintain aseptic conditions and prepare culture media. ▪ Perform micropropagation, callus culture, and suspension culture. ▪ Conduct DNA isolation, gel electrophoresis, and understand PCR. ▪ Apply practical knowledge in professional plant biotechnology labs.	
Sr. No.	**Contents**	**Hours**
1	Introduction and demonstration of instruments required in Plant Tissue Culture.	**4**
2	Introduction to aseptic conditions-Glassware washing, packing and sterilization.	**4**
3	Lab ware preparation for aseptic transfer.	**4**
4	Stock Solution Preparation-Stock solutions calculations and Growth hormone calculation and prepation.	**4**
5	Media preparation and calculation for Plant Tissue Culture.	**4**
6	Micropropagation.	**4**
7	Callus culture technique - Initiation of culture, callus morphology & internal structure.	**4**
8	Suspension culture technique - Initiation of culture, sub culture and growth measurement	**4**
9	Initiation of shoot tip culture / Axillary bud culture / Embryo culture	**4**
10	Initiation of anther culture.	**4**
11	Introduction to DNA isolation and Gel electrophoresis.	**4**
12	DNA isolation from a suitable plant material.	**4**
13	Separation of DNA by Agarose Gel Electrophoresis.	**4**
14	Introduction to PCR.	**4**
15	Visit to plant tissue culture laboratory	**4**
Study Resources	▪ Razdan M.K. (2009) - Introduction to Plant Tissue culture (Oxford & IBH Publ, New Delhi) ▪ Plant tissue culture: Basic and applied Jha TB &Ghosh B (2017) – (Universities Press, Hyderabad) and latest editions ▪ Plant Tissue culture (2010) – Kalyan Kumar De (New central Book Agency Calactta). ▪ A Laboratory Mannual of Plant Biotechnology (2009) –S SPurohitAgrobias India.	

Skills acquired and Job prospects for the Botany students

Courses after B.Sc. botany might just be one of the most preferred careers in India and abroad. After dully completing their bachelor's education in Botany, a candidate can look forward to being a part of the industry by working as a technician, whereas, a candidate after completing his/her master's education can look forward to working with some industry giants or being a part of good research teams.

With increasing advancements in science and technology, the field of Botany has gained a tremendous impetus. A lot of students are showing their desire to explore the varied range of careers available in Botany.

Equally, there are prestigious companies in the globe offering lucrative job prospects and a plethora of options to students having a degree in Botany.

There are environmental organizations, Government companies, park rangers as well as top scientific-based research centers hiring Botanists on a good package.

The amount of diversity in the field of Botany gives it students to choose their specializations as per their choice, aptitude and interests.

There is a huge scope of being a part of this industry merely keeping in mind the amount of diversity it has to offer. One can be a part of any reputed organization as a plant explorer, conservationist, ecologist, environment consultant, horticulturist, plant biochemist, nursery manager, genetics, molecular biologist, taxonomist, plant pathologist, environmental consultant, and farming consultant.

Moreover, the application of plant sciences improves the yield and supply of medicines, foods, fibers, building materials and other plant products. The knowledge of plant sciences is essential for the development and management of forests, parks, wastelands, sea wealth, etc.