Course Curriculum of First Semester
as per the ICAR-Sixth Deans' Committee Report for the Academic Programmes in
BIOTECHNOLOGY

- UG-Certificate in Biotechnology
- UG-Diploma in Biotechnology
- UG-Degree: B.Tech. (Biotechnology)

Mahatma Phule Krishi Vidyapeeth, Rahuri

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UG Degree Syllabus State Coordinator

with

UG Degree Syllabus Discipline Coordinators &

DICC - UG Degree Syllabus Core Committee

Submitted to the

Directors of Instruction Coordination Committee

~ w.e.f. AY, 2024-25 ~

Course Layout

B.Tech. (Biotechnology)

Semester: I (New) ***w.e.f.*** **Academic Year: 2024-25**

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark
1.	**CAC-111**	*Deeksharambh* (Induction-cum-Foundation Course)	2(0+2)	NG (2 Weeks)
2.	**AEC-111**	National Service Scheme (NSS-I)/ National Cadet Corps (NCC-I)	1(0+1)	
3.	**AEC-112**	Communication Skills	2(1+1)	
4.	**MDC-111**	Farming-based Livelihood Systems	3(2+1)	
5.	**MATH-111*/ BOT-111****	Basic Mathematics*/ Basic Botany**	2(2+0)	Need-based
6.	**BT-111**	Molecular Biology	3(3+0)	
7.	**BT-112**	Introductory Cell Biology	3(3+0)	
8.	**BT-113**	Fundamentals of Genetics	3(3+0)	
9.	**SEC-111**	Skill Enhancement Course-I *(To be offered from the bouquet of SEC Courses)*	2(0+2)	
10.	**SEC-112**	Skill Enhancement Course-II *(To be offered from the bouquet of SEC Courses)*	2(0+2)	
		Total Credits Hrs.	**21(14+7) G 2(0+2) NG**	

CAC: Common Academic Course, **AEC**: Ability Enhancement Course,
MDC: Multidisciplinary Course, **SEC**: Skill Enhancement Course,
G: Gradial, **NG**: Non-Gradial

Note: *MATH-111 for **PCB** student/ **BOT-111 for PCM student / **PCMB** students may opt any 1 choice-based course viz., MATH-111 or BOT-111 for completion of the mandatory gradial credits.

Course-wise Syllabus with Teaching Schedules

Semester	**:**	**I**	
Course No.	**:**	**CAC-111**	**Credit Hrs. : 2 (0+2) NG/ 2 Weeks**
Course Title	**:**	***Deeksharambh* (Induction-cum-Foundation Course)**	
Non-Gradial Common Academic Course for the said UG degree with the activities to be conducted during initial two weeks.			

Objectives:

(i) To create a platform for students to help for cultural Integration of students from different backgrounds,

(ii) To know about the operational framework of academic process in university, instilling life and social skills,

(iii) To create Social awareness, Ethics and Values, Team work, Leadership, Creativity,

(iv) To identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

ACTIVITIES

- Introduction/Orientation and Discussions on operational framework of academic process in University/ College, as well as interactions with Academic and Research Managers of the University.
- Interaction with Alumni, Business Leaders, Perspective Employers, Outstanding Achievers in related fields and people with inspiring life experiences.
- Group activities to identify the strength and weakness of students and to learn from each other's life experiences.
- Activities to enhance Cultural Integration of students from different backgrounds.
- Field visits to the relevant fields/ establishments.
- Sessions on Personality Development (Instilling Life and Social skills, Social awareness, Ethics and Values, Team work, Leadership etc.) and imbibing the Communication skills.

Note: *The details of the relevant activities will be decided by the parent University in line with the above-mentioned broad activities.*

Semester : I		
Course No. : AEC-111	**Credit Hrs. : 1 (0+1)**	
Course Title : National Service Scheme (NSS-I) / National Cadet Corps (NCC-I)		
Gradial Common Course across all UG Degrees		

Course No.: AEC-111	**Course Title: National Service Scheme-I (NSS-I)**	**Credit Hrs: 1(0+1)**

SYLLABUS

PRACTICAL

Introduction and Basic Components of NSS

- Orientation: History, Objectives, Principles, Symbol, Badge; Regular Programs under NSS.
- Organizational structure of NSS, Code of conduct for NSS volunteers, Points to be considered by NSS Volunteers' awareness about Health.
- NSS program activities. Concept of regular activities, Special camping, Day camps, Basis of adoption of village/slums, Conducting survey, Analysing Guiding financial patterns of scheme, Youth program/schemes of GOI, Coordination with different agencies and maintenance of diary. Understanding youth. Definition, Profile, Categories, Issues and Challenges of youth; and Opportunities for youth who is agent of the social change.
- Community mobilization. Mapping of community stakeholders, Designing the message as per problems and their culture; Identifying methods of mobilization involving youth-adult partnership. Social harmony and National integration.
- Indian history and culture, role of youth in nation building, Conflict resolution and peace building. Volunteerism and Shramdaan. Indian tradition of volunteerism, its need, importance, motivation and constraints; Shaman as part of volunteerism.
- Citizenship, Constitution, and Human rights. Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and rights and Right to information. Family and Society. Concept of family, Community (PRIs and other community-based organizations) and Society.

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title	Weightage (%)
1	Orientation, History, Objectives, Principles, Symbols, Badge	10
2	Regular Programmes under NSS	10
3	Organisational Structure of NSS	10
4	Code of Conduct of NSS Volunteer	10
5	Points to be considered about NSS Volunteers awareness about Health	5
6	NSS Programme Activities- Concept of Regular activities	5
7	NSS Programme Activities- Special Campaign	5
8	NSS Programme Activities- Day Camps	5
9	NSS Programme Activities- Adoption of village, Conducting survey, Analysing Guiding financial patterns of scheme	5
10	NSS Programme Activities- Youth programs/schemes of GOI, Coordination with different agencies and maintenance of diary. Understanding youth. Definition, Profile, Categories, Issues and Challenges of youth and Opportunities for youth who is agent of the social change.	5
11	Community Mobilization- Mapping of community stakeholders, Designing the message as per problems and their culture; Identifying methods of mobilization involving youth-adult partnership.	5
12	Community Mobilization-Culture, Social harmony and National integration.	5
13	Indian History and Culture- Role of youth in Nation Building	5
14	Volunteerism and Shramdaan: Indian tradition of volunteerism, its need, importance, motivation and constraints; Shaman as part of volunteerism.	5
15	Citizenship, Constitution and Human Rights: Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and rights and Right to information.	5
16	Family and Society: Concept of family, Community (PRIs and other community-based organizations) and Society.	5
	Total =	**100**

Course No.: AEC-111	Course Title: National Cadet Corps-I (NCC-I)	Credit Hrs.: 1(0+1)

SYLLABUS

Objective: To integrate and develop qualities of leadership, discipline, character and patriotism and foster the NCC Motto: **"Unity and Discipline"** among the youth.

