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.

Course Curriculum of Second 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

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

Maharashtra Agricultural Universities Examination Board, Pune

Compiled & Submitted by

Dr. Anil A. Kale

Incharge, State-level Biotechnology Centre, MPKV, Rahuri.

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

Course Layout

B.Tech. (Biotechnology)

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

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark (if any)
1.	**AEC-123**	National Service Scheme (NSS-II)/ National Cadet Corps (NCC-II)	1(0+1)	--
2.	**AEC-124**	Personality Development	2(1+1)	--
3.	**MDC-122**	Entrepreneurship Development and Business Management	3(2+1)	--
4.	**VAC-121**	Environmental Studies and Disaster Management	3(2+1)	--
5.	**BT-124**	Introduction to Biotechnology	3(3+0)	--
6.	**BT-125**	Elementary Microbiology	2(1+1)	--
7.	**PB-121**	Introduction to Plant Breeding	3(2+1)	--
8.	**SEC-123**	Skill Enhancement Course-III[#] (Basic Techniques of Molecular Biology and Biotechnology)	2(0+2)	--
9.	**SEC-124**	Skill Enhancement Course-IV[#] (Bioinformatics and Biocomputation)	2(0+2)	--
		Total Credits Hrs.	**21(11+10)**	**G**
AEC: Ability Enhancement Course, **MDC**: Multidisciplinary Course, **SEC**: Skill Enhancement Course, **VAC**: Value Added Course, **G**: Gradial				
Post-II Semester (Only for Exit option for award of UG-Certificate)				
10.	**INT-121**	Internship (10 Weeks)	10(0+10)	--

Semester	**:**	**II**	
Course No.	**:**	**AEC-123**	**Credit Hrs. : 1(0+1)**
Course Title	**:**	**National Service Scheme-II (NSS-II)/ National Cadet Corps-II (NCC-II)**	
Gradial Common Course across all UG Degrees			

Course No.: AEC-123	**Course Title: National Service Scheme-II (NSS-II)**	**Credit Hrs.:1(0+1)**

SYLLABUS

Objectives :

(i) To evoke social consciousness among students through various activities viz., working together, constructive and creative social work,

(ii) To be skilful in executing democratic leadership and developing skill in program,

(iii) To be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

PRACTICAL

Importance and role of youth leadership. Meaning, types and traits of leadership, qualities of good leaders; Importance and roles of youth leadership, Life competencies. Definition and importance of life competencies, Problem-solving and Decision-making, Interpersonal communication. Youth development programs Development of youth programs and policy at the national level, state level and voluntary sector; Youth-focused and youth-led organizations Health, hygiene and sanitation. Definition Needs and Scope of health education; Role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; National health programs and reproductive health. Youth health, lifestyle, HIV-AIDS and first aid. Healthy lifestyles, HIV-AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths and misconceptions about yoga; Yoga traditions and its impacts, Yoga as a tool for healthy lifestyle, preventive and curative method.

TEACHING SCHEDULE

PRACTICAL [AEC-123 / NSS-II]

Exercise No.	Topic	Exercise Title/ Sub-topics
1	**Orientation on NSS**	Introduction to NSS, its Objectives, History and Role in community service.
2	**Youth Leadership**	Discuss the importance and role of youth leadership, types and traits of leadership and qualities of good leaders.
3	**Life Competencies**	Understanding life competencies, their importance and Practical exercises in problem-solving and decision-making.
4	**Interpersonal Communication**	Practice exercises to improve interpersonal communication skills, Focusing on active listening and effective communication.
5	**Youth Development Programs**	Overview of youth development programs, Policies at national and state levels and Understanding youth-led organizations.
6	**Health, Hygiene, and Sanitation**	Practical activities on the importance of hygiene and sanitation, including Swachh Bharat Abhiyan tasks.
7	**Nutrition and Health Education**	Discuss the role of food, nutrition, and safe drinking water in health; Explore the impact of waterborne diseases.
8	**National Health Programs**	Introduction to key national health programs and their roles in promoting public health and awareness on reproductive health.
9	**Youth Health and Lifestyle**	Sessions on healthy lifestyle choices including exercise, balanced diet and stress management.
10	**HIV/AIDS Awareness**	Educational activities on HIV/AIDS, its prevention, and reducing stigma; Awareness on reproductive health.
11	**Substance Abuse Awareness**	Discussing the dangers of drug and substance abuse, its impact on health and practical ways to prevent addiction.
12	**First Aid and Home Nursing**	Hands-on training in first aid techniques including handling injuries, CPR basics and home nursing care.
13	**Introduction to Yoga**	Introduction to the History, Philosophy and various Traditions of Yoga as a Holistic health practice.
14	**Yoga Practice**	Practical Yoga Sessions focusing on Asanas, Pranayama and Meditation for a healthy lifestyle.
15	**Yoga as Preventive and Curative Tool**	Understanding and Practicing Yoga as a preventive and curative approach for physical and mental health.
16	**Reflection on NSS and Youth Development**	Group Discussion and Reflection on the role of NSS in community building and personal growth, Focusing on youth leadership.

