SYLLABUS FOR

FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP)

AS PER PROVISIONS OF NEP-2020

BOTANY

(MAJOR, MINOR FROM DISCPLINE, MINOR FROM VOCATIONAL AND MDC)

EFFECTIVE FROM SESSION 2023-27 ONWARDS AND

SESSIONS 2022- 26 SEMESTER III ONWARDS

ALL CONSTITUENTS/ AFFLIATED COLLEGES UNDER

BINOD BIHARI MAHTO KOYLANCHAL UNIVERSITY, DHANBAD, JHARKHAND

Members of Board of Studies for preparing Provisional Syllabus of Four- Year Undergraduate Programme (FYUGP)

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   v. **Dr. Monalisha Saha**
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   Department of Botany,
   S. S. L. N. T. Mahila Mahavidhyalaya, Dhanbad

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Table 1: Credit Framework for Four Year Undergraduate Programme (FYUGP) under State Universities of Jharkhand [Total Credits = 160]

Level of Courses	Semester	MJ: Discipline Specific Courses – Core or Major (80)	MN: Minor from discipline (16)	MN: Minor from vocational (16)	MDC: Multidisciplinary Courses [Life sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc.] (9)	AEC: Ability Enhancement Courses (Modern Indian Language and English) (8)	SEC: Skill Enhancement Courses (9)	VAC: Value Added Courses (6)	IAP: Internship/ Dissertation (4)	RC: Research Courses (12)	AMJ: Advanced Courses in lieu of Research (12)	Credits	Double Major (DMJ)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
100-199: Foundation or Introductory courses	I	4	4		3	2	3	4				20	4+4
	II	4+4		4	3	2	3					20	4+4
	Exit Point: Undergraduate Certificate provided with Summer Internship/ Project (4 credits)												
200-299: Intermediate-level courses	III	4+4	4		3	2	3					20	4+4
	IV	4+4+4		4		2		2				20	4+4
	Exit Point: Undergraduate Diploma provided with Summer Internship in 1st or 2nd year/ Project (4 credits)												
300-399: Higher-level courses	V	4+4+4	4						4			20	4+4
	VI	4+4+4+4		4								20	4+4
	Exit Point: Bachelor's Degree												
400-499: Advanced courses	VII	4+4+4+4	4									20	4+4
	VIII	4		4						12	4+4+4	20	4+4
	Exit Point: Bachelor's Degree with Hons. /Hons. with Research											160	224

Note: Honours students not undertaking research will do 3 courses for 12 credits in lieu of a Research project / Dissertation.

Table 2: Courses of Study for Four-Year Undergraduate Programme (FYUGP) with Honours/Honours with Research FYUGP (NEP)

Sem	Code	Paper	Credit	Full Mark
I	AEC-1	Academic Enhancement Course-1: Hindi/English	2	50
	VAC-1	Value Added Course-1	4	100
	SEC-1	Skill Enhancement Course-1	3	75
	MDC-1	Multi-disciplinary Course-1	3	75
	MN-1A	Minor from Discipline-1	4	100
	MJ-1	Major Paper-1	4	100
II	AEC-2	Academic Enhancement Course-2:- English/Hindi	2	50
	SEC-2	Skill Enhancement Course-2	3	75
	MDC-2	Multi-disciplinary Course-2	3	75
	MN-2A or MN 1A	Minor from Vocational or Discipline-2	4	100
	MJ-2	Major Paper-2	4	100
	MJ-3	Practical-I based on MJ-1 & MJ-2 (Major-3)	4	100
III	AEC-3	Academic Enhancement Course-3: Hindi/English/	2	50
	SEC-3	Skill Enhancement Course-3	3	75
	MDC-3	Multi-disciplinary Course-3	3	75
	MN-1B	Minor from Discipline-1	4	100
	MJ-4	Major Paper-4	4	100
	MJ-5	Practical based on MJ-4 (Major Paper-5)	4	100
IV	AEC-3	Academic Enhancement Course-4: Hindi/English/Urdu/Bangla/TRL	2	50
	VAC-2	Value Added Course-2	2	50
	MN-2B/MN-IB	Minor from Vocational or Discipline-2	4	100
	MJ-6	Major Paper-6	4	100
	MJ-7	Major Paper-7	4	100
	MJ-8	Practical based on MJ-6 & MJ-7 (Major Paper-8)	4	100

V	MN1-C	Minor from Discipline-1	4	100
	MJ-9	Major Paper-9	4	100
	MJ-10	Major Paper-10	4	100
	MJ-11	Practical based on MJ-9 & MJ-10 (Major Paper-11)	4	100
	IAP	Internship/Apprenticeship/Field Work/Dissertation/Project	4	100
VI	MN-2C/MN-1C	Minor from Vocational/Discipline-2	4	100
	MJ-12	Major Paper-12	4	100
	MJ-13	Major Paper-13	4	100
	MJ-14	Major Paper-14	4	100
	MJ-15	Practical based on MJ-12, 13 & 14 (Major Paper-15)	4	100
VII	MN-1D	Minor from Discipline-1	4	100
	MJ-16	Major Paper-16	4	100
	MJ-17	Major Paper-17	4	100
	MJ-18	Major Paper-18	4	100
	MJ-19	Practical based on MJ-16, 17 & 18 (Major Paper-19)	4	100
VIII	MN-2D or MN-1D	Minor from Vocational or Discipline-2	4	100
	MJ-20	Major Paper-20	4	100
	RC* or	Research Courses - Research Internship/Field Work/Dissertation	12	300
	AMJ-1	Advance Major-1	4	100
	AMJ-2	Advance Major-2	4	100
	AMJ-3	Practical based on AMJ-1 & 2 (Advance Major-3)	4	100
		TOTAL CREDIT =	160	

***Note Honours Students not undertaking research will do 3 courses (AMJ) for 12 Credit**

In lieu of a Research project/ Dissertation.

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY
Dhanbad- 826004
E-mail:- registrarbbmku@gmail.com

Ref no. – BBMKU/DSW/1225/2024, धनबाद Date- 29/07/2024

आवश्यक सूचना

विषय - FYUGP (Four Year Under Graduate Programme) पाठ्यक्रम से संबंधित।

- **Minor from Discipline (MN-1) और Minor From Vocational (MN-2) -**

समस्त	विषय	टिप्पणी
सत्रांत – I	MN-1a	1. यदि छात्र सत्रांत -2 में Minor From Vocational का चयन करते है तो वे अपने संकाय से MN-2a विषय/पत्र का चयन करेंगे और पढ़ेंगे। यदि छात्र Discipline 2 का चयन करते है तब भी अपने संकाय के MN-1a का चयन करेंगे। सत्रांत 1 में पढ़े MN-1a तक का चयन नहीं करेंगे
सत्रांत – II	MN-2a / MN-1a	
सत्रांत – III	MN-1b	
सत्रांत – IV	MN-2b/ MN-1b	
सत्रांत – V	MN-1c	2. जो विषय मेजर में पढ़ रहे उसका भी चयन Minor विषय के रूप में नहीं करेंगे। किन्तु Minor विषय अपने संकाय का ही होना चाहिए।
सत्रांत – VI	MN-2c/ MN-1c	
सत्रांत – VII	MN-1d	3. सेमेस्टर-1 और सेमेस्टर-2 में रखे विषय / पत्र को ही छात्र आगे के समस्त में पढ़ेंगे।
सत्रांत – VIII	MN-2d/ MN-1d	

- **Ability Enhancement Courses (AEC)** – AEC पत्र समस्त I से समस्त – IV तक पढ़ना है। छात्र- छात्राएं AEC पत्र का चयन निम्नलिखित तालिका के अनुसार करेंगे –

समस्त	विषय	टिप्पणी
समस्त – I	हिन्दी या अंग्रेजी	यदि छात्र ने समस्त – I में हिन्दी विषय का चयन किया है तो समस्त – II में अंग्रेजी विषय का चयन करेंगे।
समस्त – II	अंग्रेजी या हिन्दी	
समस्त – III	अंग्रेजी/ हिन्दी/ उर्दू / बांग्ला / क्षेत्रीय भाषा	समस्त III में जिस विषय का चयन छात्र करेंगे वही समस्त IV में भी पढ़ेंगे।
समस्त – IV		

- **Value Added Courses (VAC)** – विश्वविद्यालय द्वारा इस पत्र हेतु तीन विषयों को विकल्प के रूप में रखा है, यह सेमेस्टर-I और सेमेस्टर-IV में पढ़ना है। विवरणी तालिका अनुसार है –

समस्त	विषय	टिप्पणी
समस्त – I	1. Understanding India or 2. Health & Wellness, Yoga Education, Sports & Fitness	छात्र इन दो विषयों में से किसी एक का चयन करेंगे।
समस्त – IV	1. Environment Studies	-

समस्त – I की परीक्षा पद्धति निम्नवत होगी –
प्रश्न प्रकार – बहुविकल्पी प्रश्न, प्रश्न संख्या – 50, पूर्णांक – 100, अंक वितरण – 2 अंक प्रतिप्रश्न होंगे, समयावधि – 3 घंटा ।
समस्त – 4 की परीक्षा पद्धति निम्नवत होगी –
प्रश्न प्रकार – बहुविकल्पी प्रश्न, प्रश्न संख्या – 50, पूर्णांक – 50 , अंक वितरण – 1 अंक प्रतिप्रश्न होंगे, समयावधि – 2 घंटा ।

- **Skill Enhancement Courses (SEC)** - इस पत्र के लिए दो विषय का विकल्प विश्वविद्यालय द्वारा तैयार किया गया है जिसे छात्र को समस्त I से III तक पढ़ना है।
1) Digital Education
or
2) Mathematical and Computational Thinking & Analysis
छात्र उपर्युक्त में से कोई एक विषय तीनों समस्त में पढ़ेंगे।

- **Multidisciplinary Courses (MDC)** – इस पत्र को प्रथम तीन समस्त (I से III) तक छात्रों को पढ़ना है , तीनों समस्त में अलग अलग विषय का चयन करना है। यह पत्र कक्षा 12 वीं में पढ़े विषय से भिन्न होनी चाहिए।

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY

Dhanbad- 826004

E-mail:- registrarbbmku@gmail.com

ef no. – BBMKU/DSW/ R/1225 / 2024, धनबाद Date- 29/07/2024

- अंक वितरण –

विषय/ पत्र	सामसत्र	आंतरिक परीक्षा कुल अंक	आंतरिक परीक्षा पास अंक	अंतिम समसत्र परीक्षा कुल अंक	अंतिम समसत्र परीक्षा पास अंक
Minor (Discipline /Vocational)	सभी	25	10	75	30
AEC	I-IV	-	-	50	20
VAC	I	-	-	100	40
	IV	-	-	50	20
SEC	I-III	-	-	75	30
MDC	I-III	-	-	75	30

नोट –

1. छात्र किस भी विषय / पत्र का चयन करेंगे अपने महाविद्यालय में वह विषय उपलब्ध है की नहीं इसकी जांच कर लेंगे।
2. सभी पाठ्यक्रम विश्वविद्यालय के वेबसाईट पर उपलब्ध है। Minor from Discipline के पाठ्यक्रम Major पाठ्यक्रम के साथ ही उपलब्ध है। Minor From Vocational के पाठ्यक्रम अलग से उपलब्ध है।

कुलपति के आदेशानुसार

ह./-

कुलसचिव

दिनांक – 29/07/2024

ज्ञापांक – BBMKU/DSW/R/ 1225 /2024, धनबाद

प्रतिलिपि:

1. परीक्षा विभाग, बि. वि. म. को. वि., धनबाद।
2. प्राचार्य/प्राचार्या सभी अंगीभूत/अल्पसंख्यक /सम्बद्ध महाविद्यालय।
3. विश्वविद्यालय वेबसाईट।
4. कुलपति /प्रतिकुलपति/डी.एस.डब्ल्यू. / कुलसचिव के निजी सहायक को कुलपति /प्रतिकुलपति/डी.एस.डब्ल्यू. / कुलसचिव के सूचनार्थ।
5. गार्ड फाइल।

Kanoh/ 29/07/2024

कुलसचिव (I/c)

Printed 29/7/2024

BINOD BIHARI MAHTO KOYALANCHAL UNIVERSITY
Dhanbad- 826004
E-mail:- registrarbbmku@gmail.com