PRACTICAL

- Aims, Objectives, Organization of NCC and NCC Song. DG's Cardinals of Discipline.
- Drill- aim, General words of command, Attention, Stands-at-ease, Stand-easy and Turning.
- Sizing, Numbering, Forming in three ranks, Open and Close order march and Dressing.
- Saluting at the halt, Getting on parade, Dismissing and Falling-out.
- Marching, Length of pace and time of marching in quick/slow time and halt. Side pace, Pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
- Marking time, Forward march and halt. Changing step, Formation of squad and squad drill.
- Command and control, Organization, Badges of rank, Honours and Awards.
- Nation Building- Cultural heritage, Religions, Traditions and Customs of India. National integration. Values and ethics, Perception, Communication, Motivation, Decision making, Discipline and duties of good citizens. Leadership traits, Types of leadership. Character/ Personality development. Civil defence organization, Types of emergencies, Fire-fighting, Protection. Maintenance of essential services, Disaster management, Aid during development projects.
- Basics of Social Service, Weaker sections of society and their needs, NGO's and their contribution, Contribution of youth towards Social welfare and Family planning.
- Structure and Function of human body, Diet and Exercise, Hygiene and Sanitation. Preventable diseases including AIDS, Safe blood donation, First aid, Physical and mental health. Adventure activities. Basic principles of Ecology, Environmental conservation, Pollution and its control.

TEACHING SCHEDULE

PRACTICAL [AEC-111]

Exercise No.	Exercise Topic	Exercise Sub-topics	Weightage (%)
1-2	**Introduction to NCC**	Aims, Objectives, NCC Organizational structure, NCC Song, DG's Cardinals of Discipline.	4
3-5	**Drill Basics**	Aim of drill, General words of command, Positions of attention, Stand-at-ease and Stand-easy, Turning.	8
6-8	**Formation Drills**	Sizing, Numbering, Forming in three ranks, Open and Close order march and Dressing.	8
9-11	**Saluting Drills and Parade Movements**	Saluting at halt, Getting on parade, Dismissing and Falling-out.	8
12-14	**Marching Techniques**	Length of pace and time of marching in Quick/slow march, Side pace, Forward/rear pace, Turning on the march, Wheeling and Saluting on the march	10
15-17	**Squad Formation and Control**	Marking time, Forward march, Halt, Changing step, Formation of squad and Squad drill.	10
18-19	**Command and Control in NCC**	Organization, Badges of rank, Honours and Awards.	4
20-22	**Nation Building and Citizenship; Leadership**	Cultural heritage, Religions, Traditions, Customs of India, National integration, Values and Ethics, Communication, Leadership traits, Discipline and Motivation, Character/ Personality Development.	12
23-24	**Civil Defence and Emergency Management**	Types of emergencies, Fire fighting techniques, Maintenance of essential services, Disaster management and Aid during development projects, Civil Defence Organizations.	10
25-26	**Social Service and Youth Welfare**	Weaker sections of society, Role of NGOs, Youth participation in Social welfare and Family planning	8
27-29	**Health, Hygiene and First Aid**	Human body structure, Diet, Hygiene, Preventable diseases (including AIDS), Safe blood donation, First aid practices, Mental and Physical health.	10
30-32	**Environment and Ecology**	Basic Principles of Ecology, Environmental conservation, Pollution and its control, Adventure activities.	8
		Total =	**100**

Semester	**:**	**I**			
Course No.	**:**	**AEC-112**	**Credit Hrs.**	**:**	**2(1+1)**
Course Title	**:**	**Communication Skills**			
Gradial Common Course across all UG Degrees					

SYLLABUS

Objectives:(i) To acquire competence in oral, written and non-verbal communication,

(ii) To develop strong personal and professional communication and

(iii) To demonstrate positive group communication.

THEORY

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and Non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication. Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/Abstracting/Summarizing; Style of technical communication, Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions; Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; Phrases and clauses; Case: subjective case, possessive case, objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

PRACTICAL

Listening and note taking; Writing skills: précis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; Vocabulary building exercises; Interview techniques; Organization of events.

TEACHING SCHEDULE

THEORY [AEC-112]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	**Communication Process: The Magic of Effective Communication**	Elements of Communication process such as Communicator, Message, Channel treatment of message, Audience and Audience response.	5
2	**Building Self-esteem and Overcoming Fears**	Points to build Self-esteem, Build social connections, Encourage yourself, Focus on solutions and Set realistic goals, Strategies to overcome fears, Practice, Visualise Success, Preparation, Know your audience, Seek feedback and Active listening.	5
3	**Communication**	Concept, Nature and Significance of Communication process	10
4		Meaning, Types and Models of communication	10
5		Verbal and Non-verbal communication, Linguistic and Non-linguistic communication	10
6		Barriers to communication and Reasons behind communication gap/ miscommunication	5
7	**Basic Communication Skills**	Listening, Speaking, Reading, Writing skills	5
8		Précis writing/ Abstracting/ summarizing- Styles of technical communication, Curriculum Vitae/resume writing	10
9		Innovative methods to enhance vocabulary, analogy questions	5
10	**Structural and Functional Grammar**	Sentence structure, modifiers, connecting words and verbal; Phrases and Clauses	5
11		Case: Subjective case, Possessive case, Objective case	5
12		Correct usage of nouns, Pronouns and Antecedents	5
13		Adjectives, Adverbs and Articles	5
14		Agreement of verbs with the subject: Tense, Mood, Voice	5
15		Writing effective sentences	5
16		Basic sentence faults	5
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [AEC-112]

Exercise No.	Exercise Topic/ Title
1	Listening and Note taking
2	Writing skills- Précis writing
3	Writing skills- Abstracting
4	Writing skills- Summarizing
5	Reading and Comprehension (written and oral) of general and technical articles
6	Micro-presentations
7	Impromptu presentations
8	Feedback on presentations
9	Stage manners- Grooming
10	Stage manners- Body language
11	Stage manners- Voice modulations, speed
12	Group discussions
13	Public speaking exercise
14	Vocabulary building exercises
15	Interview techniques
16	Organisation of events

Suggested Readings:

1. Allport, G W, 1937. Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele & Gyles Brandreth, 1994, How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale, 1997. The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter S J, 2012. Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi.
5. Kumar S and Pushpa Lata, 2011. Communication Skills. Oxford University Press.
6. Neuliep James W, 2003. Intercultural Communication- A Contextual Approach. Houghton Mifflin Co Boston.
7. Pease, Allan, 1998, Body Language. Sudha Publications, Delhi.
8. Raman M and Singh P, 2000. Business Communication. Oxford University Press.
9. Ray G L, 2008. Extension, Communication and Management. Kalyani Publishers, Ludhiana
10. Ray G. Land Mondal Sagar, 2012. Textbook on Rural Development Entrepreneurship and Communication Skills. Kalyani Publishers, Ludhiana.
11. Seely J, 2013, Oxford Guide to Effective Writing and Speaking. Oxford University Press.
12. Thomson A J and Martinet A V, 1977, A Practical English Grammar. Oxford University.