Course No.: AEC-123	Course Title: National Cadet Corps-II (NCC-II)	Credit Hrs.:1(0+1)

SYLLABUS

Objectives: (i) To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen,

(ii) To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

PRACTICAL

Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice-versa. Guard mounting, Guard of honor, Platoon/Coy Drill. Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding. Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG. Introduction to map, scales, and conventional signs. Topographical forms and technical terms. The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs. Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

TEACHING SCHEDULE

PRACTICAL (AEC-123/ NCC-II)

Exercise No.	Topic	Exercise Title/ Sub-topics
1	**Basic Arms Drill**	Attention, stand at ease, stand easy, getting on parade, dismissing and falling out.
2	**Advanced Arms Drill**	Ground/take up arms, examine arms, shoulder from the order and vice versa.
3	**Saluting with Arms**	Saluting at the shoulder both at a halt and while on the march.
4	**Rifle Handling Techniques**	Short/long trail from the order and vice-versa, guard mounting and guard of honor procedures.
5	**Platoon and Company Drill**	Practice and demonstration of platoon and company drill formations.
6	**Rifle Characteristics and Handling**	Characteristics of rifles (.22/.303/SLR), ammunition, firepower, and basic care, cleaning and sight setting.
7	**Rifle Operations and Safety**	Loading, cocking, unloading, safety procedures; lying position, trigger control and firing a shot.
8	**Range Procedures and Target Practice**	Range procedures, aiming, sight alteration, theory of groups, snap shooting and firing at moving targets.
9	**Map Reading Basics**	Introduction to maps, scales, conventional signs, topographical forms and the grid system.
10	**Advanced Map Skills**	Relief, contours, gradients, cardinal points, bearings, and use of the service protractor.
11	**Field Navigation with Compass**	Use of prismatic compass, setting a map, finding north, positioning, map-to-ground and ground-to-map.
12	**Field Engineering Skills**	Knots and lashings, camouflage, handling explosives, IEDs, field defenses, obstacles and mines.
13	**Watermanship and Field Water Supplies**	Bridging techniques, field water supplies, track construction and distance judgment.
14	**Target Recognition and Indication**	Identifying and describing targets, observing, concealment, field signals and indication of landmarks.
15	**Section Battle Drills and Movement**	Section formations, fire control orders, fire and movement, movement with/without arms, section battle drill.
16	**Communication Skills and Modern Trends**	Types of communication, media and latest trends in NCC communication.

Semester	**:**	**II**		
Course No.	**:**	**AEC-124**	**Credit Hrs.**	**: 2(1+1)**
Course Title	**:**	**Personality Development**		
Gradial Common Course across all UG Degrees				

SYLLABUS

Objectives: To make students realize their potential strengths and cultivate their inter-personal skills and improve employability.

THEORY

Personality: Definition, Nature of personality, Theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, Shaping of personality, Determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, Personality and Organizational Behaviour. Foundations of individual behavior and Factors influencing individual behavior, Models of individual behavior, Perception and Attributes; Factors affecting perception, Attribution theory and Case studies on Perception and Attribution. Learning: Meaning and Definition, Theories and Principles of Learning, Learning and Organizational behavior, Learning and Training, Learning feedback. Attitude and Values, Intelligence- Types of Intelligence, Theories of intelligence, Measurements of intelligence, Factors influencing intelligence, Intelligence and Organizational behavior, Emotional intelligence. Motivation- Theories and Principles, Teamwork and Group dynamics.