Ref no. – BBMKU/DSW/1270 / 2024, धनबाद Date- 05/08/24,

शुद्धि-पत्र

NEP CORE COMMITTEE की आहूत बैठक दिनांक- 27.04.2024 को लिए गए निर्णय के आलोक में Minor From Vocational course की परीक्षा पद्धति निम्न प्रकार से होगी –

"Minor from Vocational का पत्र 100 अंक (4 Credit) का होगा तथा इस पत्र की परीक्षा 75+25 के आधार पर होगा। 75 अंक की परीक्षा लिखित परीक्षा समसत्र परीक्षा के रूप में की जाएगी। 25 अंक की परीक्षा Practical/Demonstrator/Skill Test/ Viva Voce आदि के रूप में की जाएगी। इस पत्र के लिए Internal Exam नहीं होगी।"

विश्वविद्यालय के ज्ञापांक - BBMKU/DSW/R/1225 /2024, धनबाद, दिनांक – 29.07.2024 के अंतिम बुलेट वाले टेबल में अंकित Minor (Discipline /Vocational) में Minor from Vocational के लिए उपर्युक्त वर्णित अनुसार प्रतिस्थापित समझा जाय। उपर्युक्त ज्ञापांक का शेष अंश अपरिवर्तित रहेंगे।

कुलपति के आदेशानुसार
ह./-
कुलसचिव

ज्ञापांक – BBMKU/DSW/R/1270 /2024, धनबाद दिनांक – 05/08/2024

प्रतिलिपि:

1. परीक्षा विभाग, बि. बि. म. को. वि., धनबाद।
2. प्राचार्य/प्राचार्या सभी अंगीभूत/अल्पसंख्यक /सम्बद्ध महाविद्यालय।
3. विश्वविद्यालय वेबसाईट।
4. कुलपति /प्रतिकुलपति/डी एस.डब्ल्यू / कुलसचिव के निजी सहायक को कुलपति /प्रतिकुलपति/डी.एस.डब्ल्यू / कुलसचिव के सूचनार्थ।
5. गार्ड फाइल।

05/08/2024
कुलसचिव (I/c)

05/08/2024

Table 3: Marks Distribution

(Pass Marks shown in bracket)

**There is no internal exam in practical*

Subject		Semester	Credit	Full Marks	Theory		Practical*
					End Semester	Internal	End Semester
Major (MJ) Theory Paper		All	4	100	75 (30)	25 (10)	-
Major (MJ) Practical Paper		All	4	100	-	-	100 (40)
Advance Major (AMJ) Theory		VIII	4	100	75 (30)	25 (10)	-
Advance Major (AMJ) Practical		VIII	4	100	-	-	100 (40)
Minor from Discipline (MN-1)		All	4	100	60 (24)	15 (6)	25 (10)
Minor from Vocational (MN-2)		II, IV, VI, VIII	4	100	75 (30)	-	25 (10)
Ability Enhancement Courses (AEC)		I-IV	2	50	50 (20)	-	-
Value Added Courses (VAC)		I	4	100	100 (40)	-	-
		IV	2	50	50 (20)	-	-
Skill Enhancement Courses (SEC)		I-III	3	75	75 (30)	-	-
Multi-disciplinary Course (MDC)		I-III	3	75	75 (30)	-	-
Research Courses (RC)	Research Methodology	VIII	4	100	75 (30)	25 (10)	-
	Synopsis, Thesis & Others		8	200	200 (80)	-	-

Table 4: List of Major (MJ) and Advance Major (AMJ) Paper for Botany

Sem	Code	Paper	Credit	Full Marks
I	MJ-1 (Theory)	MICROBIOLOGY, ALGAE, FUNGI AND BRYOPHYTA	4	100
II	MJ-2 (Theory)	PTERIDOPHYTA, GYMNOSPERMS AND PALAEOBOTANY	4	100
	MJ-3 (Practical)	PRACTICAL-I BASED ON MJ-1 & MJ-2	4	100
III	MJ-4 (Theory)	MORPHOLOGY AND ANATOMY	4	100
	MJ-5 (Practical)	PRACTICAL-II BASED ON MJ-4	4	100
IV	MJ-6 (Theory)	CELL BIOLOGY AND BIOCHEMISTRY	4	100
	MJ-7 (Theory)	GENETICS AND MOLECULAR BIOLOGY	4	100
	MJ-8 (Practical)	PRACTICAL-III BASED ON MJ-6 & MJ-7	4	100
V	MJ-9 (Theory)	EMBRYOLOGY OF ANGIOSPERMS	4	100
	MJ-10 (Theory)	ECOLOGY AND ENVIRONMENTAL SCIENCE	4	100
	MJ-11 (Practical)	PRACTICAL-IV BASED ON MJ-9 & MJ-10	4	100
VI	MJ-12 (Theory)	PLANT SYSTEMATICS AND TAXONOMY	4	100
	MJ-13 (Theory)	ECONOMIC BOTANY	4	100
	MJ-14 (Theory)	ADVANCE GENTICS, EVOLUTION AND PLANT BREEDING	4	100
	MJ-15 (Practical)	PRACTICAL-V BASED ON MJ-12, MJ-13 & MJ-14	4	100
VII	MJ-16 (Theory)	PLANT CONVERSERVATION	4	100
	MJ-17 (Theory)	PLANT PHYSIOLOGY AND METABOLISM	4	100
	MJ-18 (Theory)	PLANT BIOTECHNOLOGY AND NANOBIOTECHNOLOGY	4	100
	MJ-19 (Theory)	PRACTICAL-VI BASED ON MJ-16, MJ-17 & MJ-18	4	100
VIII	MJ-20 (Theory)	BIOSTATISTICS AND RESEARCH METHODOLOGY	4	100
	AMJ-1 (Theory)	ANALYTICAL TECHNICIES IN PLANT SCIENCE	4	100
	AMJ-2 (Theory)	BIOINFORMATICS AND COMPUTATIONAL BIOLOGY	4	100
	AMJ-3 (Practical)	PRACTICAL BASED ON AMJ-1 & AMJ-2	4	100

Table 5: List of Minor from Discipline and Vocational Paper in Botany

Sem	Code	Paper	Credit	Full Marks
I	MN-1A (Minor from Discipline-1)	PLANT DIVERSITY-I AND CYTOGENETICS	4	100
II	MN-2A (Minor from Vocational) or	NATURAL RESOURCE MANAGEMENT	4	100
	MN-1A (Minor from Discipline-2)	PLANT DIVERSITY-I AND CYTOGENETICS		
III	MN-1B (Minor from Discipline-1)	PLANT DIVERSITY-II AND PLANT PHYSIOLOGY	4	100
IV	MN-2B (Minor from Vocational) or	MINOR FOREST PRODUCE	4	100
	MN-1B (Minor from Discipline-2)	PLANT DIVERSITY-II AND PLANT PHYSIOLOGY		
V	MN-1C (Minor from Discipline-1)	ANATOMY, EMBRYOLOGY, ECONOMIC BOTANY	4	100
VI	MN-2C (Minor from Vocational) or	NURSERY AND GARDENING	4	100
	MN-1C (Minor from Discipline-2)	ANATOMY, EMBRYOLOGY, ECONOMIC BOTANY		
VII	MN-1D (Minor from Discipline-1)	ECOLOGY, TAXONOMY, BIOTECHNOLOGY	4	100
VIII	MN-2D (Minor from Vocational) or	HERBAL TECHNOLOGY	4	100
	MN-1D (Minor from Discipline-2)	ECOLOGY, TAXONOMY, BIOTECHNOLOGY		

Note: If subject for Minor from Discipline-1 is opted as Botany, the same subject (Botany) cannot be opted as Minor from Discipline-2.

Table 6: List of Multi-disciplinary Course- Botany

Sem	Code	Paper	Credit	Full Maks
I/II/III	MDC-1/2/3	MDC in Botany	3	75

Note: For detailed curriculum framework, regulations and guidelines check University FYUGP (NEP-2020) Guideline

Part-II

Syllabus for Major and Advance Major

Semester - I

MAJOR COURSE: MJ- 01.

MICROBIOLOGY, ALGAE, FUNGI AND BRYOPHYTA

(Credit course: Theory- 04)

Course Objectives:

On completion of this course, the students will be able to understand

1. To gain knowledge of diversity, life forms, life cycles, morphology and importance of microorganisms.
2. To gain knowledge of diversity, life forms, life cycles, morphology of fungi, symbiotic associations and diseases of plants and their control.
3. To introduce students with general characters and life cycle of bryophytes and their usefulness to mankind.
4. To introduce the evolution of gametophyte and sporophyte in bryophytes.

Course Learning Outcomes:

On successful completion of this course the student should know:

1. Students would understand the classification, characteristic features, cell structure and growth and reproduction in viruses, bacteria and economic importance.
2. Students would understand the general characteristics, morphology, life cycle under classification of algae proposed by Fritsch.
3. Students would understand the classification of fungus given by Ainsworth, lichens as symbiotic associations.
4. Application of fungus in food industry.
5. Clear views of general symptoms of different plant diseases, stages involved in development of disease and their control measures.
6. To learn the organ formation in early land plants and information on the ecological and economic importance of bryophytes

Instruction to Question Setter for

Mid semester exam (MSE): 1 hr.

• The mid semester exam shall have two groups of questions.

Group A is compulsory which will contain two questions.Question no. 1 will be very short answer type consisting of five questions of 1 marks each.

Question no. 2 will be of short answer type of 5 marks.

Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.

• Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions GROUP-A is compulsory and will contain 3 questions.

Q. No-1 (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

Unit-1 Microbes:

Viruses- Virion, prions and viroids, DNA virus (T- phage); Lytic and lysogenic cycle, RNA virus (TMV); economic importance; Basic concept of vaccine and vaccine production

Bacteria– Basic concept of bacterial culture; reproduction– vegetative, asexual and recombination (conjugation, transformation and transduction)

Unit-2 Algae

General characteristics; Range of thallus organization and reproduction; classification of algae; morphology and life-cycles of:- *Spirulina, Oedogonium, Chara, Vaucheria*, *Ectocarpus* & *Polysiphonia*; Economic importance of algae.

Unit-3 Fungi:

Introduction-general characteristics, classification (G.C. Ainsworth); *Phytophthora* (Oomycota), *Penicillium* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); *Alternaria* (Deutromycota), Symbiotic associations: Lichens- General account, reproduction and significance; Mushroom- introduction, cultivation and economic importance

Unit 4 Bryophyte:

General characteristics, adaptations to land habit, classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Anthoceros* and *Sphagnum*

Suggested readings

1. Pelczar, M.J, (2001) Microbiology, 5th edition, Tata McGraw-hill Co, NewDelhi.
2. Sharma,P.D.(2014) Microbiology. Rastogi Publication, Meerut
3. Pelzar. M.J. J R. Chen E.C.S. Krieg, N.R (2010) Microbiology- An application based approach, Tata MC Graw Hill Education Pvt. Ltd. NewDelhi
4. Tortora, G.J. Funke, B.R. Case, C.L. (2007), Microbiology, Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition
5. Vashishta, B.R., Singh, V.P., and Sinha A.K. (2014) Botany for Degree Students (Algae) S. Chand & Company Ltd.
6. Gangulee, H.C. and Kar, A.K. 2012, College Botany Volume-II
7. Lee, R.E. (2008), Phycology, Cambridge University Press, Cambridge. 4thedition.
8. Singh, Pande, Jain (2020) A textbook of Botany, Rastogi Publication.
9. Alexopoulos, C.J., Mims, C.W, Blackwell, M. (1996).Introductory Mycology, John Wiley & Sons (Asia) Singapore, 4th edition.
10. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge, 3rd edition.
11. Sethi, I.K. and Walia, S.K. (2011). Textbook of Fungi and their Allies, Macmillan Publishers India Ltd.

Semester - II

PTERIDOPHYTA, GYMNOSPERMS AND PALAEOBOTANY
(Credit course: Theory- 04)

Course Objectives:

On successful completion of this course the student should be able to:

1. To introduce students with general characters and life cycle of archegoniates and their usefulness to mankind.
2. To study palaeobotanical fossil plants and geological time scale.

Course Learning Outcomes:

On successful completion of this course the student should know:

1. To learn the organ formation in early land plants that resulted to diversity of species of "Pteridophytes" and "Gymnosperms".
2. Information on the ecological and economic importance of pteridophytes and gymnosperms will help to understand their role in ecosystem functioning.
3. Knowledge of fossil plants formed in different era.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions. Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each. Question no. 2 will be of short answer type of 5 marks. Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.

- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions. Q. No-1
(A) will be multiple choice 10 questions of 1 mark each. Q. No-1
(B) will contain 2 short answers type questions (max. 50 words)
each of 2½ marks.
GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

Unit 1. Pteridophytes

General characteristics, classification, early land plants classification (upto family), morphology, anatomy and reproduction of *Selaginella* and *Equisetum*, heterospory and seed habit, stelar evolution.

Unit 2 Gymnosperms

General characteristics, classification (up to family), morphology, anatomy and reproduction of *Pinus, Ginkgo* and *Gnetum*

UNIT 3: Paleobotany (20 classes)

Introduction, Definition and objectives of Palaeobotanical studies, Nomenclature of Fossils, Process and types of Fossilization, Geological Time-Scale; General characteristics features of *Rhynia.*

Suggested Reading

1. Parihar, N.S, (1991), An introduction to Embryophyta : Vol. 1. Bryophyta, Central Book Deposit, Allahabad.
2. Raven, P.H., Johnson, G.B.Losos, J.B.,Singer, S.R. (2005), Biology, TataMc Graw Hill, Delhi.
3. Vander – poorteri 2009 Introduction to Bryophyta, COP.
4. Vashistha, P.C., Sinha, A.K.Kumar, A.(2010), Pteridophyta. S.Chand, Delhi,India
5. Prasad, C. (2013) An Introduction to Pteridophyta, Emkay Publication, NewDelhi, India.
6. Bhatnagar, S.P. &Moitra, A.(1996), Gymnosperms, New Age International

   (P) Ltd Publishers, New Delhi, India.
7. Stewart, N.W. and Roothwell, G.W. (2020): Palaeobotany and the evolution of Plants, 2nd Edition
8. Arnold, C.A., (2020): An Introduction to Palaeobotany, Surjeet Publications

MAJOR COURSE: MJ-03

Practical/ Lab course (BOT-MJ-3 P-I) Credit: 04 LECTURES/CONTACT- 60HRS

MARKS: ESE = 100 PASS MARKS: ESE = 40

1. Study of microbes (included in the syllabus) with permanent slide and temporary slide prepared in the laboratory. Study of structure of TMV by photographs. Study of Bacteria by slides/photographs. Gram staining technique.
2. Study of vegetative and reproductive structures (Slide preparation) of algae included in the syllabus by temporary and permanent slides.
3. Study of vegetative and reproductive structures (Slide preparation) of fungi included in the syllabus by temporary and permanent slides.
4. Study of different forms of lichen by photographs.
5. Study of vegetative and reproductive structures (Slide preparation) of bryophytes included in the syllabus by temporary and permanent slides.
6. **Selaginella:** Morphology, whole mount leaf with ligule, strobilus, microsporophyll and megasporophyll (temporary slides), T.S. stem, L.S. strobilus (permanent slide).
7. **Equisetum:** Morphology, T.S. internode, L.S. strobilus, T.S and L.S. strobilus, whole mount sporangiophore,. Spores (wet and dry) (temporary slides); T.S. rhizome (permanent slide).
8. **Pteris:** Morphology, T.S rachis, V.S. sporophyll, whole mount sporangium and spores (temporary slides), T.S. rhizome, whole mount prothallus with sex organs and young sporophyte (permanent slide).
9. **Pinus:** Morphology (long and dwarf shoots, male and female cones), T.S. needle and stem, L.S./T.S. male cone, whole mount microsporophyll and microspores (temporary slides), L.S. female cone, TLS and RLS stem (permanent slide).
10. Study of fossil plants included in the syllabus by permanent/ slides/ photographs/ rock specimens

Examination **F.M.100** **Time- 04 hrs**

1. Study of TMV/bacteria by slide/photographs/Gram staining technique of bacteria. 10
2. Preparation of temporary slides of any one genus of Algae included in the syllabus 12
3. Preparation of temporary slides of any one genus of fungi included in the syllabus 12
4. Preparation of temporary slide of any one genus of Bryophyte (included in syllabus) 12
5. Preparation of temporary slide of any one genus of Pteridophyte (included in syllabus) 12
6. Preparation of temporary slide of any one genus of Gymnosperm (included in syllabus) 12
7. Spotting 2x5 - 10
8. Viva - 10
9. Class record & Collection 10

Suggested readings

- Pandey, B.P. (2014). Modern Practical Botany Vol. II. S. Chand and Company Ltd., New Delhi.
- Bendre, A.M. and Kumar A. (2003). Manual of Practical Botany Vol. II. Rastogi Publications, Meerut.
- Santra S.C. and Chatterjee (2005). College Botany Practical Vol. II New Central Book Agency Pvt. Ltd.

Semester - III

MAJOR COURSE: MJ-04

MORPHOLOGY AND ANATOMY

Course Objectives:

On completion of this course, the students will be able to understand:

1. Study of various tissue systems and their development and functions in plants.
2. To know anamolous behavior, plant adaptive and protective systems in plants.

Course Learning Outcomes:

On successful completion of this course the student shall know:

1. Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants.
2. Knowledge of basic structure and organization of plant parts in angiosperms.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-1 (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY

Lectures 60

Full marks: 100 **Time: 03 Hrs.**

Unit 1:

Internal organization of plant body, Three tissue systems, types of cell and tissues. Development of plant body: Polarity, cytodifferentiation and organogenesis during embryogenic development.

Unit 2

Meristematic and permanent tissues: Root and shoot apical meristems, Theories related to apical meristem,(Apical cell theory, Histogen theory, & Tunica Corpus theory), Classification of tissue: simple, complex and secretary tissues .

Unit 3

Organs: Structure of dicot and monocot root, stem and leaf.

Unit 4

Adaptive and protective systems: Epidermis, cuticle and stomata.

Unit 5

Secondary growth: Structure and function of Vascular cambium, secondary growth in stem and roots, anomalous secondary growth (*Boerhaavia* & *Dracaena*).

Unit 6

Periderm: Development and composition , lenticel and rhytidome, sapwood , heartwood, early and late wood.

Unit 7

Anatomical adaptation of hydrophytes and xerophytes.

Suggested readings

1. Dickison, W.C.(2000). Integrative plant Anatomy. Harcourt Academic Press, USA.
2. Fahn. A.(1974), Plant Anatomy, Pergmon Press. USA
3. Mauseth, J.D.(1998), Plant Anatomy. The Benjamin/ Cummings Publishers,USA.
4. Esau. K.(1977). Anatomy of seed plants. John Wiley & Sons. Inc., Delhi.
5. Pandey, B.P., (2016) .A text of Botany Angiosperms,S. Chand & Company Pvt. Limited
6. Sharma, P.C. (2017). Text Book of Plant Anatomy. Arjun Publishing House.
7. Menan, A.B. (2008). Introduction to Plant Anatomy, Neha Publishers and Distributors
8. Sharma, M.K. (2013). Plant Structures (An Introduction to Plant Anatomy), Vayu Education of India

MAJOR COURSE: MJ-05

PRACTICALS-II (Credit course: Prt.- 04)

Credit: 04 **LECTURES/CONTACT 60 HRS**

MARKS: ESE = 100 **PASS MARKS: ESE = 40**

1. Study of Meristematic and Permanent tissues by temporary and permanent slide preparation and photograph.
2. Study of Root and Shoot apical meristems by photograph.
3. Study of simple, complex and secretory tissues by photograph.
4. Study of anatomical details of monocot root, stems and leaf by preparing temporary slide and also by permanent slide or by photographs.
5. Study of anatomical details of dicot root, stems and leaf by preparing temporary slide and also by permanent slide or by photographs.
6. Study of anatomical structure of cambium by slides.
7. Study of normal secondary growth in stem and roots by photograph.
8. Study of anomalous structure of *Boerhaavia* stem and *Dracaena* stem by preparing temporary slide and by permanent slide or by photographs.
9. Study of anatomical details of Epidermis, Cuticle and Stomata by preparing temporary slide/photograph.
10. Study of parenchyma, collenchymas, sclerenchyma and different components of Xylem and Phloem by preparing temporary slide/photographs.
11. Study of anatomical adaptations in xerophytes and hydrophytes by preparing temporary slides.

Examination **F.M.100** **Time- 04 hrs**

1. Study of anatomical details (TS) of monocot/dicot root OR stem OR leaf by preparing temporary slide. 15

2. Study of anomalous structure of *Boerhaavia* OR *Dracaena* stem by preparing temporary slide. 15

3. Study of anatomical adaptations in xerophytes OR hydrophytes by preparing temporary slide. 15

4.Study of anatomical details of Epidermis OR Stomata by preparing temporary slide. 15

5. Study of parenchyma/collenchymas/sclerenchyma/xylem/phloem by preparing temporary slide/photographs. 10

6. Spotting 2x5 - 10

7. Viva 10

8. Class record & Collection 10

Semester IV

MAJOR COURSE: MJ- 06
CELL BIOLOGY AND BIOCHEMISTRY
(Credit course: Theory- 04)

Course Objectives:

After completion of the course, the learner shall be able to understand:

1. The course will provide insight to the organization of cell, its features and regulation at different levels.
2. Through the study of cell organelles, they will be able to understand the various metabolic processes such as respiration, photosynthesis etc. which are important for life.

Course Learning Outcomes:

On successful completion of this course the student should know:

1. This course will be able to demonstrate foundational knowledge in understanding of cell.
2. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

CELL BIOLOGY

1. Differences between prokaryotic and eukaryotic cell.
2. Chemistry, Structure and Function of plant cell wall, Plasma Membrane and Nucleus.
3. Structure & Functions of: Chloroplast, Mitochondria, Ribosomes, Endoplasmic reticulum, Golgi apparatus, Lysosomes.
4. Cell division: Mitosis and Meiosis.

BIOMOLECULES

1. **Carbohydrates:** Nomenclature and classification, Role of monosaccharides, disaccharides, oligosaccharides and polysaccharides.
2. **Proteins:** Structures of amino acids; Structure of Protein – primary, secondary, tertiary and quaternary structure; biological roles of proteins.
3. **Lipids**: Types and function.
4. **Enzyme**: Definition, discovery, Structure of: holoenzyme, apoenzyme. Prosthetic group, Cofactors; mechanism of enzyme action. Factors affecting enzyme activity.

SUGGESTED READINGS

1. Campbell, MK (2012) Biochemistry, 7th ed., published by Cengage Learning.
2. Camphell, PN and Smith AD (2011) Biochemistry illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoezko JL, Berg JM and Stryer L (2012) Biochemistry; A short course, 2nd. W.H.Freeman
4. Berg JM, Tymoezko JL, and Stryer L (2011) Biochemistry, W.H.Freeman and Company.
5. Karp, G. (2010), Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
6. Hardin, J., Becker, G., Skliensmith, L.J, (2012), Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
7. Cooper, G.M, and Hausman, R.E. 2009 The Cell: A Molecular Approach, 5thedition, ASM Press & Sunderland, Washington, D.C, Sinauer Associates, MA.
8. Becker, W.M, Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. 2009.The world of the cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
9. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5thed. W.H. Freeman and Company.

MAJOR COURSE: MJ- 07
GENETICS AND MOLECULAR BIOLOGY
(Credit course: Theory- 04)

Course Objectives:

1. To gain the knowledge of structure and functions of DNA and RNA.
1. The paper will deal with heredity inheritance pattern among the organism.
2. Linkage and genetic recombination.
3. Gene mapping
2. Chromosomal structure.

Course Learning Outcomes:

1. Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
2. Processing and modification of RNA and translation process, function and regulation of expression.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY

Lectures 60 **Full marks: 100** **Time: 03 Hrs.**

GENETICS AND MOLECULAR BIOLOGY

1. MENDELIAN GENETICS & ITS EXTENSION

Mendel's laws of inheritance, Incomplete dominance and co-dominance, Epistatis, Complementary and Duplicate genes.

2. EXTRACHROMOSOMAL INHERITANCE

Cytoplasmic inheritance: Variation in four O'clock plant & infective heredity Kappa particles in *Paramecium*.

3. LINKAGE AND CROSSING OVER

Mechanism and significance of Linkage and crossing over

4. VARIATION IN CHROMOSOME NUMBER & STRUCTURE

Euploidy, Aneuploidy, Deletion, Duplication, Inversion, Translocation, origin of *Rhaphobrassica* & *Triticale*.

5. GENE MUTATION

Types of mutations, Molecular basis of mutations, Mutagens – Physical and chemical, Role of mutation in crop improvement.