Semester	**:**	**I**		
Course No.	**:**	**MDC-111**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Farming-based Livelihood Systems**		
Gradial Common Course across all UG Degrees				

SYLLABUS

Objectives: (i) To make the students aware about farming-based livelihood systems in Agriculture,

(ii) To disseminate the knowledge and skills that how farming-based systems can be a source of livelihood.

THEORY

Status of Agriculture in India and different States, Income of farmers and rural people in India, Livelihood- Definition, Concept and Livelihood patterns in urban and rural areas, Different indicators to study livelihood systems. Agricultural Livelihood Systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming-based livelihood systems, Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems: Crops and cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agroforestry systems, Aquaculture, Duck/Poultry-cum-Fish, Dairy-cum-Fish, Piggery-cum-Fish etc.; Small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country; Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Governments; Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing lifestyle.

PRACTICAL

Survey of farming systems and agriculture-based livelihood enterprises, Study of components of important farming-based livelihood models/systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing-based and integrated farming-based livelihood models, Field Visit of innovative farming system models. Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis, Case study of Start-Ups in agri-sectors.

TEACHING SCHEDULE

THEORY [MDC-111]

Lecture No.	Topic	Sub-topics/Key Points	Weightage (%)
1	Status of Agriculture in India	Historical background, Current status, Role of Agriculture in Indian Economy	4
2	Status of Agriculture in Different States	State-wise scenario, Major crops, Regional diversity	4
3	Income of Farmers and Rural People in India	Factors affecting income, Rural-urban income gap, Government initiatives	4
4	Livelihood: Definition, Concept, and livelihood Patterns in urban and rural areas	Livelihood-Definition and its Concept, Urban vs Rural livelihood patterns, Sources of income	4
5	Different Indicators to Study Livelihood Systems	Economic, Social and Environmental indicators, Measuring livelihood resilience	4
6	Agricultural Livelihood Systems (ALS): Meaning and Approaches	Definition, Significance of ALS, Integrated farming systems, Approaches	4
7	ALS Framework and Case studies	Framework for ALS, Case studies in India	4
8	Definition of Farming Systems and farming based Livelihood Systems	Definition and Role of farming systems in rural livelihoods, Examples of systems	4
9	Prevalent Farming Systems in India contributing to livelihood	Traditional vs. Modern farming systems, Regional differences	4
10	Types of Traditional and Modern Farming Systems	Types; Differences; Strengths, Limitations, Case studies	4
11	Components of farming system/farming-based livelihood systems - Crops and Cropping Systems	Components, Crop diversification, Cropping pattern, Mixed cropping, Importance for rural livelihoods	4
12	Livestock-based Farming Systems	Importance and Management of dairy, piggery, poultry, goatry, duckry, etc.	4
13	Horticultural Crops and Livelihoods	Role of fruits, vegetables and spices in rural income generation	4
14	Agroforestry Systems	Agroforestry- Definition, Combining trees and crops, Agroforestry models in India	2
15	Aquaculture as a Livelihood System	Importance of Aquaculture, Integrated systems (e.g. Duck/Poultry-cum-Fish, Dairy-cum-Fish, Piggery-cum-Fish etc.)	4
16	Challenges in Aquaculture-based Systems	Feasibility, Government support and Market access	2

Continued…

17	Small Enterprises in Farming	Role of small enterprises, Value addition, Local processing	2
18	Medium and Large Enterprises in Farming	Value chains, Secondary enterprises as livelihood components for farmers, Agri-processing.	2
19	Factors affecting Integration of various enterprises of farming for livelihood	Technology, Market access, Credit and infrastructure challenges etc.	4
20	Strategies for Enterprise Integration	Successful integration, Government policies, Examples.	2
21	Overview of Agro-Climatic Zones in India	Characteristics of different zones and their agricultural potential.	2
22	Feasibility of different Farming Systems for different Agro-Climatic Zones	Suitable farming systems for different zones, Climate adaptation.	2
23	Commercial Farming Based Livelihood Models by NABARD, ICAR and other organizations across the country	Role of NABARD, ICAR and other Organizations in promoting commercial models, Successful cases.	4
24	Case studies on different Livelihood Enterprises associated with farming	Analysis of successful enterprises, Dairy Cooperatives etc.	4
25	Risk Factors in Farming-based Livelihood Systems	Climate, Market fluctuations, Input costs; Mitigation strategies etc.	4
26	Success Factors in Farming-based Livelihood Systems	Innovation, Market access, Government support, Social capital etc.	2
27	Schemes and Programmes by the Central Government	Overview of schemes like, PM-KISAN, National Rural Livelihood Mission.	2
28	Schemes and programmes by State Governments	State-specific programs promoting rural livelihoods, Case examples.	2
29	Role of Private Sector in Livelihood Promotion	Public-Private Partnerships, Role of private agribusiness.	2
30	Public-Private Partnerships in Agriculture	Successful collaborations in rural development and farming systems	2
31	Farming-based Livelihoods in the 21st Century	Circular economy, Green economy, Climate change, Sustainability.	2
32	Impact of Digitalization and Changing Lifestyles	Technology in Agriculture, Future prospects for rural livelihoods.	2
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [MDC-111]