PRACTICAL

MBTI Personality Analysis, Learning Styles and Strategies, Motivational Needs, Firo-B, Interpersonal Communication, Teamwork and Team Building, Group Dynamics, Win-Win Game, Conflict Management, Leadership Styles, Case Studies on Personality and Organizational Behavior.

TEACHING SCHEDULE

THEORY [AEC-124]

Lecture No.	Topic	Sub-topics / Key Points	Weightage (%)
1	**Personality**	Definition, Nature of Personality	5
2	**Theories of Personality and its Types**	The Humanistic Approach- Maslow's self-actualization theory; Types-Extroversion, Introversion, Conscientiousness, Agreeableness	10
3		Shaping of Personality - improving communication skills, stepping out of comfort zone, learning to say no, tapping into creativity, getting curious, giving yourself a daily affirmation, practicing self-care. Determinants of Personality- Physical, Intellectual, Social and Psychological	10
4		Myers- Briggs Typology indicator Four Indicators- Introvert/Extrovert, Thinking/ Feeling, Sensing/ Intuiting, Judging/ Perception, Locus of Control and Performance	10
5		Type A and Type B Behaviours Theory	5
6	**Personality and Organizational Behaviours**	Difference between Personality and Organizational Behaviours	5
7		Foundations of individual behaviours, Factors influencing individual behaviour- Personality, Values, Motivation, Perspectives and Social impacts	5
8		Models of Individual Behaviour- Rational Economic man, Social man, The Self Actuating man, Complex man	5
9	**Perception**	Attributes and Factors affecting perception; Attribution theory and Case studies on Perception and Attribution	10
10	**Learning**	Meaning, Definition; Theories and Principles of Learning	10
11		Difference between Learning and Organizational behavior; Difference between Learning and Training; Feedback of Learning	5
12	**Attitude and Value**	Meaning, Definitions, Concept	5
13	**Intelligence**	Types of Intelligence, Theories of intelligence	
14		Measurement of intelligence Factors affecting intelligence Difference between intelligence and organizational behaviour, Emotional intelligence	5
15	**Motivation**	Meaning, Theories and Principles	5
16	**Team & Group Dynamics**	Meaning, Definitions, Concept	5
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [AEC-124]

Exercise No.	Exercise Topic
1	Myers- Briggs Type Indicator (MBTI) analysis- Extroversion/ Introversion
2	Myers- Briggs Type Indicator (MBTI) analysis- Sensing/ Intuition
3	Myers- Briggs Type Indicator (MBTI) analysis- Thinking/Feeling
4	Myers- Briggs Type Indicator (MBTI) analysis- Judging/ Perception
5	Learning Styles and Strategies
6	Motivational Needs
7	Fundamental Interpersonal Relations Orientation Behaviour (FIRO-B)
8	Interpersonal Communication
9	Team Work
10	Team Building
11	Group Dynamics
12	Win-Win Game
13	Conflict Management
14	Leadership Styles
15	Case Studies on Personality
16	Case Studies on Organizational Behaviour

Suggested Readings [AEC-124]:

1. **Andrews, Sudhir, 1988,** How to Succeed at Interviews. 21st(rep.) New Delhi. Tata -McGraw Hill.
2. **Heller, Robert, 2002,** Effective Leadership. Essential Manager Series. DK Publishing.
3. **Hindle, Tim, 2003,** Reducing Stress. Essential Manager Series. DK Publishing.
4. **Kumar, Pravesh, 2005,** All about Self- Motivation. New Delhi. Goodwill Publishing House.
5. **Lucas, Stephen, 2001,** Art of Public Speaking. New Delhi. Tata - McGraw Hill.
6. **Mile, D.J., 2004,** Power of Positive Thinking. Delhi. Rohan Book Company.
7. **Smith, B., 2004,** Body Language. Delhi: Rohan Book Company.
8. **Shaffer, D. R., 2009,** Social and Personality Development (6th Edn). Belmont, CA: Wadswo.