MOLECULAR BIOLOGY

Historical perspective: DNA as the carrier of genetic information (Griffith's & Hershey & Chase experiment)

1. **Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleotide; types of nucleic acids; DNA structure and function: Watson and Crick Model of DNA, structure of BDNA, A-DNA and Z- DNA; Structure and function of RNA; tRNA, rRNA and mRNA.

2. Chromosome:

Structure and function, nucleosome model, Chromatin structure – Euchromatin, heterochromatin – Constitutive & Facultative heterochromatin. Polytene and Lampbrush chromosome.

3. Replication of DNA: Mechanism of DNA replication, Enzymes involved in DNA replication

4. Central Dogma and Genetic Code: General account of Central dogma and genetic code.

5. Mechanism of Transcription:-Transcription in prokaryotes and eukaryotes

6. Translation: Process of translation in Prokaryotes and eukaryotes, Proteins involved in translation.

7. Regulation of Gene expression: Regulation of gene expression in Prokaryotes, Operon – inducible system – Lac operon, Repressible system, Tryptophan operon.

SUGGESTED READINGS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics. John Wiley & sons. India 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010) Principles of Genetics, John Wiley & Sons, Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Speneer. C.A. (2012). Concepts of Genetics. Benjamin Cummings, USA. 10th edition.
4. Griffiths, A.J.F, Wessler, S.R., Carroll, S.B., Doebley. I. (2010). Introduction to Genetic Analysis. W.H. Freeman and Co., U.S.A., 10th edition.
5. Gupta, P.K., (2004) Biotechnology and Genomics. Rastogi Publications, Shivaji Road, Meerut, India. 1st edition.
6. Acquaah, G. (2007) Principles of Plant Genetics & Breeding BlackwellPublishing.

MAJOR COURSE: MJ-08
PRACTICALS-III (Credit course: Prt.- 04)

MARKS: ESE = 100 **PASS MARKS: ESE = 40**

1. Study prokaryotic and eukaryotic cell by photograph.
2. Perform qualitative tests for carbohydrates.
3. Perform qualitative tests for proteins.
4. Study of different stages of mitosis by preparing temporary slide.
5. Study of different stages of meiosis by preparing temporary slide.
6. Study plant cell wall, Plasma Membrane and Nucleus by photograph.
7. Study Chloroplast, Mitochondria and Ribosomes by slide/photograph.
8. Study mechanism of enzyme action by photograph.
9. Study incomplete dominance, co-dominance, Epistatis, Complementary and Duplicate genes by photograph.
10. Study mechanism of crossing over by slide/photograph.
11. Study structure of nitrogenous bases, nucleotide, DNA, B-DNA, A-DNA and Z- DNA by photograph.
12. Study structure of RNA by photograph.
13. Study replication of DNA by photograph.

Examination **F.M.100** **Time- 04 hrs**

1. Preparation of temporary slides of any stage of mitosis OR meiosis. 15
2. Biochemical test of carbohydrates or protein 15
3. Testing of goodness of fit by chi-square method. 15
4. Study of Watson and Crick model of DNA/nucleosome model/ polytene/ Lambrush chromosome by photographs 15
5. Study of DNA replication mechanism by photographs 10
6. Spotting 2x5 - 10
7. Viva 10
8. Class record & Collection 10

Semester V

MAJOR COURSE: MJ-09

EMBRYOLOGY OF ANGIOSPERMS
(Credit course: Theory- 04)

Course Objectives:

On completion of this course, the students will be able to understand:
1. Brief account of embryology.
2. Understand the mechanism underling the shift from vegetative to reproductive phase.
3. Trace the development of male and female gametophyte.
4. Understand the recent advances in palynology.

Course Learning Outcomes:

On successful completion of this course the student shall know
1. Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development
2. Understand the various concepts of plant development and reproduction.
3. Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.
Q. No-1 (A) will be multiple choice 10 questions of 1 mark each.
Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.
GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

UNIT 1: Anther
Anther wall: structure and function, microsporogenesis.

UNIT 2: Ovule
Sporogenesis, microsporogenesis and megasporogenesis, Structure and Types of ovule, Male and Female gametophyte - (monosporic, bisporic and tetrasporic)

UNIT 3: Pollination and fertilization
Pollination types and significance, path of pollen tube in pistil; double fertilization and triple fusion.

UNIT 4: Endosperm
Types, development, structure and functions.

UNIT 5: Embryo
Development of dicot embryo and monocot embryo.

UNIT 6: Polyembryony & Apomixis
Introduction, classification; causes & application.

UNIT 7: PALYNOLOGY

Palynology – aeropalynology – pollen allergy and palynological calendars. Pollen analysis of

Honey; pollen loads. Importance of palynology and palyontology. Paleopalynology – role in

Coal and oil genesis. Recent advances in palynological studies.

Suggested Readings

1. Bhojwani, S.S and Bhatnagar, S.P.(2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi 5th edition.
2. Shivanna, K.R. (2013). Pollen Biology and Biotechnology, Oxford and IBHPublishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V.(2000). Development Biology of Flowering plants, Springer,Netherlands.
4. Johri, B.M.I (1984), Embryology of Angiosperms, Springer-Verlag,Netherlands.
5. Pandey, B.P., (2016) .A text of Botany Angiosperms,S. Chand & Company Pvt. Limited
6. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co.,Madras.
7. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill
8. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant
9. Mani, M.S. 1973. Plant galls of India. The Mac Millan company of India Ltd., Madras.

MAJOR COURSE: MJ-10
ECOLOGY AND ENVIRONMENTAL SCIENCE
(Credit course: Theory- 04)

Course Objectives:

After completion of the course, the learner shall be able to understand:

1. To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment.
2. To study the plant communities and plant succession stages.
3. . To be aware of the causes, impacts and control measures of pollution.
4. To study biodiversity management and conservation.
5. To enhance the knowledge of the students and equip them in evaluate and protecting invaluable components of nature and interactions with the environment

Course Learning Outcomes:

On successful completion of this course the student should know:

1. Understand the scope and importance of population ecology, plant communities and ecosystem ecology.
2. Understand the applied aspect of environmental botany.
3. Students will spot the sources and pollution and seek remedies to mitigate and rectify them.
4. Identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.
5. Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

UNIT 1: Introduction, Objectives of Environmental Science, Levels of organization

UNIT 2: Biosphere

Atmosphere, Hydrosphere and Lithosphere.
Soil Importance, origin, formation, composition; Physical and Chemical and biological components, Soil profile.
Water Importance, states of water in environment, atmospheric moisture, precipitation types (rain, fog, snow, hail.), hydrological cycle

UNIT 4: Plant Communities
Analytic and synthetic characters, Mechanism of succession–Hydrosere & Xerosere, Concept of Climax.

UNIT 5: Ecosystem
Basic concept, Structural and functional components of ecosystem, types of ecosystem, Grass land and Pond ecosystem, Food web and Food chain, Ecological pyramids.

Understanding Ecosystems, Destruction of Ecosystem due to changing pattern of land use, Migration, Transportation, Urbanization, Industrialization and Environmental Impact Assessment.

UNIT 5: Phytogeography
Phytogeographical regions of Jharkhand; Local Vegetation and Endemism; hotspots.

UNIT 6: Environmental issues
Air pollution, Water pollution, noise pollution – Cause, effect & control,Global warming, greenhouse effect and consequences of climate change
International and National laws for environmental protection and role of judiciaryin India, Environmental summits- Kyoto protocol, Montreal protocol, Earth summit, Ramsar convention.

Suggested Readings

1. Singh, Y.K., (2020). Environmenal Science, New Age International Publishers, India
2. Gupta, S. (2018). Environmental Studies, Sahitya Bhawan Publications, Agra
3. Odum, E.P and Barrett, G.W., (2017) Fundamentals of Ecology, 5th Edition, Cengage Learning, New Delhi
4. Shukla, R.S. and Chandel, P.S (2016): A text book of Plant Ecology, S. Chand & Company Pvt. Limited
5. Sharma, P.D (2017): Ecology and Environment, 13th Edition, Rastogi Publications, Meerut
6. Verma, P.S. and Agarwal, V.K., (2000): Environmental Biology: Principles of Ecology, S.Chand Limited

MAJOR COURSE: MJ-11
PRACTICALS-IV (Credit course: Prt.- 04)

PRACTICAL

Embryology, Ecology and Environmental Science

1. Study the structure and prepare temporary slides of anther (pollen grains) of ten common plants.
2. Study the germination of pollen grains in easily available plants species.
3. Study the structure of anatropous ovule
4. Dissection of embryo in *Tridax* / tomato/ mustard/ lady's finger
5. Study of pond-ecosystem, grass land ecosystem, Food wave, Food chain by photographs.
6. Determination of pH of soil and water.
7. Study of college vegetation (density and frequency) by quadrats.
8. Morphological adaptations of hydrophytes and xerophytes.

Practical examination

Full marks: 100 **Pass Marks: 40** **Time: 03 Hrs**

01. Dissect the embryo of *Tridax* / tomato/ mustard/ lady's finger. 12

02. Morphological adaptations of hydrophytes or xerophytes. 12

03. Estimation of density or frequency of college vegetation by quadrat. 12

04. Determination of pH of soil and water and extract the results. 12

05. Prepare a temporary slides of anther (pollen grains) of common plants./ Study the germination of pollen grains in given plants species 12

06. Spotting (5 X 2)=10

07. Viva voce 10

09. Class record 10

10. Collection, model, Project 10

Semester VI

MAJOR COURSE: MJ-12
PLANT SYSTEMATICS AND TAXONOMY
(Credit course: Theory- 04)

Course Objectives :

1. To be familiar with the basic concepts and principles of plant systematics.
2. To develop a suitable method for correct characterization and identification of plants.
3. To understand the importance of taxonomic relationships in research of plant systematics.
4. To provide information on various classification systems

Course Learning Outcomes:

On successful completion of this course the student shall know

1. Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data.
2. Validate the ability to handle and analyze plant materials in the laboratory and herbarium and in the field.
3. Distinguish dicot and monocot families with specific examples and engage themselves scientifically evaluating nature and planet earth's treasures.
4. Demonstrate comprehension of basic concepts and the ability to use scientific terminology accurately through effective oral and written communication and the use of dichotomous keys in a regional floristic manual**.**

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions
GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.
Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.
GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

UNIT I: TAXONOMY AND SYSTEMATICS

Taxonomy and systematics, objectives of plant systematics, Concepts of Taxonomic hierarchy.

Systems of classification – Bentham and Hooker (upto series), Engler and Prantl (upto series), Hutchison (upto series) & Takhtajan, APG-IV system, Bar coding, ICN- Importance and principles of binomial nomenclature, RET species-India.

Taxonomic keys- single access and multi access, Botanic Gardens, Herbaria, Herbarium technique, Virtual Herbarium.

UNIT II: MODERN TRENDS IN TAXONOMY

Modern trends in Taxonomy - Numerical taxonomy - Chemotaxonomy - Biosystematics.

Botanical Survey of India (BSI), its organization and role. - Valid and effective publication, Author citation, rejection and retention of names, Typification, Limitation to priority.

UNIT III: SYSTEMATIC ANALYSIS OF PLANTS-I

Study of systematic position, salient features, description, distribution of economic importance of the following families: **Ranunculaceae, Moringaceae, , Cucurbitaceae** and **Apiaceae.**

UNIT IV: SYSTEMATIC ANALYSIS OF PLANTS-II

Study of systematic position, salient features, description, distribution of economic importance of the following families: **Compositae, Apocynaceae, Euphorbiaceae, Asclepiadaceae, Lamiaceae, Orchideae, Cyperaceae** and **Graminaceae**

UNIT IV: BIOMETRICS AND CLADISTICS

Characters, Varitations, OTUs, Character weighting and coding, Clusters analysis, Phenograms, Cladograms (definitions and Differences).

Recommended Texts

1. Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.
2. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
3. Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.
4. Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.
5. Lawrence, G.H.M. 2017. Taxonomy of Vascular Plants. Scientific Publishers, Jodhpur.
6.Bentham, G and Hooker, J.D. 1924. Handbook of the British Flora. 7 th Ed. Revised by A. B. Rendle, L. Reeve & Co., London, UK.
7. Rendle, A.B. 1967. Classification of flowering plants, Cambridge University Press, Cambridge.
8. Hutchinson, J. 1973. The Families of Flowering Plants. 3 rd ed. Oxford University Press, UK.