Exercise No.	Exercise Topic	Exercise Sub-topics/ Titles
1	Survey of Farming Systems and Agriculture-based Livelihood Enterprises	Methods of data collection; Field survey techniques; Preparing reports on surveyed farms.
2	Study of Components of Farming-based Livelihood Models in Different Agro-Climatic Zones	Components: Crop, livestock, fishery, agroforestry; Identifying models suited to specific zones.
3	Study of Production and Profitability of Crop-based Models	Analysis of input-output relations; Identifying profitable crops
4	Study of Livestock-based Models	Livestock systems: Dairy, poultry, goat farming; Profitability and market access
5	Study of Processing-based Models	Value addition in agriculture; Studying small-scale food processing units
6	Study of Integrated Farming-based Models	Study of crop-livestock-aquaculture integration; Synergies and challenges
7	Field Visit to Innovative Farming System Models	Visit to farms using modern technologies; Documenting practices
8	Visit to Agri-based Enterprises	Enterprises involved in input supply or value addition
9	Study of Functional Aspects: Integration of Production, Processing and Distribution	Backward and forward linkages; Assessing supply chain models
10	Agri-Enterprises in Industry and Service Sectors (Value Chain Models)	Studying value chain enterprises; Evaluating sustainability models
11	Concept of Project Formulation on Farming-based Livelihood Systems	Identifying project objectives; Structuring budgets and timelines
12	Cost and Profit Analysis of Farming-based Livelihood Projects	Developing Cost-Benefit analysis; Identifying Break-Even points
13	Case Study of Start-ups in Agri-sectors	Analysing real-world Start-ups; Identifying success factors
14	Group Project: Develop a Farming-based Livelihood Model	Formulating a working model; Feasibility and sustainability analysis
15	Preparation of Report on Farming Systems Survey and Livelihood Models	Compiling field data; Preparing reports with recommendations
16	Presentation and Evaluation of Practical Project Reports	Group presentations; Internal assessment of reports and participation

Suggested Readings [MDC-111]:

1. **Ashley, C., & Carney, D. (1999)**. *Sustainable Livelihoods: Lessons from Early Experience.* Department for International Development, London, UK.
    - **Relevance**: This book explores sustainable livelihood frameworks, which are key to understanding livelihood patterns and rural income systems.
2. **Agarwal, A., & Narain, S. (1989)**. *Towards Green Villages: A Strategy for Environmentally Sound and Participatory Rural Development.* Centre for Science and Environment, New Delhi, India.
    - **Relevance**: Provides strategies for participatory rural development, focusing on environmental sustainability—a core concept in farming systems.
3. **Carloni, A. (2001)**. *Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa.* FAO, Rome, Italy.
    - **Relevance**: Offers insights into global farming system challenges, with lessons that can be adapted for Indian contexts in agricultural development.
4. **Dixon, J., Gulliver, A., & Gibbon, D. (2001)**. *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World.* FAO & World Bank, Rome & Washington, DC.
    - **Relevance**: Focuses on farming systems' role in poverty alleviation and rural livelihood improvement.
5. **Evenson, R.E. (2000)**. *Agricultural Productivity and Production in Developing Countries.* In *FAO, The State of Food and Agriculture.* FAO, Rome, Italy.
    - **Relevance**: Discusses agricultural productivity, a critical factor in sustainable farming and improved livelihoods.
6. **Bhatt, B.P., *et al.* (ICAR Research Complex for Eastern Region)**. *Livelihood Improvement of Underprivileged Farming Community: Experiences from Bihar.* Patna, Bihar.
    - **Relevance**: Case studies on improving livelihoods in rural India, relevant to learning about region-specific agricultural interventions.
7. **Panwar *et al.* (2020)**. *Integrated Farming System Models for Agricultural Diversification, Enhanced Income, and Employment.* Indian Council of Agricultural Research, New Delhi.
    - **Relevance**: Provides models for agricultural diversification and income enhancement, which align with farming system topics.
8. **Reddy, S.R. (2016)**. *Farming System and Sustainable Agriculture.* Kalyani Publishers, New Delhi.
    - **Relevance**: Covers sustainable agriculture principles and farming system models, essential for sustainable livelihood systems.
9. **Singh, J.P. *et al.* (2016)**. *Region Specific Synthesized Integrated Farming System Models for Improved Production, Profitability and Nutrition (Series-1).* Bulletin, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut (U.P.).
    - **Relevance**: Discusses integrated farming models tailored to different agro-climatic regions of India, essential for practical learning.
10. **Walia, S.S., & Walia, U.S. (2020)**. *Farming System and Sustainable Agriculture.* Scientific Publishers, Jodhpur, Rajasthan.
    - **Relevance:** Provides insights into sustainable agricultural practices and integrated farming systems with regional focus.

Semester	**:**	**I**	
Course No.	**:**	**MATH-111***	**Credit Hrs. : 2(2+0) Need-based; G/NG**
Course Title	**:**	**Basic Mathematics**	
***Gradial** Need-based Common Course for **B.Tech. (Biotechnology)**; ***Non-Gradial** Need-based Common Course for **B.Tech. (Agril. Engg.)** & **B.Tech. (Food Technology)**			

SYLLABUS

Objectives:

(i) To study the basic principles and functions in mathematics like limits and continuity,

(ii) To study differentiation and integration,

(iii) To study matrices and determinants.

THEORY

Functions:

Function and types of functions, Limit: Introduction, left-handed and right-handed limits, Algebra of limits, Standard limits. Continuity: Definition of continuity, continuity of algebraic functions. Continuity of trigonometric and exponential functions.

Differentiation:

Differentiation by the first principle, Rules of Differentiation: sum, difference, product and quotient formulae, differentiation using the chain rule, differentiation of functions in parametric and implicit form, logarithmic differentiation, geometrical interpretation of derivative. Successive differentiation, maxima and minima.

Integration:

Definition of indefinite integrals, Integrals of elementary functions (Formulae only), Theorems of integration (without proof), Integration by substitution, integration by partial fractions, integration by parts, Definition of definite Integral with examples, properties of definite integral (without proof).

Matrices and Determinants:

Definition of determinants, example up to Third order determinant, properties of determinant (statements only), Definition of matrix, types of matrices, Algebra of Matrix (addition, subtraction and multiplication), inverse of matrix, Solution of linear equations by Crammer's rule.

TEACHING SCHEDULE

THEORY [MATH-111]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1-5	**Functions:**	Definition of Function, Types of functions	15
		Some Basic Functions: Definition and Properties of: Constant Function, Identity Function, Power Function. Polynomial Function, Linear, quadratic and cubic function, Radical Function, Rational Function. Exponential, Logarithmic and Trigonometric Function	
	Limit:	Introduction, Definition of Limit, Left-handed and Right-handed limits, Algebra of limits	
		Standard limits: Method of Factorization, Rationalization, Limit of Trigonometric, Exponential Logarithmic and Functions. Limit of Infinity	
	Continuity:	Definition of continuity, Continuity of algebraic functions, Continuity of trigonometric and exponential functions.	
6 -15	**Differentiation:**	Definition, Differentiation by the first principle, Derivative of some standard functions (Formulae only), Rules of Differentiation (Sum, Difference, Product and quotient without proof), Differentiation using the chain rule, Differentiation of functions in parametric and implicit form, Logarithmic Differentiation, Successive differentiation, Maxima and minima	30
16 -25	**Indefinite and Definite Integration**:	Definition of indefinite Integral, Integrals elementary functions (Formulae only) Theorems of integration (without proof) Methods of Integration: Integration by Substitution, Integration by parts, Integration by partial fractions Some special integrals formulae only. Definition of definite Integral with examples Properties of definite integral (without proof)	30
26 -32	**Determinants and Matrices:**	Definition of determinants, Expansion up to third order determinant, Properties of determinant (Statements only) Definition of matrix, Order of Matrix, Types of matrices, Algebra of Matrices, Inverse of matrix by elementary transformations, Solution of linear equations by Crammer's rule	25
		Total=	**100**