Semester : II		
Course No. : MDC-122	**Credit Hrs. : 3(2+1)**	
Course Title : Entrepreneurship Development and Business Management		
Gradial Common Course among 5 UG Degrees viz., **B.Sc. (Hons.) Horti. / B.Tech. (Biotech.)/ B.Sc. (Hons.) Forestry / B.F.Sc. (Hons.) / B.Sc. (Hons.) C.S.**		

SYLLABUS

Objectives:

(i) To provide an insight into the concept and scope of entrepreneurship.
(ii) To expose the student to various aspects of establishment and management of a small business unit.
(iii) To enable the student to develop financially viable agribusiness proposal.

THEORY

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning–spotting of opportunity-scanning of environment– identification of product/ service – starting a project; factors influencing sensing the opportunities. Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection and formulation of project; project report preparation, Enterprise management. Production management – product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management / Accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement and taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management- raw material, production, leadership, market, finance, natural etc.

PRACTICAL

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

TEACHING SCHEDULE

THEORY [MDC-122]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Introduction to Entrepreneurship	Meaning and Definitions of an Entrepreneur, Entrepreneurship; Concept & Scope of Entrepreneurship	6
2	Importance of Entrepreneurship	Importance of Entrepreneurship in Agribusiness	
3	Entrepreneurship Development	Need for and objectives of Entrepreneurial development	4
4	Motivational Factors	Types of motivational factors, Role of social and environmental factors in entrepreneurship	4
5	Characteristics of Entrepreneurs	Characteristics, Entrepreneurial attributes and Competencies	4
6	Types of Entrepreneurs	Various types and their significance	4
7	Functions of Entrepreneurs	Key roles and Responsibilities	2
8	Evolution of Entrepreneurship	Historical perspective and Growth	3
9	Process of Entrepreneurship Development	Stages and Approaches in developing entrepreneurship	4
10	Environmental Scanning	Need for scanning, Techniques	2
11	Opportunity Identification	Spotting and Analysing opportunities	2
12	Infrastructure and Support Systems	Policies, Schemes and Role of financial and other agencies in entrepreneurship development	4
13	Enterprise Functioning Steps	Steps to establish an enterprise	4
14	Selection of Products/Services	Choosing products, Services and Business forms	3
15	Enterprise Location and Capital Sources	Registration, Site selection, Capital sources / Acquisition	3
16	Manufacturing and Distribution	Acquiring manufacturing know-how, Packaging and Distribution essentials	3
17	Planning of an Enterprise	Short term and Long-term planning of an enterprise	3
18-19	Project Formulation	Project identification, Selection, Steps in project formulation and Report preparation, etc.	8
20	Enterprise Management	Basics and Importance of managing an enterprise	3

Continued….

21	Production Management	Product types, Levels of products, Product mix, Quality control, Cost of production, Production control	4
22	Material Management	Raw material costing and Inventory control strategies	4
23	Personnel Management / Human Resource Management	Manpower planning, Labour turnover, Wages / Salaries	4
24	Financial Management	Funds, Fixed and Working capital, Costing, Pricing, Book-keeping basics	4
25-26	Accounting and Taxation	Journals, Ledgers, Subsidiary books, Annual financial statements, Taxation basics	4
27	Marketing Management	Market, Types of markets, Marketing assistance	4
28-29	Market Strategies and Pricing	Marketing strategies, Pricing strategies and Market penetration	4
30	Crisis Management	Crisis types, Strategies for managing raw material, etc.	2
31	Leadership in Crisis Situations	Role of leadership in handling crises	2
32	Financial Crises and Solutions	Strategies for financial crisis management	2
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL [MDC-122]

Exercise No.	Exercise Topic/Title
1	Visit to Small-Scale Industries/ Agro-Industries. (Objective: To understand setup and operations of small-scale units)
2	Interaction with Successful Entrepreneurs. (Objective: To gain insights from real-life entrepreneurial experiences)
3	Case Study on Agro-Entrepreneurs. (Objective: To analyse successful agribusiness ventures)
4	Visit to Financial Institutions. (Objective: To learn about funding options and financial support)
5	Identification of Agribusiness Ideas. (Objective: To identify viable agribusiness ideas based on demand)
6	Analysing Project Proposals. (Objective: To study structure and elements of project proposals)