MAJOR COURSE: MJ- 13
ECONOMIC BOTANY

(Credit course: Theory- 04)

Course Objectives :

1. To be familiar with the basic concepts and principles of plant systematics.
2. To develop a suitable method for correct characterization and identification of plants.
3. To understand the importance of taxonomic relationships in research of plant systematics.
4. To provide information on various classification systems

Course Learning Outcomes:

On successful completion of this course the student shall know

1. Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data.
2. Validate the ability to handle and analyze plant materials in the laboratory and herbarium and in the field.
3. Distinguish dicot and monocot families with specific examples and engage themselves scientifically evaluating nature and planet earth's treasures.
4. Demonstrate comprehension of basic concepts and the ability to use scientific terminology accurately through effective oral and written communication and the use of dichotomous keys in a regional floristic manual**.**

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions
GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.
Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.
GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

Unit 1: **Origin of Cultivated Plants**

Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of Major plant introductions; Crop domestication and loss of genetic diversity; evolution of new

Crops/varieties, importance of germplasm diversity.

Unit 2: **Cereals**

Wheat and Rice (origin, morphology, processing & uses); Brief account of millets.

Unit 3: **Legumes**

Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Unit 4: **Sources of sugars and starches**
Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato

- Morphology, propagation & uses.

Unit 5: **Spices**

Listing of important spices, their family and part used. Economic importance with special Reference to fennel, saffron, clove and black pepper

Unit 6: **Beverages**

Tea, Coffee (morphology, processing & uses)

Unit 7: **Sources of oils and fats**

General description, classification, extraction, their uses and health implications groundnut, Coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses).

Essential Oils: (lemon grass and Menthol)
General account, extraction methods, comparison with fatty oils & their uses.

Unit 8: **Natural Rubber and Resin**

Para-rubber: tapping, processing and uses.
Resins and gums (Asafoetida and gum arabic),

Unit 9: **Drug-yielding plants**

Listing of important medicinal plants of Jharkhand. Therapeutic and habit-forming drugs with Special reference to Cinchona, Digitalis, Papaver and Cannabis; Tobacco (Morphology, Processing, uses and health hazards).

Unit 10: **Timber plants**

General account with special reference to teak and Sal.

Unit 11: **Fibers**

Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and Uses).

Unit 12: **Aesthetics and Energy plants**

Plants used as avenue trees for shade, pollution Control and aesthetics and Energy plantation – uses of Casuarina.

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Suggested Books

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic

Publishers,The Netherlands.

3. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett

_Publishers.

4. Hill.A.W. 1981. Economic Botany. McGraw Hill Pub. Inc., New York.
5. Thompson, H.C. 1949. Vegetable Crops. 4 th ed. McGraw- Hill Book Co., Inc., New York.
6. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
7. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi

MAJOR COURSE: MJ- 14.
ADVANCE GENTICS, EVOLUTION AND PLANT BREEDING
(Credit course: Theory- 04)

Course Objectives :

1. To understand the evolutionary processes that has shaped the diversity of plant life on Earth**.**

2. The students will come to know basic ideas of genomics

3.Knowledge on the structure, , function and modifications of genetic materials in relation to diverse gene types and mutation.

4. Gain knowledge of the various plant breeding principles and how molecular genetics techniques are used to improve crops.

5. To study the origin and evolution of major plant groups.

6. To explore the molecular mechanisms underlying plant evolution.

7. To analyze the evolutionary relationships among plant species using phylogenetic methods.

Course Learning Outcomes:

On successful completion of this course the student shall know

1. Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data.

2. The students will analyze the wide application of genomics.

3. Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism and genetic code

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

UNIT 1: Advance Genetics

-Organisation of genetic material, gene size, C value, Gene code, Gene Expression, Population Genetics
-Organization and structure of genomes, genome size, sequence complexity, introns and exons, Genome structure in prokaryotes, Isolation of chromosome
-Gene identification and expression, genome annotation, traditional gene identification routes, detecting open read frame, gene ontology, application of genomics analysis, overview of comparative genomics.
-Application of genomics- Analysis of genomics in plants, role in plant genetics and breeding

UNIT 2: Introduction to Plant Evolution

Historical Background of Plant Evolution, Overview of evolutionary theories, Role of plants in the history of life on Earth, Concepts of Evolutionary Biology, Natural selection, genetic drift, and gene flow., Speciation and adaptive radiation.

Unit 2: Origin of Life and Early Plant Evolution

Origin of Life, Prebiotic Earth and the origin of life, Evolution of photosynthesis, Evolution of Algae and Bryophytes, Early algal forms and the transition to land, Evolution and diversity of bryophytes (mosses, liverworts, hornworts).

Unit 3: Evolution of Vascular Plants

Origin of Vascular Tissue, Evolution of xylem and phloem, Adaptive significance of vascular tissues, Evolution and Diversification of Pteridophytes, Ferns and fern allies: Evolutionary history and diversification, Spore-bearing plants and the transition to seed plants.

Unit 4: Evolution of Seed Plants

Gymnosperms Evolution, Origin and early evolution of gymnosperms, Major gymnosperm groups and their evolutionary significance, Angiosperm Evolution, Origin and diversification of flowering plants,Evolution of reproductive structures in angiosperms, Co-evolution with pollinators.

Unit 5: Molecular Evolution in Plants

Molecular Phylogenetics,Methods and tools for molecular phylogenetics, Molecular clocks and dating plant evolutionary events, Genomic Evolution, Whole-genome duplications and polyploidy, Gene family evolution and functional divergence.

Unit 6: Evolution of Plant-Environment Interactions

Adaptation to Environmental Changes, Evolution of photosynthetic pathways (C3, C4, CAM), Evolutionary

responses to biotic and abiotic stress, Plant-Microbe Interactions, Co-evolution with mycorrhizae and nitrogen-fixing bacteria, Evolutionary aspects of plant pathogens and defense mechanisms.

Unit 7: Recent Advances and Future Directions in Plant Evolution

Evolutionary Developmental Biology (Evo-Devo), Insights from Evo-Devo in plant evolution, Evolution of plant morphology, Current Research and Future Trends, Genomic insights into plant evolution, Future directions in evolutionary plant biology.

Unit 8: PLANT BREEDING

Introduction and objectives.-
Methods of Crop Improvement, Introduction, Selection, Hybridization.
Inbreeding, Inbreeding Depression, Heterosis
Role of Mutation, Polyploidy, Distant Hybridization, Role of Biotechnology in crop improvement.

Suggested Textbooks and References:

1. Sharma, A.K and Sharma, A. 1980. Chromosome Techniques. Theory and Practice, Butterworth.
2. The Evolution of Plants by Kathy Willis and Jennifer McElwain
3. Paleobotany and the Evolution of Plants by Wilson N. Stewart and Gar W. Rothwell
4. Molecular Evolution and Phylogenetics by Masatoshi Nei and Sudhir Kumar
5. Selected research articles from journals such as Nature, Science, New Phytologist, and Evolution.
6. Plant Evolution by Karl J. Niklas
7. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall.
8. Chahal, G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
9. Darbeshwar Roy. 2000. Plant Breeding: Analysis and Exploitation of variation, Narosa Publishing House, New Delhi.
10. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi
11. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
12. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.
13. Stoskf, N.C., Tomes, D.T and Christie B.R. 2019. Plant Breeding- Theory and Practice (First Indian Print), Scientific Publishers, India.

MAJOR COURSE: MJ-15
PRACTICALS-IV (Credit course: Prt.- 04)

PRACTICALS

1. Charts on plant breeding techniques.

*-2. Hybridization techniques in self and cross pollinated plants (anthesis, emasculation, bagging). (Demonstration). 3. Induction of polyploidy in plants by colchicines (Demonstration).

4. Study of DNA replication mechanism by photographs

5. Photographs establishing nucleic acid as a genetic material.

6. Study of families included in the syllabus

7. Determination of probability by tossing coins

8. Mendel's laws through seed ratios: Law of segregation and independent assortment.

9. Testing good fit or not by chi-square method

10. Field visit and report making of back cross and test cross method of plant breeding.

11. Preparation of herbarium

Practical examination

Full marks: 100 **Pass Marks: 40** **Time: 03 Hrs.**

1. Study of Plant Community/ Vegetation of College Campus by Quadrate method and measurement of frequency and density. 15

2. Study of microbial flora of water samples 10

3. testing good fit or not by chi-square method 10

4. Write the comparative Floral character, Floral Formula, Floral Diagram and Systematic position of any two families included in the syllabus 15

5. Identification of any ten specimen of economic importance from syllabus 10

6. Watson and Crick model of DNA, nucleosome model, polytene and lampbrush chromosome, DNA replication mechanisms, nucleic acid as genetic material 10

7. Spotting (five photographs from syllabus) 10

8. Viva voce 10

9. Class records 10

10. Herbarium/ Chart. 10

Semester VII
MAJOR COURSE: MJ-16
PLANT CONVERSERVATION
(Credit course: Theory- 04)

Course Objectives:

1.To organize conservation efforts and exploit biodiversity sustainably in systems of management like forestry, fisheries, and agriculture.
2. To utilize a range of in situ and ex situ techniques to safeguard and restore ecosystems, species and genetic diversity.
3. To equitably share the benefits of biodiversity through social and economic tools.
4. To be aware of the legislation and regulations governing biodiversity conservation
5. To create a framework for law governing sustainable development, human and institutional capacity to incorporate measures at the bioregional scale.

Course Outcomes:

1. Apply various methods for the conservation of biodiversity.
2 Understanding of ecological interactions, enhances interpreting skills for real-time environmental protection
3. To protect the biodiversity through ecological programmes.
4. Communicate the acquire knowledge for the well-being of the human society.
5. Awareness on adverse effect of the pollution on environment with the perspective biodiversity conservation

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions
GROUP-A is compulsory and will contain 3 questions.

Q. No-1 (A) will be multiple choice 10 questions of 1 mark each.
Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.
GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

Unit 1:

- Introduction to Plant Conservation
- Definition and scope of plant conservation
- Biodiversity and its significance
- Threats to biodiversity: habitat loss, overexploitation, pollution, climate change, invasive species
- Conservation biology: principles and goals

Unit 2:

- Biodiversity Assessment and Monitoring
- Biodiversity indicators and their use
- Biodiversity surveys and monitoring techniques
- Species richness and diversity indices
- Habitat assessment and evaluation

Unit 3:

- In-Situ Conservation
- Protected areas: types, management strategies
- Wildlife sanctuaries and national parks
- Biosphere reserves
- Community-based conservation initiatives

Unit 4:

- Ex-Situ Conservation
- Botanical gardens and arboreta
- Seed banks and gene banks
- Tissue culture and micropropagation
- Reintroduction and captive breeding programs

Unit 5:

- Plant Conservation Policy and Law
- International treaties and conventions (e.g., CITES, CBD)
- National conservation laws and regulations
- Environmental impact assessment
- Sustainable use of plant resources

Unit 6:

- Conservation of Threatened Plants
- Identification and assessment of threatened species
- Recovery plans and action strategies
- Case studies of successful conservation efforts

Unit 7:

- Restoration Ecology
- Principles and techniques of ecological restoration
- Habitat restoration and rehabilitation
- Reforestation and afforestation
- Wetland restoration

Unit 8:

- Community Participation and Awareness
- Role of local communities in conservation
- Environmental education and awareness programs
- Sustainable livelihoods and conservation

Practical Work:

- Biodiversity surveys and monitoring
- Herbarium preparation and identification
- Seed collection and storage
- Tissue culture techniques
- Ecological restoration activities
- Community outreach and education programs

Evaluation:

- Internal assessments (assignments, quizzes, presentations)
- Practical examinations
- End-semester examination

Recommended Textbooks:

- Primack, R.B. (2017). Essentials of Conservation Biology. Sinauer Associates.
- Heywood, V.H. (2002). Plant Conservation: A Global Overview. Cambridge University Press.
- IUCN Red List of Threatened Species. https://www.iucnredlist.org/
- National Wildlife Federation. https://www.nwf.org/

MAJOR COURSE: MJ-17.

PLANT PHYSIOLOGY AND METABOLISM
(Credit course: Theory- 04)

Course Objectives:

1. The course aims at making students realize how plants function, namely the importance of water, minerals, hormones, and light in plant growth and development; understand transport mechanisms and translocation in the phloem, and appreciate the commercial applications of plant physiology.
2. Current understanding of regulation and integration of metabolic processes in plants with reference to crop productivity.
3. To gain the knowledge of physiological and biochemical processes in the plant system

Course Learning Outcomes:

On successful completion of this course the student should be able to:

1. To understand water and nutrient uptake and movement in plants, role of mineral elements, translocation of sugars. Role of various plant growth regulator as phytochrome, cytochromes and phototropins, and flowering stimulus.
2. Students will gain the knowledge on reproductive strategies in higher plants along with physiology of flowering, molecular and hormonal basis of flowering mechanism.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions
GROUP-A is compulsory and will contain 3 questions.