Suggested Readings:

1. NCERT, 2012, Mathematics of Class XII, NCERT, India.
2. A Textbook of Mathematics XI and XII (Part I and II) Maharashtra State Board of Secondary and Higher Secondary Education, Pune.
3. Sharma RD, 2014, Mathematics of Class XII, Dhanpat Rai Publisher.

Semester	**:**	**I**		
Course No.	**:**	**BOT-111****	**Credit Hrs. : 2(2+0)**	**Need-based; G/NG**
Course Title	**:**	**Basic Botany**		

**Need-based Common Course among 3 UG Degrees:

B.Tech. (Biotech.) - Gradial / B.Sc. (Hons.) A.B.M. - Gradial / B.Tech. (Food Tech.) - Non-Gradial

SYLLABUS

Objectives:
i. To study the basic taxonomy and classification of plants,
ii. To study the features of plant kingdom and morphology,
iii. To study the internal structures of plants.

THEORY

Plant Kingdom and Features of each group. Plant taxonomy, Systems of classification. Morphology, Modifications and Functions of Root, Stem, Leaf, Flower and Inflorescence. Pollination and Fertilization. Fruit types. Structure of dicot and monocot seed, and seed germination. Cell structure. Chromosome, DNA and Genes. Cell and tissue types. Internal structure of root, stem and leaf. Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

TEACHING SCHEDULE

THEORY [BOT-111]

Lecture No.	Topics	Sub-topics/ Key Points	Weightage (%)
1-3	**Plant Kingdom and Features:**	Classification of Plant Kingdom (Major plant groups: Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms.) Key distinguishing features/ characteristics of each group with examples. Plantae Kingdom.	8
4-5	**Plant Taxonomy and Systems of Classification:**	Binomial nomenclature and other systems of classification (in brief)	5
6-7	**Plant Cell and Tissue Types:**	Basic Structure of a Plant Cell and Tissue, Types of Plant Cells and Tissues; Plant Cell Functions.	8
8-9	**Chromosome:**	Definition and Overview, Chemical Composition; Chromosome Morphology, Types of Chromosomes.	8

Continued…

10-11	**DNA:**	Brief historical overview of DNA discovery, Watson-Crick model of DNA, Chemical composition, Components of a nucleotide, Structures of Purines and Pyrimidines.	8
12	**Genes:**	Definitions (Gene, Allele, Genotype, Phenotype, Exon, Intron, Codon) and Historical Overview; Structure: Basic layout of a gene- (Exon, Intron, etc.); Types of genes, Codons (Start/ Stop).	8
13-14	**Pollination and Fertilization:**	Definitions/Terminology, Types, Agents of pollination, Processes/Events, Significances, Barriers to Fertilization, Differences between their types.	10
15-16	**Root and Stem:**	Morphology, Modifications with examples and Functions	8
17-19	**Leaf, Flower and Inflorescence:**	Morphology, Modifications with examples and Functions	8
20	**Fruits:**	Types of fruits with examples	3
21-22	**Structures of Monocot and Dicot Seeds:**	Structure, Diagrams, Differences	5
23-24	**Seed Germination:**	Definitions, Types, Differences and Stages of seed germination	5
Plant taxonomy-Classification; Characteristics and Economic Importance; Members/ Examples of following Families viz.,			
25-26	Poaceae and Brassicaceae		4
27-28	Fabaceae and Malvaceae		4
29-30	Rutaceae and Rosaceae		4
31-32	Asteraceae and Solanaceae		4
		Total=	**100**

Suggested Readings [BOT-111]:

1. Bendre AM and Kumar A, 1999, Textbook of Practical Botany. Vol. 2, 7th Edn, Rastogi Publications.
2. Bendre AM and Pande PC, 2009, Introduction to Botany, Rastogi Publications.
3. Bhatia KN and Tyagi MP, 2020, Elementary Biology. A Truemen Publication.
4. David M Hillis, H Craig Heller, Sally D Hacker, David W Hall, David E Sadava, 2020. (eBook) Life: The Science of Biology, 12th Edn, Sunderland Publication.
5. Dutta AC, 1995, A Class-Book of Botany, 16th Edn, Oxford University Press.
6. NCERT, 2021. Biology of Class XI. NCERT, India.
7. Pande PC and Jain DK, 2022, A Textbook of Botany Angiosperm. S. Chand Publications.

Semester	**:**	**I**	
Course No.	**:**	**BT-111**	**Credit Hrs : 3(3+0)**
Course Title	**:**	**Molecular Biology**	

SYLLABUS

Objectives:

(i) To study the principles and techniques of Molecular Biology.

(ii) To study the Central dogma of life.

(iii) To study the tools in Molecular Biology.

THEORY

History of Molecular Biology. Central Dogma of Life. Structures of DNA and RNA. Gene structure and function. DNA replication and transcription. Genetic code and translation. Structure of prokaryotic and eukaryotic nuclear, and organelle genomes. Gene regulation in prokaryotes. *Lac* Operon concept and *Tryp* Operon concept. Introduction to Microbial Genetics; Conjugation, transformation and transduction. Tools in Molecular Biology. Role of enzymes in Molecular Biology. Principles of Polymerase Chain Reaction and Electrophoresis.