Continued…

7	Preparing a Project Proposal. (Objective: To develop a basic proposal for an agribusiness venture)
8	Project Report Writing Techniques. (Objective: To practice format and structure for project reports)
9	Marketing Strategies Case Study. (Objective: To analyse effective marketing strategies in agribusiness)
10	Production and Cost Control Analysis (Objective: To study basic cost control measures in production)
11	Inventory Control Simulation (Objective: To apply inventory management methods in a hypothetical setup)
12	Basic Bookkeeping (Objective: To practice fundamental bookkeeping for small businesses)
13	Market Research Techniques (Objective: To use surveys and questionnaires for market insights)
14	Project Proposal Presentation (Objective: To present project ideas for feedback)
15	Review of Project Proposal (Objective: To refine project proposals based on feedback)
16	Final Evaluation of Proposals (Objective: To assess and finalize projects)

Suggested Readings [MDC-122]:

1. **Charantimath P.M. 2009.** Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. **Desai V. 2015.** Entrepreneurship: Development and Management, Himalaya Publishing House.
3. **Desai Vasant. 1997.** Small Scale Industries and Entrepreneurship. Himalaya Publ. House.
4. **Gupta C.B. 2001.** Management Theory and Practice. Sultan Chand and Sons.
5. **Indu Grover. 2008.** Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
6. **Khanka S.S. 1999.** Entrepreneurial Development. S. Chand and Co.
7. **Mehra P. 2016.** Business Communication for Managers. Pearson India, New Delhi.
8. **Pandey M. and Tewari D. 2010.** The Agribusiness Book. IBDC Publishers, Lucknow.
9. **Singh D. 1995.** Effective Managerial Leadership. Deep and Deep Publ.
10. **Singhal R.K. 2013.** Entrepreneurship Development and Management, Katson Books.
11. **Tripathi P.C and Reddy P.N. 1991.** Principles of Management. Tata McGraw Hill.

Semester	**:**	**II**	
Course No.	**:**	**VAC-121**	**Credit Hrs. : 3(2+1)**
Course Title	**:**	**Environmental Studies and Disaster Management**	
Gradial Common Course across all UG Degrees			

SYLLABUS

Objectives : (i) To expose and acquire the knowledge on the environment,
(ii) To gain the state-of-the-art skill and expertise on management of disasters.

THEORY

Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of Environmental Studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources, Food resources. Energy resources. Land resources. Soil resources. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of Ecosystems. Biodiversity and its conservation: Introduction, Definition, Types. Biogeographical Classification of India. Importance and Value of Biodiversity. Biodiversity Hotspots. Threats and Conservation of Biodiversity.

Environmental Pollution: Definition, Cause, Effects and Control measures of: (a) Air pollution. (b) Water pollution. (c) Soil pollution. (d) Marine pollution. (e) Noise pollution. (f) Thermal pollution. (g) Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, Effects and Control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. Water conservation, Rain water harvesting, Watershed management. Environmental Ethics: Issues and possible solutions, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and Holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and Human Health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and Human health.

VAC-121…..

Disaster Management– Disaster: Definition - Types - Natural Disasters: Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves. Man-made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, National disaster management framework; Financial arrangements; Role of NGOs, Community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed Forces in disaster response; Police and other organizations in disaster management.

PRACTICAL

Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain. Energy: Biogas production from organic wastes. Visit to wind mill/hydro power/solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site- Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of *E. coli* in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystems – Visit to pond /river / hills. Visit to areas affected by natural disaster.

TEACHING SCHEDULE

THEORY [VAC-121]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Introduction to Environmental Studies	Definition, Scope and Importance; Multidisciplinary nature	4
2	Segments of Environment	Spheres of Earth – Lithosphere, Hydrosphere, Atmosphere and Different Layers of Atmosphere.	4
3-5	Natural Resources	Classification of resources; Forest, water, mineral, food, energy, land, and soil resources	10
6-7	Concept of an Ecosystem	Concept, Structure, Function and Energy flow in ecosystems	5
8-9	Types of Ecosystems	Terrestrial, Aquatic, Agro-ecosystems, Forest ecosystems and Human-modified ecosystems	5
10-12	Biodiversity and its Conservation	Importance, Value, Types, Bio-geographical classification, Hotspots, Threats, Conservation strategies	8
13-16	Environmental Pollution	Definition, Causes, Effects, Control measures: Air, Water, Soil, Marine, Noise, Thermal and Light pollution	12
17-18	Solid Waste Management	Classification of solid wastes; Management methods like, Composting, Incineration, Pyrolysis, Biogas production	6
19	Urban and Industrial waste	Causes, Effects and Control measures of Urban and Industrial waste	4
20	Social Issues Related to the Environment	Urban energy problems, Water conservation, Rainwater harvesting, Watershed management	4
21-22	Environmental Ethics	Issues, Possible solutions, Climate change, Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and Holocaust.	6
23	Environment Protection Laws	Environment Protection Act, Air and Water (Pollution) Acts, Wildlife Protection Act, Forest Conservation Act	4

Continued….