Q. No-1 (A) will be multiple choice 10 questions of 1 mark each.
Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.
GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

UNIT 1: Plant water relationship

A. Water Potential, water absorption by roots, pathway of water movement, symplast, apoplast transmembrane pathways, root pressure, guttation.

B. Ascent of sap, cohesion-tension theory, Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.

UNIT 2: Mineral nutrition

Essential and beneficial elements macro- and micronutrients, roles of essential elements, Hydroponics, Absorption of mineral elements.

UNIT 3: Phloem Translocation

Mechanism of translocation of food.

UNIT 4: Nitrogen metabolism

Biological nitrogen fixation, reductive amination and transamination

UNIT 5: Carbon assimilation

Historical background, photochemical reactions, photosynthetic electron transport, PSI, PSII, CO_2 reduction, red drop Emerson effect, Quantum Yield, C_3, C_4 Cycle, photorespiration, photophosphorylation.

UNIT 6: Carbon oxidation

Glycolysis, oxidative decarboxylation of pyruvate, TCA Cycle, anaerobic reactions, mitochondrial electron transport.

UNIT 7: Lipid metabolism

Introduction, saturated and unsaturated fatty acids, ß- oxidation of fatty acids/ lipids.

UNIT 8: ATP- synthesis

Mechanism of ATP synthesis, substrate level phosphorylation, (oxidative and photophosphorylation).

UNIT 9: Plant growth regulators

Discovery, chemical nature (basic structure), roles of Auxin, Gibberellins and Cytokinin.

UNIT 10: Physiology of flowering

Photoperiodism, florigen concept and vernalization.

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. JohnWiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Muller, I.M and Murphy, A (2015). Plant Physiology and development. Sinauer Associates Inc. USA 6th edition.
3. Bajracharya D. (1999).Experiments in Plant Physiology-A Laboratory Manual, Narosa Publishing House, New Delhi.

MAJOR COURSE: MJ- 18.

PLANT BIOTECHNOLOGY AND NANOBIOTECHNOLOGY
(Credit course: Theory- 04)

Course Objectives:

1. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including tissue culture for healthy plants, plants with improved characteristics.
2. This course explores the use of biotechnology to both generate genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypes and hence to phenotypic variation.
3. Understanding of biotechnological processes such as recombinant DNA technology.
4. This knowledge is central to our ability to modify plant responses and properties for global food security and commercial gains in biotechnology and agriculture.
5. To familiarize the students with the fundamental principles of Nanobiotechnology and its various potential application.

Course Learning Outcomes:

1. Learn the basic concepts, principles and processes in plant biotechnology. Have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological and agricultural applications.
2. Use basic biotechnological techniques to explore molecular biology of plants.
3. Understand how biotechnology is used to for plant improvement and discuss the biosafety concern and ethical issue of that use.
4. Able to carry out research/investigation independently in specialized area of Nanobiotechnology.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

UNIT 1: Plant Tissue Culture (15 classes)

History: Basic requirement of tissue culture, Technique, Prospect and application, Totipotency, Organogenesis, Embryogenesis, Protoplast Isolation, micropropagation, Somatic hybridization, anther culture, pollen culture, Cyropreservation, Germplasm Conservation.

Unit 2: Recombinant DNA Technology (20 classes)

Tools, Restriction endonucleases, Plasmid, Cloning Vectors: Prokaryotic (pBR322, Ti plasmid); Lambda phage, Cosmid, Concept of Shuttle vector; Eukaryotic Vectors (YAC). Properties, Ti-Plasmid, Process and application of r-DNA technology, electrophoresis as an important tool, construction of genomic and c-DNA library, PCR technology and PCR mediated gene cloning; Blotting – Northern and southern, DNA – finger printing.

Unit 3: Methods of gene transfer (7 classes)

Biological method (Indirect): Agrobacterium-mediated; Physical methods (Direct): Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit 4: Application of Bio-technology (8 classes)

Pest resistant (Bt-cotton), herbicide resistant plants (Roundup Ready soybean), Transgenic crops with improved quality traits (*Flavr savr* tomato, Golden rice), Impact of transgenic crops on society, Role of transgenics in bioremediation (Superbug); edible vaccines; Intellectual Property Right in Biotechnology

Unit 5: Nanobiotechnology (10 classes)

Introduction,application and role of nanotechnology in agriculture, synthesis of drugs and food production; Biopesticides, biofertilizers and DNA based biosensors as nanoparticles.

Suggested Readings

1. Gilick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology – Principlesand Applications of recombinant DNA. ASM Press, Washington.
2. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles,Techniques and Applications. John Willey & Sons Inc. U.S.A.
3. Dubey, R.C. – 2015, A. Text book of Biotechnology, S. Chand & Co. Pvt.Ltd- New Delhi.
4. Ramawat, K.G. & Goyal, Shaily- 2015, Comprehensive Biotechnology-S. Chand & Co. New Delhi
5. Singh, B.D., (2019): Molecular biology and Recombinant DNA Technology, Kalyani Publication.
6. Verma, P.S., and Agarwal, V.K., (2019): Genetic Engineering, S. Chand & Co. Pvt.Ltd- New Delhi.
7. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
8. The 2018-2023 World Outlook for Nanobiotechnology Paperback – December 18, 2017, Icon group international.
9. Arunava Goswami and Samrat Roy Choudhary, Nanobiotechnology, Basic and Applied Aspects.
10. Clive Jarvis, Nanobiotechnology: An Introduction.
11. H B Singh, S Mishra, L F Fraceto, R D D Lima; Emerging Trends in Agri-Nanotechnology.
12. Elements of X-ray diffraction, B D Cullity- Addison-Wesley Publishing Company, Inc.

MAJOR COURSE: MJ-19
PRACTICALS-VI (Credit course: Prt.- 04)

Plant Physiology

1. Determination of water potential of given tissue (potato tuber) by weight method.
2. Calculation of stomatal frequency from the two surfaces of leaves of a mesophyte.
3. To determine the rate of transpiration by Farmer's and Ganong's potometer.
4. IAA Bioassay experiment on *Avena* coleoptile elongation.
5. Separation of Pigments by Chromatography method.
6. Experiment showing O_2 is evolved during photosynthesis
7. Experiment showing that light is essential for photosynthesis
8. Experiment showing that CO_2 is essential for photosynthesis.

Plant Biotechnology and Nanobiotechnology

1. Preparation of culture media and inoculation of explants – seeds and leaf meristem.
2. Study of anther, embryo, endosperm culture, micro propagation and somatic hybridization through photographs.
3. Study the principles and functioning of instrument used in biotechnology laboratory- laminar air flow, hot air oven, autoclave, pH meter, weighing machine, centrifuge and bio-oxygen demand incubator.
4. Study of cloning vectors through photographs
5. Project report on application of biotechnology.

Long trip/ excursion/ research institutes visits

Practical examination
Full marks: 100 Pass marks: 40
Time: 03 Hrs.

i. Preparation of culture media and inoculation of explants
Or anther, embryo, endosperm culture, micropropagation, somatic hybridization, cloning vectors and cell fractionation equipments through photographs. (any three) 15 marks

ii. Experiment showing CO_2 is essential for photo synthesis
Or Determination of water potential of given tissue (potato tuber) by weight method.
Or Separation of pigments by Chromatography method. 15 marks

iii. To study the effect of different concentration of IAA on *Avena* coleoptile elongation.
Or Experiment showing O_2 is evolved during photosynthesis
Or To determine the rate of transpiration by Farmer's and Ganong's potometer. 15 marks.

iv. Spotting (5 x4 marks) 20 marks

v. Viva voce 15 marks

vi. Class records and Project Report/ Model/ Chart. 20 marks

Semester VIII
MAJOR COURSE: MJ-20.
BIOSTATISTICS AND RESEARCH METHODOLOGY
(Credit course: Theory- 04)

Course Objectives:

1. To help students understand the value of research in learning.

2. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.

3. To give an exposure to various forms of field research and data analysis techniques.

4. To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.

5. To understand the value of research, its general concept, and the craft of thesis and paper writing and publication

Course Learning Outcomes:

1. Understand general laboratory procedures and maintenance of research equipments, microscopy.

2. Realize the need of centrifuges and chromatography and their uses in research.

3. Learn the principles and applications of electrophoresis.

4. Realize the importance of biosafety guidelines.

5. Understand the methods of writing scientific paper and components of research paper

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs.**

Unit 1:Biostatistics
Definition - statistical methods - basic principles. Variables - measurements, functions,limitations and uses of statistics.

Unit 2:Collection of data primary and secondary
Types and methods of data collection procedures - merits and demerits. Classification -tabulation and presentation of data - sampling methods.

Unit 3:Measures of central tendency
Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient ofvariations.

Unit 4:Correlation
Types and methods of correlation, regression, simple regression equation, fitting prediction,similarities and dissimilarities of correlation and regression.

Unit 5:Statistical inference
Hypothesis - simple hypothesis - student 't' test - chi square test.

Unit 6: Basic concepts of research
Research-definition and types of research (Descriptive vs analytical; applied vs fundamental;quantitative vs qualitative; conceptual vs emperical).Research methods vs methodology.
Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 7: General laboratory practices
Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases.Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions.Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 8: Data collection and documentation of observations
Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissuespecimens and application of scale bars. The art of field photography.

Unit 9: Overview of Biological Problems
History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics- Transcriptional regulatory network.

Unit 10: **Methods to study plant cell/tissue structure**

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

Unit 11: Plant microtechniques

Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags).Cytogenetic techniques with squashed plant materials.

Unit 12: The art of scientific writing and its presentation

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

SUGGESTED READINGS

1. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press. 4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
5. The Principles of scientific research, Freedman, P. New York, Pergamon Press.
6. Statistics for Biologists, Campbell, R.C., 1998.Cambridge University Press.
7. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
8. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
9. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

Semester VIII

ADVANCED MAJOR COURSE: AMJ- 01.
ANALYTICAL TECHNICIES IN PLANT SCIENCE
(Credit course: Theory- 04)

Course Objective

1. To help students understand the value of research in learning.
2. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
3. To give an exposure to various forms of field research and data analysis techniques.
4. To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.

Course Learning Outcomes

1. Understand general laboratory procedures and maintenance of research equipments, microscopy.
2. Realize the need of centrifuges and chromatography and their uses in research.
3. Learn the principles and applications of electrophoresis.
4. Realize the importance of biosafety guidelines..

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE):1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-1 (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs**

Unit 1: Imaging and related techniques

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Useof fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting;

Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell fractionation

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient,CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes

Use in biological research, auto-radiography, pulse chase experiment.

Unit 4: Spectrophotometry

Principle and its application in biological research.

Unit 5: Chromatography

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchangechromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6: Characterization of proteins and nucleic acids

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins andnucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

SUGGESTED READINGS

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-HillPublishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York.
3. 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. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

ADVANCED MAJOR COURSE: AMJ- 02.
BIOINFORMATICS AND COMPUTATIONAL BIOLOGY
(Credit course: Theory- 04)

Course Objectives:

1. The students will come to know basic ideas of genomics.
2. To familiarize the students with the fundamental principles of Bioinformatics and Computational biology.
3. Various potential application of Bioinformatics and Computational tools in biology.

Course Learning Outcomes:

1. The students will analyze the wide application of genomics.
2. Ability to carry out research /investigation independently in specialized area of Bioinformatics and Computational Biology.

INSTRUCTIONS FOR QUESTION SETTER

Mid semester exam (MSE): 1 hr.

- The mid semester exam shall have two groups of questions.
- Group A is compulsory which will contain two questions. Question no. 1 will be very short answer type consisting of five questions of 1 marks each.
- Question no. 2 will be of short answer type of 5 marks.
- Group B will contain descriptive type two questions of 10 marks each, out of which any one to answer.
- Class attendance score and extracurricular activities of 5 marks

End semester exam (ESE): 3hrs

There will be 2 groups of questions

GROUP-A is compulsory and will contain 3 questions.

Q. No-[1] (A) will be multiple choice 10 questions of 1 mark each.

Q. No-1 (B) will contain 2 short answers type questions (max. 50 words) each of 2½ marks.

GROUP-B will contain descriptive type 8 questions of 15 marks each out of which any 4 are to be answered.