TEACHING SCHEDULE

THEORY [BT-111]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
Unit-I			
1	**History of Molecular Biology**	Concept, Historical evidences and prospects	2
2-3	**Central Dogma of Life**	Concept Evidences for DNA as the genetic material- the transformation experiments.	6
4-7	**Structures of DNA and RNA**	History, Watson and Crick model of DNA, Structure of DNA and RNA; its types and function of nucleic acids (DNA and RNA).	6
8-9	**Gene Structure and Function**	Gene: Gene concept, Unit of function, One gene - one enzyme hypothesis	3
10-14	**DNA Replication**	Outline of DNA replication, Meselson and Stahl experiment, Mechanism of DNA replication in prokaryotes and eukaryotes.	8
15-17	**Transcription**	Prokaryotic and Eukaryotic transcription.	6
18-19		Post-transcriptional modifications mechanism.	3

Continued…

20-21	**Genetic Code**	Amino acids involved in Protein synthesis, Characteristics of Genetic code *viz*; Triplet code, Non-overlapping, Comma less, Polarity, Codons and anticodons, Initiation codons, Termination codons, Degenerate and universal, Wobble hypothesis.	4
22-24	**Translation**	Prokaryotic and Eukaryotic translation	6
25-26		Post-translational modification mechanism	2
Unit-II			
27-29	**Prokaryotes and Eukaryotes Nuclear and Organelle Genomes**	Genome organization in Prokaryotes and Eukaryotes, Special features of eukaryotic gene structure and organization, Genome organization of mitochondria and chloroplast.	6
30-31	**Gene Regulation in Prokaryotes**	Concept of Operon, *Lac* Operon and *Tryptophan* Operon.	6
32-34	**Introduction to Microbial Genetics**	Scope and development, Recombination in bacteria and viruses, Conjugation, Transformation, Transduction- generalized and specialized.	8
Unit-III			
35-36	**Tools in Molecular Biology**	Types, nomenclature, characteristics and uses of restriction endonucleases	6
37-38	**Role of enzymes/ DNA Modifying Enzymes in Molecular Biology**	Nuclease, Ligases, Polymerase, Topoisomerase, Alkaline phosphatase etc.	4
39-41	**Vectors**	Concept, Properties and Vectors i.e. Plasmid (pBR 322, pUC 18/19, Bacteriophage and Cosmid.	8
42-43		Construction of Genomic and c-DNA Libraries.	4
44-46	**Principles of Polymerase Chain Reaction**	Concept, Components, Procedure and Applications of PCR.	7
47-48	**Principles of Electrophoresis**	Principles and its Types *viz*; SDS-PAGE, Agarose gel and 2D Electrophoresis.	5
		Total=	**100**

Suggested Readings [BT-111]:

1. Lewin B, 2017, Gene XII, Oxford University Press.
2. Cooper GM and Hausman RE, 2018, The Cell: A Molecular Approach. Sinauer Associates Inc, 8th Edn.
3. Nelson DL and Cox MM, 2017, Lehninger Principles of Biochemistry, 7th Edn, W. H. Freeman.
4. Satyanarayana U and Chakrapani U, 2021, Essentials of Biochemistry, Elsevier.

Semester	**:**	**I**	
Course No.	**:**	**BT-112**	**Credit Hrs. : 3(3+0)**
Course Title	**:**	**Introductory Cell Biology**	

SYLLABUS

Objectives:

(i) To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

(ii) To understand how these cellular components are used to generate and utilize energy in cells.

(iii) To understand the cellular components underlying mitotic cell division.

(iv) To apply the basic knowledge of cell biology to selected examples of changes or losses in cell function that include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

THEORY

Origin and evolution of cell. Introduction to microscopy. Sub-cellular structure of prokaryotic and eukaryotic cells. Membrane structure and function: Plasma membrane, cell wall and extracellular matrix. Structural organization and function of intracellular organelles and organelle biogenesis. Nucleus, Mitochondria, Endoplasmic reticulum, Golgi apparatus, Lysosomes, Peroxisomes, Plastids and Vacuoles. Structure and function of the cytoskeleton and its role in motility. Cell membrane transport. Introduction to cell signaling. Cell growth, Cell cycle and its control. Cell death and cell renewal.

Suggested Readings [BT-112]:

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P. 2008. Molecular Biology of the Cell. 5th Ed. Garland Science/ Taylor and Francis Group.
2. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A & Scott MP. 2012. Molecular Cell Biology. WH Freeman.
3. Sadava DE. 1993. Cell Biology: Organelle Structure and Function. Jones and Bartlett Publishers
4. Verma PS and Agarwal VK, 2016, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S Chand and Sons.
5. Cooper GM and Hausman RE, 2018, The Cell: A Molecular Approach. Sinauer Associates Inc.

TEACHING SCHEDULE

THEORY [BT-112]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
Unit-I			
1-2	**Origin and Evolution of Cell**	a. Evolution of molecules and first cell b. Evolution from Prokaryotes to Eukaryotes c. Evolution of single cells to multicellular organisms d. Cell theory	4
3-4	**Introduction to Microscopy**	Principles and Applications of ~ a. Light microscopy- b. Compound microscopy-	4
5-8		Principles and Applications of ~ c. Phase contrast microscopy d. Dark-field microscopy e. Fluorescence microscopy f. Differential interference microscopy g. Confocal laser scanning microscopy (CLSM) h. Electron microscopy	6
9-11	**Sub-cellular Structure of Prokaryotic and Eukaryotic Cells**	a. Sub-cellular structure of prokaryotic cells b. Sub-cellular structure of eukaryotic cells c. Differences between Prokaryotic and Eukaryotic cells	4
12-14	**Membrane Structure and Function - Plasma membrane**	a. Origin of plasma membrane b. Chemical composition of Plasma membrane (lipids, proteins, carbohydrates) c. Different models of plasma membrane structure d. Functions of plasma membrane	8
15-17	**Cell wall and Extracellular matrix**	a. Cell wall composition and structure: Prokaryotic and Eukaryotic b. Functions of cell wall c. Cell-cell junctions, cell adhesion and extracellular matrix.	4
18-20	**Structural Organization; Functions of Intracellular Organelles and Organelle Biogenesis:**	a. Structural organization and function of intracellular organelles and organelle biogenesis b. Structure and Functions of Nucleus	6
21-22		Structure and Functions of Plastids	8
23-24		Structure and Functions of Mitochondria	
25-26		Structure and Functions of Endoplasmic reticulum	8
		Structure and Functions of Golgi apparatus	
		Structure and Functions of Lysosomes, Peroxisomes, Vacuoles.	2

Continued…

Unit-II			
27-28	**Structure and Functions of Cytoskeleton and its Role in motility**	a. Origin of cytoskeleton b. Cytoskeleton structure- Microtubules, Microfilaments and Intermediate filaments	4
29-30		c. Cilia and centrioles d. Function of cytoskeleton and its role in motility	4
31-34	**Cell Membrane Transport**	a. Principles of membrane transport b. Active transport and its types c. Passive transport and its types d. Transporter, Channels: Types and function	8
35-39	**Introduction to Cell Signaling**	a. General principles of signaling b. Stages of cell signaling c. Types of cell signaling d. Signaling molecules e. Receptor and its types f. Functions of cell surface receptors	10
40-41	**Cell Growth, Cell Cycle and its Control**	a. Overview of Cell cycle	4
42-43		b. Mitosis and Cytokinesis c. Meiosis	4
44-45		d. Components of cell cycle control system e. Regulation of cell cycle	4
46-47	**Cell Death and Cell Renewal**	a. Programmed cell death/ Apoptosis	4
48		b. Cell renewal: stem cells and maintenance of adult tissues	4
		Total =	**100**

Semester	**:**	**I**	
Course No.	**:**	**BT-113**	**Credit Hrs. : 3(3+0)**
Course Title	**:**	**Fundamentals of Genetics**	

SYLLABUS

Objectives:

i. To study the history of Genetics,
ii. To study the principles of inheritance and variation,
iii. To study chromosomes and cell division,
iv. To study the genetic basis of traits.