24-25	Human Population and Environment	Environment and human health, Human rights, Value education, Women and child welfare, Role of IT in environment and health	5
26-28	Introduction to Disaster Management	Definition, Types of natural and man-made disasters; Floods, Droughts, Cyclones, Earthquakes, Landslides, Fires	10
29-30	Disaster Management Framework	National and International strategies, disaster response framework, Financial arrangements, Role of NGOs and media	5
31	Central and Local Administration in Disasters	Role of Central, State, District and Local Administrations; Coordination in disaster response	4
32	Disaster Response Organizations	Central, State, District and Local Administrations in Disaster Control; Role of Armed Forces, Police and Other organizations in disaster response &control	4
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [VAC-121]

Exercise No.	Exercise Title
1	Visit to a local area to document environmental assets: River /Forest / Grassland / Hill / Mountain.
2	Visit to Biogas production, Windmill, Hydro/Solar power generation units
3	To assess floral and faunal diversity in farming systems.
4	Assessment of biodiversity in farming system.
5	Floral and faunal diversity assessment in polluted and unpolluted system.
6	Visit to Local Polluted Site - Urban/Rural/Industrial/Agricultural to study the common plants, insects and birds. Environmental sampling and preservation.
7	Water quality analysis: pH and electrical conductivity (EC) in water samples.

Continued…

8	Estimation of total dissolved solids (TDS) in water samples
9	Estimation of acidity and alkalinity in water samples.
10	Estimation of water hardness in water samples.
11	Determination of dissolved oxygen (DO) and biological oxygen demand (BOD) in water samples.
12	Performing COD estimation on water samples.
13	Enumeration of *E. coli* in water samples to check for contamination.
14	Assessment of Suspended Particulate Matter (SPM) in an environmental sample.
15	Study of simple ecosystem – Visit to Pond/ River/ Hills.
16	Visit to areas affected by natural disaster.

Suggested Readings (VAC-121):

1. **De, A.K. 2010.** Environmental Chemistry. Published by New Age International Publishers, New Delhi. ISBN:139788122426175.384 pp.
2. **Dhar Chakrabarti, P.G. 2011.** Disaster Management - India's Risk Management Policy Frameworks and Key Challenges. Published by Centre for Social Markets (India), Bangaluru. 36 pp.
3. **Erach Bharucha,** Text Book for Environmental Studies. University Grants Commission, New Delhi.
4. **Parthiban, K.T., Vennila, S., Prasanthrajan, M. and Umesh Kanna, S. 2023**. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India.
5. **Prasanthrajan, M. and Mahendran, P.P. 2008.** A Text Book on Ecology and Environmental Science.1st Edn. ISBN 8183211046. Agrotech Publishing Academy, Udaipur - 313 002.
6. **Prasanthrajan, M. 2018.** Objective Environmental Studies and Disaster Management, ISBN 9789387893825. Scientific Publishers, Jodhpur, India. 146 pp.
7. **Sharma, P.D. 2009.** Ecology and Environment, Rastogi Publications, Meerut, India.
8. **Tyler Miller and Scot Spoolman. 2009.** Living in the Environment (Concepts, Connections, and Solutions). Brooks/Cole, Cengage Learning Publication, Belmont, USA.

Semester	**:**	**II**		
Course No.	**:**	**BT-124**	**Credit Hrs.**	**: 3(3+0)**
Course Title	**:**	**Introduction to Biotechnology**		

SYLLABUS

Objectives:

(i) To understand the basic concepts of Molecular Biology and methods used in the manipulation of nucleic acids to isolate and characterize genes.