THEORY
Lectures 60

Full marks: 100 **Time: 03 Hrs**

UNIT 1: Genomics (30 classes)

1. Organization and structure of genomes, genome size, sequence complexity, introns and exons, Genome structure in prokaryotes, Isolation of chromosome
2. Gene identification and expression, genome annotation, traditional gene identification routes, detecting open read frame, gene ontology, application of genomics analysis, overview of comparative genomics.
3. Application of genomics- Analysis of genomics in plants, role in plant genetics and breeding

UNIT 2: Bioinformatics (30 classes)

1. Bioinformatics: Introduction – genomics – transcriptome – proteome.
   Biological databases: Generalized and specialized databases – DNA, protein and carbohydrate databases – nucleic acid sequence databases – premier institutes for databases – nucleic acid codes used in database formats; Collection and down loading of information from databases – literature search.

2. Sequence alignment and its evolutionary basis: Simple alignment and multiple sequence alignment - searching the database for sequence similarity – search programmes with special reference to FASTA, BLAST, CLUSTAL W. Application of bioinformatics in phylogenetic analysis.

UNIT 3: Computational Biology (30 classes)

Computer assisted drug design- concept, methods and practical approaches.

1. Diagrammatic, graphical and tabular representations of data; measures of central tendency: mean, mode and median, dispersion, skewness and kurtosis.
2. Basic concepts of hypothesis testing, two kinds of error, level significance, p value, t-Test for mean and difference between two means, partial t-test., and Chi square test for goodness of fit.

Suggested Readings

1. Alonso, M.J. and Stepanova, A.N. (2015): Plant Functional Genomics Methods and Protocols, 2nd Edition, Springer Nature.
2. Caldwell, G.A., Williams, S.N., and Caldwell, K.A.(2014): Integrated Genomics, John Wiley Publications
3. Archbald, J. (2018): Genomics A very short Introduction, OUP Oxford
4. Zweiger, G. (2002): Transducing the genome,McGraw- Hill Education
5. Roy, H. and Prasad, D.P.,(2008): Gene and Genomics, Asian Books Private Limited
6. D'costa, S (2015): Advances in Genomics, Callisto Reference
7. Xiong, Essential Bioinformatics, Cambridge University Press.
8. Marketa J Zvelebil, Understanding Bioinformatics, Garland Sciences.
9. Shui Quing Ye, Bioinformatics: A practical approach.
10. Anna Tramantano, Introduction to Bioinformatics.
11. David W Mount, Bioinformatics. CBS.
12. Mani K and Vijayaraj N, Bioinformatics, Kalaikathir Achchagam.

ADVANCED MAJOR COURSE: AMJ-03
PRACTICALS-VII (Credit course: Prt.- 04)

Research methodology for plants

1. Experiments based on chemical calculations.
2. Technique of handling micropipettes in laboratory.
3. Data collection and documentation of observations in laboratory as well as field .
4. The art of imaging of samples through microphotography and field photography.
5. Plant microtechnique experiments.
6. Fixing agents and preservative in laboratory:- Squash preparations, clearing, maceration and sectioning; Mounting of an object under some common media.
7. Plant tissue dehydration using graded solvent series for permanent slide preparation.
8. Cytogenetic techniques with squashed plant materials.
9. Powerpoint and poster presentation on assigned topics.

Genomics

1. Learning and application of genomics
2. Techniques of genome sequencing
3. Genome application.
4. Project report submission on various topics of genomics.

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Bioinformatics and Computational biology

1. Testing good fit or not by chi-square method.
2. 't- test' significance to find differences between the two different sample.
3. Calculation of standard error to test ratio between two given Mendel's ratio
4. Experiments based on chemical calculations.
5. The art of imaging of samples through microphotography and field photography.
6. Poster presentation on defined topics.
7. Technical writing on topics assigned.

Research lab visits

Practical examination

Full marks: 100 Pass Marks: 40 Time: 03 Hrs.

1. Preparation of permanent slides of plant tissues specimens by dehydration methods using graded solvent series.
   Or To study different plant materials through maceration techniques (Schultze's method)
   Or Preparation of squash of the onion root tips to study all the stages of mitosis. 15 marks
2. Methods for preparing genomic library
   Or Preparation of gel electrophoresis (Agarose gel for DNA and RNA).
   Or Testing good fit or not by chi-square method. 15 marks

3. Calculation of standard error to test ratio between two given Mendel's ratio
   Or Experiments based on chemical calculations
   Or 't- test' significance to find differences between the two different sample. 15 marks
4. Spotting (5x4 marks) 20 marks
5. Viva voce 15 marks
6. Class records and Project Report/ Model/ Chart. 20 marks

Part-III

Syllabus for

Minor from Discipline (Botany)

SYLLABUS OF BOTANY MINOR COURSE- NEP,

BINOD BIHARI MAHTO KOYLANACHAL UNIVERSITY

Note: If subject for Minor from Discipline-1 is opted as Botany, the same subject (Botany) cannot be opted as Minor from Discipline-2.

Minor from Discipline
Subject: Botany
Semester I/II

Minor-1A (MN-1A): PLANT DIVERSITY-I AND CYTOGENETICS
Credit – 4 (3+1), Theory=3, Practical=1 **Lectures – 45**
Hours Full Marks = 100 [Theory = 75 + Practical = 25]
Theory [End Semester = **60**] + [Internal Examination = **15** (Written Examination = **10** + Class Performance & Attendance = **05**)]
Pass Marks = Theory [End Semester = **24**] [Internal Examination = **6**]

Instructions:

- In all **8 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of short answer type carrying **5 marks** each.
- **Group B** will contain **descriptive** type **five questions*** of **15 marks** each, out of which **any three** to be answer.
  ***Question no. 8** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus

THEORY
Lectures 60

Full marks: 75 **Time: 03 Hrs.**

PLANT DIVERSITY-I AND CYTOGENETICS

UNIT-01- Plant Diversity-I

ALGAE:-General characteristics, Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas, Batrachospermum.*

FUNGI:- general characteristics , morphology and life cycle of albugo, pucinia, alternaria , lichens-general account.

BRYOPHYTA:- General characteristics , morphology , anatomy and reproduction of marchantia.

UNIT-02- Cytology and Genetics

Cytology:- Structure of cytoplasm cell organelles – Mitochondria, Chloroplast, Ribosome ; Cell Division –Mitosis , Meiosis.

Genetics:- Principles of inheritance , Mendel's Law ; complimentary gene & Epistasis ; Gene- mutationand polyploidy

Suggested Readings

1. Pelczar, M.J, (2001) Microbiology, 5th edition, Tata McGraw-hill Co, NewDelhi.
2. Sharma,P.D.(2014) Microbiology. Rastogi Publication, Meerut
3. Vashishta, B.R., Singh, V.P., and Sinha A.K. (2014) Botany for Degree Students (Alage) S.Chand & Company Ltd.
4. Singh, Pande, Jain (2017-2018) A Text book of Botany Microbiology and Phycology
5. Singh, Pande, Jain (2018) A Text book of Botany 5th edition.

Minor-1A Practical

Minor-1A Practical (MN-1A-P): PLANT DIVERSITY-I AND CYTOGENETICS

Credit – 1 **Lectures – 30 Hours**

Full Marks = 25 [End Semester = **25**] [No Internal Examination]

Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Practical	**Marks Distribution**
1. Study of vegetative and reproductive structures by preparation of temporary slides from unit-1(algae , fungi , & bryophyte)	- 06
2. Cytological slide preparation	-05
3. Spotting	- 05
4. Record & Project	-05
5. Viva	-04

Total = 25 Marks

Minor from Discipline
Subject: Botany
Semester III/IV

Minor-1B (MN-1B): PLANT DIVERSITY-II AND PLANT PHYSIOLOGY

Credit – 4 (3+1), Theory=3. Practical=1 Lectures – 45 Hours Full Marks = 100 [Theory = 75 + Practical = 25]
Theory [End Semester = **60**] + [Internal Examination = **15** (Written Examination = **10** + Class Performance & Attendance = **05**)]
Pass Marks = Theory [End Semester = **24**] [Internal Examination = **6**]

Instructions:

- In all **8 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type **five questions*** of **15 marks** each, out of which **any three** are to answer.
  ***Question no. 8** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus.

THEORY **Lectures 60**

PLANT DIVERSITY-II AND PLANT PHYSIOLOGY

UNIT-01- PLANT DIVERSITY-II :

Pteridophytes:-General characteristics, morphology, anatomy and reproduction of *Selaginella*,and *Pteris*.

Gymnosperms
General characteristics; morphology, anatomy and reproduction of *Pinus*. Ecological andeconomical importance.

UNIT-02 – PLANT PHYSIOLOGY
Transpiration - Mechanism and Significance.
Ascent of sap – Root pressure theory and transpiration pull theory.**Photosynthesis** – Photophosphorylation , C_3 , C_4 - cycle
Respiration – Glycolysis, TCA- cycle.
Growth hormone- Auxin , Gibberellin

Minor-1B Practical

Minor-1B Practical (MN-1B-P): PLANT DIVERSITY-II AND PLANT PHYSIOLOGY

Credit – 1 **Lectures – 30 Hours**

Full Marks = 25 [End Semester = **25**] [No Internal Examination]

Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Practical	**Marks Distribution**
1. Study of vegetative and reproductive structures by preparation of te-fromunit-1(Ptredophytes & gymnosperm)	6
2. To perform physiological experiment from the syllabus	-05
3. Spotting	- 05
4. Record and project	-05
5. Viva	-04
	Total = 25 Marks

Minor from Discipline
Subject: Botany
Semester V/VI

Minor-1C (MN-1C): Anatomy, Embryology, Economic Botany

Credit – 4 (3+1), Theory=3, Practical=1 **Lectures – 60**
Hours Full Marks = 100 [Theory = 75 + Practical = 25]
Theory [End Semester = **60**] + [Internal Examination = **15** (Written Examination = **10** + Class Performance & Attendance = **05**)]
Pass Marks = Theory [End Semester = **24**] [Internal Examination = **6**]

Instructions:

- In all **8 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type **five questions*** of **15 marks** each, out of which **any three** are to answer.
  ***Question no. 8** will be short answer type. There will be **four options** of which **any two** to be answers each carrying equal marks covering the whole syllabus.

Anatomy, Embryology, Economic Botany

Unit- 1- ANATOMY
Tissues – apical, lateral and intercalary meristem; simple and complex tissues,Anomalous secondary growth in Boerhaavia & Dracaena.

Unit-2- EMBRYOLOGY
Outlines of cycle of an angiospermic plant,
Types of ovules,
Types of Embyo Sacs,
Development of Polygonum type.
Double fertilization.
Endosperm & polyembryony.

Unit-3- ECONOMIC & BOTANY
Morphology & uses of Following –Cereal – Wheat
Legumes- gram
Timber- Seeshum, teak Oil – Mustard, Sunflower
Medical – Tulsi , Neem & Amla

Minor-1C Practical

Minor-1C Practical (MN-1C-P): Anatomy, Embryology, Economic Botany

Credit – 1 **Lectures – 30 Hours**

Full Marks = 25 [End Semester = **25**] [No Internal Examination]

Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Practical	**Marks Distribution**
1. Indentification of tissue (parenchyma ,collenchymas and sclerenchyma)	
Or Anomalous secondary growth	- 06
2. Embryo dissection / photograph of ovule	-04
3. plant identification (from economic botany) and uses	04
4.Spotting	- 05
5. Record	-04
6. Viva	-02
	Total = 25 Marks

Minor from Discipline
Subject: Botany
Semester VII/VIII

Minor-1D (MN-1D): Ecology, Taxonomy, Biotechnology

Credit – 4 (3+1), Theory=3, Practical-1 **Lectures – 45**

Hours Full Marks = 100 [Theory = 75 + Practical = 25]

Theory [End Semester = **60**] + [Internal Examination = **15** (Written Examination = **10** + Class Performance & Attendance = **05**)]

Pass Marks = Theory [End Semester = **24**] [Internal Examination = **6**]

Instructions:

- In all **8 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type **five questions*** of **15 marks** each, out of which **any three** are to answer.

  ***Question no. 8** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus.

Ecology, Taxonomy, Biotechnology

Unit – I ECOLOGY

Introduction,
Ecological adaptation –
Hydrophytes, Xerophytes.
Plant communities –
Succession – Process & Types.
Eco-system structure, types – Pond, Grassland, Energy flow. Tropic organisation, Food chain, Food Web, Ecolgical pyaramid.Pollution – Air & Water- Causes & Contol.