THEORY

History of Genetics. Mendel's principles and rediscovery. Cell division. Chromosomes structure and function. Chromosomal theory of inheritance. Sex-linked, sex-limited and sex-influenced inheritance. Sex determination and sex differentiation. Multiple allelism. Linkage and crossing-over. Gene-gene interaction. Genetic analysis in prokaryotes and eukaryotes. Extra chromosomal inheritance. Mutations. Hardy-Weinberg law. Quantitative inheritance. Genetic basis of evolution. Introduction to Human Genetics.

Suggested Readings (BT-113):

1. Singh B. D., Fundamentals of Genetics, Kalyani Publication, New Delhi.
2. Phundan Singh, Elements of Genetics, Kalyani Publication, New Delhi.
3. Gardner E. J., Simmons M. J., Snustad D. P., 1991, Principle of Genetics, Wiley India (P) Ltd.
4. Brah G. S., 2014, Animal Genetics: Concepts and Implications, 2nd Edn., Kalyani Publication, New Delhi.

TEACHING SCHEDULE

THEORY [BT-113]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
Unit-I			
1-2	**History of Genetics**	Pre-Mendelian, Mendelian and Post-Mendelian era	4
3-5	**Mendel's Principles and Rediscovery**	Law of dominance, Law of segregation, Law of independent assortment, Reasons of Mendel's success and Mendelian deviations	4
6-9	**Cell Division**	Mitosis definition, Stages of mitosis and Importance of mitosis, Meiosis definition, Stages of meiosis and Significance of meiosis	4
10	**Chromosome Structure and Function**	Morphological structure, Chemical composition and function	4
11-12		**Models of chromosomes structure:** Multi-stranded model, Folded fiber model and Nucleosome solenoid model. **Special chromosomes:** Lampbrush chromosome, Salivary gland chromosome or Giant chromosome.	4
13	**Chromosomal Theory of Inheritance**	Chromosomal theory of inheritance	4
14-16	**Sex-linked, Sex-limited and Sex-influenced inheritance**	Sex-linked, Sex-limited and Sex-influenced inheritance: Definitions, Brief explanations, Examples.	4
17-18	**Sex Determination and Sex Differentiation**	Sex determination and Sex differentiation- Definitions, Brief explanations, Examples.	4
Unit-II			
19	**Multiple Allelism**	**Multiple alleles**: Def'n, Characters of multiple alleles, Examples: Blood groups, Rh factor in humans	4
20-21	**Linkage and Crossing Over**	**Linkage:** Def'n, History, Types of linkage; complete and incomplete linkage **Detection of linkage:** Detection in test cross generation, Detection in F_2 generation	4
22		**Crossing over:** Def'n, Factors affecting recombination frequency, Cytological basis of crossing over	4
23		**Crossing over:** Crossing over in four-strand stage, Relationship between chiasma and crossing over, Molecular mechanisms of c.o., Linkage maps and Linkage groups	4
24-26	**Gene Interaction**	**Gene interaction and its types:** Def'n, Types of gene interactions and allelic gene interactions; Complete dominance, Incomplete dominance, Codominance	6
27-29		**Gene interaction and its types:** Non-allelic, Supplementary, Masking, Complementary gene interactions etc.; Molecular basis of gene interaction	6

Continued…

30-31	**Genetic Analysis in Prokaryotes and Eukaryotes**	Genetic analysis in prokaryotes and eukaryotes (in brief)	4
32	**Extrachromosomal Inheritance**	**Extrachromosomal inheritance:** Definition and Characteristic features of cytoplasmic inheritance with example of *Mirabilis jalapa*, Inheritance of mitochondrial DNA and chloroplast DNA	4
33		**Extra chromosomal inheritance:** Genetic maternal effect with examples of shell coiling in snails, kappa particles in paramecium, inheritance due to parasites, symbionts and viruses	4
34	**Mutation**	**Mutation:** Definition, History, Characters of mutation, Classification of mutation, Spontaneous mutation, Induced mutation,	4
35		**Mutation:** Molecular basis of mutation, Mutator, Antimutator genes and Mutable genes, Suppressor mutation and its Mechanism (Definitions, Brief emphasis)	4
36		**Mutagens and their types with e.g.:** Physical mutagens, Chemical mutagens, Mutation induction and detection, Applications of mutation	4
37	**Hardy-Weinberg Law**	**Hardy-Weinberg Law:** Gene frequency genotype frequency, Gene pool, Random union of gametes, Random mating among genotypes	**2**
38- 39		**Hardy-Weinberg Law:** Hardy-Weinberg equilibrium, Equilibrium for one gene with two alleles, Equilibrium for one gene with multiple alleles, Equilibrium for two genes	4
40-41	**Quantitative Inheritance**	**Quantitative inheritance:** Multiple factor hypothesis, Characters of quantitative traits and their inheritance, Effects of environment on quantitative traits	4
42-45	**Introduction to Human Genetics**	**Introduction to Human Genetics:** Man the organism, Cytogenetics of man: Chromosome banding chromosome aberration. Genetics studies, Genetic diseases, Blood groups, Disputed Parentages	4
46-48	**Genetic Basis of Evolution**	**Genetic basis of evolution and Origin of species:** Theories of evolution: Lamarckism, Darwinism, Mutation theory, Neo-Darwinism.	2
		Total=	**100**

List/ Bouquet of Skill Enhancement Courses (SECs):

Sr. No.	Course No.	Course Title	Credit Hrs.
1.	**SEC-xxx**	Practices in Plant Tissue	2(0+2)
2.	**SEC-xxx**	Laboratory Management and Instrumentation	2(0+2)
3.	**SEC-xxx**	*(To be added)*	2(0+2)
4.	**SEC-xxx**	*(To be added)*	2(0+2)

Note: Skill Enhancement Courses can be added/ offered as per the facilities and resources available at the respective universities/colleges based on the relevance to the region and the UG degree subject.