Unit-2- TAXONOMY

Introduction, identification, Classification, Nomenclature.Taxonomic aids – herbarium & botanical Gardens.
Taxonomic hierarchy.
Principle & Rules of ICBN.
Classification – Benthom & Hooker and Hutchinson's system. Study of following families – Apocynaceae, Solanaceae, Poaceae.

Unit- 3- BIO-TECHNOLOGY.

Plant Tissue Culture- History, Requirement, Technique & Application

Suggested Readings

1. Pandey, B.P., (2016) .A text of Botany Angiosperms, S. Chand & Company Pvt. Limited
2. Pandey, B.P., (2016) .Taxonomy of Angiosperms, S. Chand & Company Pvt. Limited
3. Pandey, B.P., (2018) Botany for Degree Students (Plant Ecology and Taxonomy) S. Chand & Company Ltd.
4. Subrahmanyam, N.S (2020) Modern Plant taxonomy, Vikas Publication
5. Singh, Pande, Jain (2021) Plant taxonomy, Rastogi Publication, India.
6. Sharma, O.P., (2017). Plant taxonomy, Mc Graw Hill Education. 2nd edition.

Minor-1D Practical

Minor-1D Practical (MN-1D-P): Ecology, Taxonomy, Biotechnology

Credit – 1 Lectures – 30 Hours

Full Marks = 25 [End Semester = **25**] [No Internal Examination]

Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Practical **Marks Distribution**

1. Study of vegetative and floral characters of the families include in the syllabus with floraldiagram, formula and systematic position - 06
2. study of morphological adaptations of hydrophytes and xerophytes -04
3. photographs from Biotechnology -04
4. Spotting - 05
5. Record -03
6. Viva -03

Total = 25 Marks

.

Part-IV

Syllabus for

Minor from Vocational (Botany)

Minor from Vocational
Subject: Botany Semester II

Minor-2A (MN-2A): NATURAL RESOURCE MANAGEMENT
Credit – 4 (3+1), Theory=3, Practical=1 **Lectures – 45 Hours**
Full Marks = 100 [Theory = 75 + Skill Test/Viva voce/Practical/Demonstration = 25] Theory **[**End Semester = **75**] [No Internal Examination]
Pass Marks = Theory [End Semester = **30**]

Instructions:

- In all **9 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type, **six questions*** of **15 marks** each, out of which **any three** are to be answer.
  ***Question no. 9** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus.

NATURAL RESOURCE MANAGEMENT

UNIT 1: Natural resources, Definition, types, Sustainable utilization- Concept,approaches,(Economical, Socio- cultural, Ecological).

UNIT 2: Land- Soil degradation and management- Water- Fresh water estuaries,wet lands,threats, and management strategies.

UNIT 3: Biological Resource - Biodiversity- Definition and types,Significance, threat andmanagement.
Forest- Definition, Importance and management.

UNIT 4: Energy- Renewable and Non renewable sources.

UNIT 5: National and International efforts in resource management.

Suggested Books

1. Ecology & Environment: Sharma , P.D.- Rastogi Publication- Meerut.
2. Perspectives of Natural Resource Management. Prof. (Dr.) V. K. Ahuja ,Dr. Amol Deo Chavhan and Dr. Kasturi Gakul

Minor-2A (Skill Test/Viva voce/Practical/Demonstration) Minor-2A
Practical (MN-2A-P): NATURAL RESOURCE MANAGEMENT

Credit – 1 **Lectures – 30 Hours**
Full Marks = 25 [End Semester = **25**] [No Internal Examination]
Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Total = 25 Marks
Suggested Practical:

1. Study of Plant Community/ Vegetation of College Campus by Quadrat method, measurement of frequency and density.
2. Study of microbial flora of water samples.
3. Project on Waste management for clean, green Campus.
4. Principles and functioning of instrument in Microbiology Laboratory (any two)

Minor from Vocational Subject: Botany
Semester IV

Minor-2B (MN-2B): Minor Forest Produce
Credit – 4 (3+1), Theory=3, Practical=1 **Lectures – 45 Hours**
Full Marks = 100 [Theory = 75 + Skill Test/Viva voce/Practical/Demonstration = 25]
Theory **[**End Semester = **75**] [No Internal Examination]
Pass Marks = Theory [End Semester = **30**]

Instructions:

- In all **9 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type, **six questions*** of **15 marks** each, out of which **any three** are to be answer.
  ***Question no. 9** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus

Minor Forest Produce

Unit 1 Introduction- forest of Jharkhand and forest minor produce

Unit 2 Forest produce of Jharkhand
Aromatic and medicinal plants-Neem, karanj, Giloy,Munga,Pudina, Van Tulsi, Tulsi, sweet Flag, kalmegh, Satavar, lemon Grass
Nutritional plants - mushroom, Mahua flower,Imli,Chironjee, Kathal
Oil yielding plants - Sal seeds, Neem seeds, Mahua seeds, karanj Seeds, Kusum seeds, Castor Seeds
Fruit Tress- Kendu, ber, sahtoot, Mango, Jamun ,Piyar, Karonda, Carombola
Leafy Vegetables - chakor saag, Beng saag, konar Saag

Unit 3 Sources and uses of Minor Forest products (MFPs) - Gums Resins, katha, dyes,Tannins, oils. Technology's for extraction of Gum Resins Katha, Dyes, Tannins and oils

Unit 4 Post Harvest Process- Cleaning, Packaging, Storage and processing

Unit 5 Marketing of Minor Forest produce- Primary Agriculture Credit Society(PACS) Vyapaar Mandal Sahyog Samity(VMSS), Primary Minor Forest Produce Co-operative Society (PMFPCS), Women SHG and Repudiates NGOs

Unit 6 Livelihood based on Minor Forest Produce Products of Jharkhand - Bamboo, Canes and Grasses

Unit 7 Role of Minor Forest Produce in Sustainable development

Suggested readings

1. Importance of minor forest produces in tribal life Manoshi Das(2018)

2. Significance of minor forest produce in Indian tribal economy. K Mohan Reddy (2018)

3. Tribal settlement and minor forest produce. D. Thakur (2009)

4. Proceedment and marketing of forest minor produce in tribal area. D. Parthasarathy and U K Shankar Patnaik (2003)

Minor-2B (Skill Test/Viva voce/Practical/Demonstration)

Minor-2B Practical (MN-2B-P): **Minor Forest Produce** **Lectures – 30 Hours**
Full Marks = 25 [End Semester = **25**] [No Internal Examination]
Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Practical

1. Study of gum and resin yielding trees of your area.
2. Study of edible forest produce found in your locality
3. Project work - visit to local SHG or NGO.
4. Visit to local market to identify minor forest produce

Minor from Vocational Subject: Botany Semester VI

Minor-2C (MN-2C): NURSERY AND GARDENING

Credit – 4 (3+1), Theory=3. Practical=1 **Lectures – 45 Hours**
Full Marks = 100 [Theory = 75 + Skill Test/Viva voce/Practical/Demonstration = 25] Theory **[**End Semester = **75**] [No Internal Examination]
Pass Marks = Theory [End Semester = **30**]

Instructions:

- In all **9 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions**

of **1 mark** each.

- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type, **six questions*** of **15 marks** each, out of which **any three** are to be answer.

***Question no. 9** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus.

NURSERY AND GARDENING

Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion –Seed production technology - seed testing and certification.

Unit 3: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house.

Unit 4: Gardening: definition, objectives and scope - different types of gardening – landscape and home gardening - parks and its components - plant materials and design –computer Applications in landscaping - Gardening operations: soil laying, manuring, watering, Management of pests and diseases and harvesting.

Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

SUGGESTED READINGS

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co.,New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co.,New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture andCooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., SanFrancisco, USA.

(NURSERY AND GARDENING) PRACTICAL MARKS -25

01. Study of vegetative propapagation
a. Natural method- In bryophyllum,
b. Artificial methods- cutting (china rose), grafting(mango), layering (rose) , "gootee" (lemon)
02. Study of seed dormancy.
03. Computer applications in landscaping.

Minor-2C (Skill Test/Viva voce/Practical/Demonstration) Minor-2C Practical (MN-2C-P): NURSERY AND GARDENING

Credit – 1 **Lectures – 30 Hours**

Full Marks = 25 [End Semester = **25**] [No Internal Examination]

Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Minor from Vocational Subject: Botany
Semester VIII

Minor-2D (MN-2D): HERBAL TECHNOLOGY

Credit=4 (3+1), Theory=3, Practical=1 **Lectures – 45 Hours Full Marks = 100 [Theory = 75 + Skill Test/Viva voce/Practical/Demonstration = 25]**

Theory **[**End Semester = **75**] [No Internal Examination]

Pass Marks = Theory [End Semester = **30**]

Instructions:

- In all **9 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type, **six questions*** of **15 marks** each, out of which **any three** are to be answer.

***Question no. 9** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus.

HERBAL TECHNOLOGY

Unit 1: Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

Unit 2: Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

Unit 3: Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

Unit 4: Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

Unit 5: Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy).

SUGGESTED READINGS

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956.C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. InternationalBook Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994.Oxford IBH publishing Co.
5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

BOT-G-604C-P (HERBAL TECHNOLOGY) PRACTICAL MARKS -20

01. Culture of any medicinal plant mentioned in the syllabus.
02. Determination of secondary metabolites by TLC methods.
03. Systematic positioned uses of tulsi, ginger, fenugreek and Indian goose berry

Minor-2D (Skill Test/Viva voce/Practical/Demonstration) Minor-2D Practical (MN-2D-P): HERBAL TECHNOLOGY

Credit – 2 **Lectures – 60 Hours**

Full Marks = 25 [End Semester = **25**] [No Internal Examination]

Pass Marks = [End Semester = **10**] **Time: 3 Hours**

Part-V

Syllabus for
Multi-Disciplinary Course (MDC)

FYUGP-NEP 2020
Multi-disciplinary Course
(MDC) Subject: Botany
Semester I/II/III

Minor-2D (MN-2D): Botany
Credit – 3 **Lectures – 45 Hours**
Full Marks = 75 [End Semester = **75**] [No Internal Examination and No Practical]
Pass Marks = [End Semester = **30**]

Instructions:

- In all **9 questions** to be set there shall be two groups – **Group A and Group B**.
- **Group A** is compulsory which shall contain **three** questions.
- **Question no. 1** will be **very short answer type/Objective** types consisting of **five questions** of **1 mark** each.
- **Question no. 2 & 3** will be of **short answer type** carrying **5 marks** each.
- **Group B** will contain **descriptive** type, **six questions*** of **15 marks** each, out of which **any three** are to be answer.
  ***Question no. 9** will be short answer type. There will be **four options** of which **any two** to be answer each carrying equal marks covering the whole syllabus.

1. **Plant diversity and Human welfare:** Genetic, species and ecosystem level, importance of plants and their uses, conservation of plants diversity.
2. **Nursery and Gardening:** Nursery raising, gardening practices, plant propagation.
3. **Organic Farming:** Methods and types.
4. **Pollution:** Air, Water, Soil, Noise Pollution- causes, effect, and remedial measures.
5. **Biofertilizers:** General account of microbes used as Biofertilizer, Vermicompost
6. **Herbal medicine:** History and scope.
7. **Biofuels:** Definition types, and uses.
8. **Mushroom cultivation:** Process and nutraceuticals value of edible mushrooms.

Appendix

Appendix-I: Format for Question Paper

FORMAT OF QUESTION PAPER FOR END SEMESTER UNIVERSITY EXAMINATIONS

Question format for **50 Marks**:

Subject/ Code

F.M. –50 **Time**–2Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....

Group B

2. ..... [15]
3. ..... [15]
4. ..... [15]
5. ..... [15]
6. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **60 Marks**:

Subject/ Code

F.M. =60 **Time**=3Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B.**
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEMESTER UNIVERSITY EXAMINATIONS

Question format for **50 Marks**:

Subject/ Code

F.M. –50 **Time**–2Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....

Group B

2. ..... [15]
3. ..... [15]
4. ..... [15]
5. ..... [15]
6. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.

Question format for **60 Marks**:

Subject/ Code

F.M. =60 **Time**=3Hrs. Exam Year

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
iii. Answer in your own words as far as practicable.
iv. Answer all sub parts of a question at one place.
v. Numbers in right indicate full marks of the question.

Group A

1. [5x1=5]
   i. .....
   ii. .....
   iii. .....
   iv. .....
   v. .....
2. ..... [5]
3. ..... [5]

Group B

4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.