The detailed course-wise syllabus of above or other relevant SEC courses can be primarily developed and followed at College/ University level in the academic year, 2024-25; However, the same will be obtained from the respective UG Degree Coordinator/ Discipline Coordinators and can be followed w.e.f. AY, 2025-26.

[Above list is an indicative list/bouquet of SEC courses and subject to modification as applicable therein]

Semester	**:**	**I**	
Course No.	**:**	**SEC-xxx**	**Credit Hrs : 2(0+2)**
Course Title	**:**	**Practices in Plant Tissue Culture**	

SYLLABUS

Objectives:

(i) This course aims at imparting hands-on training on the calculation of per cent solutions, molarity, molality, normality; and preparation of buffers.

(ii) To study basic equipments used in Plant Molecular Biology and Cell Culture Laboratories; washing, packing and sterilization of glass and plastic wares for cell culture.

(iii) To study preparation of media and reagents for cell culture, primary culture technique, culturing and sub-culturing of continuous cell lines, viability assay by trypan blue dye exclusion method, micropropagation, haploid production, embryo rescue, cryopreservation of primary cultures and cell lines.

(iv) To prepare the phytohormones and their sterilization.

(v) To study Tissue Culture Laboratory management.

PRACTICAL

Laboratory safety and aseptic techniques, sterilization methods for equipment and media, media preparation, preparation of solid and liquid media, pH adjustment and sterilization of media. Culture initiation and explant selection. Selection of explants; meristem, node, leaf, embryo etc. Surface sterilization of plant material. Techniques for explant preparation and inoculation on to culture media. Callus induction and subculture. Subculture techniques: transfer of cultures to fresh media, monitoring and maintenance of cultures, organogenesis and embryogenesis. Micropropagation. Genetic transformation. Cryopreservation and conservation.

Project Work: Students design and conduct of a small-scale tissue culture project. (Students will choose a plant species, select appropriate explants, culture them *in vitro*, and document the progress and results).

TEACHING SCHEDULE

[Practices in Plant Tissue Culture]

PRACTICAL

Exercise No.	Exercise Title
1-2	Laboratory safety and aseptic techniques
3-5	Preparation of Standard Solution: (Percent solutions, molarity, molality, normality and preparation of buffers)
6-8	Media preparation: Solid and liquid media and pH adjustment
9-10	Sterilization methods for equipments and media
11-12	Culture initiation and explant selection: meristem, node, leaf, embryo etc.
13-14	Surface sterilization of plant material; Techniques for explant preparation and Inoculation on to the culture media.
15-16	Callus induction and subculture to the fresh media
17-18	Micropropagation: a) Organogenesis b) Embryogenesis
19-20	Monitoring and Maintenance of cultures
21-22	Demonstration of genetic transformation techniques
23-24	Demonstration of cryopreservation and conservation techniques
25-30	Project Work – Micropropagation studies: (Ornamental, Horticultural and Medicinal Plants)
31-32	Visit(s) to Commercial Plant Tissue Culture Units

Note: Project work tasks may be conducted from start to end of the semester with group of 10-20 students.

Suggested Readings [SEC-111]:

1. Bhojwani SS and Razdan MK, 1996, Plant Tissue Culture: Theory and Practice, Elsevier.
2. Reinert J and Bajaj YPS (Ed), 1989, Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer-Verlag.

Semester	**:**	**I**	
Course No.	**:**	**SEC-xxx**	**Credit Hrs : 2(0+2)**
Course Title	**:**	**Laboratory Management and Instrumentation**	

SYLLABUS

Objectives:

(i) To study the establishment and management of different molecular biology laboratories.

(ii) To impart hands-on training on good laboratory practices, calculation of per cent solutions, molarity, molality, normality; and preparation of buffers.

(iii) To study basic equipments used in Plant molecular biology and cell culture laboratories, record keeping, teamwork, and SOP of different instruments of the labs.

(iv) Safe disposal of laboratory chemicals and reagents as per the biosafety guidelines.

PRACTICAL

Importance of laboratory safety and regulatory compliance. Quality management systems: ISO9001, GLP, GMP, laboratory safety and regulatory compliance. Risk assessment and hazard identification. Inventory management and equipment maintenance. Principles of laboratory inventory management. Equipment calibration and preventive maintenance. Documentation and record-keeping for regulatory compliance. Quality assurance and control. Introduction to quality assurance (QA) and quality control (QC). Quality control checks for laboratory reagents and instruments, Troubleshooting common laboratory errors and deviations.

Spectroscopy and spectrophotometry, applications in quantitative analysis and molecular biology. Chromatography techniques, microscopy and imaging. Molecular biology techniques. Instrumentation project : students design and conduct a small-scale project using one of the laboratory instruments covered in the course. They will collect data, analyze results, and present their findings.

TEACHING SCHEDULE

[Laboratory Management and Instrumentation]

PRACTICAL

Exercise No.	Exercise Title
1-2	General Laboratory Safety Rules and Laboratory Compliance
3-4	Quality Management Systems: ISO 9001, GLP and GMP
5-6	Risk assessment and Hazard identification; Principles of laboratory inventory management.
7	Calibration of Weighing balance, pH meter and Micropipettes
8	Documentation and Record-keeping for Regulatory Compliance.
9	Calculations of Per cent Solutions, Molarity, Molality, Normality etc.
10	Preparation and Quality Control Checks for laboratory Reagents and Standards.
11-13	Determination of the Concentration of DNA, RNA and Proteins in Solutions by Spectrophotometer.
14-15	Separation and Identification of Amino acids/ Sugars by Paper Chromatography/ TLC.
16-17	Observation of Microorganisms: Bacterial cell identification by Gram staining
18-26	Extraction of Plant Genomic DNA, Plasmid DNA and Agarose gel electrophoresis, Restriction Digestion, PCR and Agarose gel electrophoresis of PCR products
27-32	**Instrumentation Project:** DNA isolation from different crops/ microbes/ animal cells/ blood, Chromatography, Spectrometry, PCR-based project etc.

Suggested Readings:

1. Gakhar S K, Miglani M and Ashwani K, 2013, Molecular Biology: A Laboratory Manual, ISBN: 9789382332305.
2. Fulekar MH and Pandey B, 2013, Bioinstrumentation, ISBN: 9789382332398.
3. Green MR and Sambrook J, 2012, Molecular cloning: A Laboratory Manual 4th Ed, Cold, Spring Harbor.
4. Rapley R and Whitehouse D, (Eds), 2015, Molecular Biology and Biotechnology, Royal Society of Chemistry.
5. Kreuzer H and Massey A, 2008, Molecular Biology and Biotechnology: A Guide for Students, 3rd Edn., ASM Press.