(ii) To understand how molecular tools are used to modify an organism. To study the history, concepts and scope of Biotechnology.

(iii) To study the applications of Biotechnology.

THEORY

Introduction to genetic material, History of genetic material, Physical and chemical basis of genetic material. Structure of DNA and RNA, Scope and importance of Biotechnology. Plant, Microbial, Animal, Medical, Environmental, Industrial, Marine, Agricultural and Food Biotechnology. Nanobiotechnology. Introduction to recombinant DNA technology. Vectors, DNA manipulating and modifying enzymes, Gene cloning. Introduction to Genomics and Proteomics. Molecular markers, DNA sequencing. Genetic transformation and transgenic organisms. Bioinformatics. Biosafety guidelines.

TEACHING SCHEDULE

THEORY (BT-124)

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
Unit-I			
1-3	Introduction to Genetic Material	Definition, Types of genetic material, History of genetic material, Physical and Chemical basis of genetic material, Structure of DNA and RNA.	6
4-6	Scope and Importance of Biotechnology	History, Definitions, Concepts, Branches of Biotechnology, Scope and Importance within its branches	5
7-10	Plant Biotechnology	Basic concepts, Various techniques of Plant Biotechnology and Applications	8
11-12	Microbial Biotechnology	Basic concepts, Various techniques and Industrial applications	4
13-14	Medical and Animal Biotechnology	Basic concepts, Various techniques and Industrial applications	4
15-16	Environmental, Industrial and Marine Biotechnology	Basic concepts, Various techniques and Industrial applications	4

Continued…

17-18	Food Biotechnology	Basic concepts, Various techniques and Industrial applications	4
19-20	Nanobiotechnology	Nano-particles, Nano-fertilizers, Applications and Future aspects of Nano-biotechnology	4
		Unit-II	
21-23	Recombinant DNA Technology	Definition, Introduction, Requirements and Tools, Steps involved in rDNA technology	5
24-27	Vectors	Definition, Properties of good vector, Types of vector and its properties - Plasmid (pBR322, pUC18, pUC19) Cosmid, Phage vector (lambda phage, M13), BAC, YAC and MAC	8
28-29	The Range of Manipulative Enzymes	Restriction enzymes, Nucleases, ligases, polymerases, topoisomerase and DNA modifying enzymes	5
30-31	Gene Cloning	Concept, Importance, Steps and Methods of gene cloning	5
32-33	Introduction to Genomics	Basics of Genomics, Structural and Functional Genomics and Applications	5
34-35	Proteomics	Basics of proteomics, Methods of protein analysis and Applications	5
36-38	Molecular Markers	Concept, Introduction and Types of markers (Biochemical, Morphological and Molecular), and Applications	5
39-41	DNA Sequencing	Introduction, Methods of sequencing (Maxam-Gilbert method, Sanger's method and Next generation sequencing)	8
42-44	Genetic Transformation and Transgenic Organisms	Concept, Methods (Direct and Indirect) and Applications	8
45	Bioinformatics	Introduction, Scope and Importance	2
46-48	Biosafety Guidelines	Definition, Biosafety concerns, Levels of biosafety, Biosafety regulatory framework, Agencies and Their roles	5
		Total =	**100**

Suggested Readings (BT-124):

1. **Chawla HS, 2024,** Introduction to Plant Biotechnology, 4th edn, CBS Publishers and Distributors Pvt. Ltd.
2. **Singh B, Gautam SK, Chauhan MS and Singla SK, 2015,** Textbook of Animal Biotechnology the Energy and Resources Institute, TERI.
3. **Singh BD, 2020,** Biotechnology Expanding Horizons, Kalyani publishers.
4. **Thieman W and Palladino M, 2018,** Introduction to Biotechnology (What's New in Biology), 4th edn, Pearson ISBN 0134650190, 9780134650197.

Semester	**:**	**II**	
Course No.	**:**	**BT-125**	**Credit Hrs. : 2(1+1)**
Course Title	**:**	**Elementary Microbiology**	

SYLLABUS

Objectives:

(i) To study the history of Microbiology and major groups of Eukaryotes and Prokaryotes.

(ii) To study the preservation methods and repositories.

(iii) To study bacterial growth and metabolism.

(iv) To study the applications of microbes.

THEORY

History of Microbiology and its applied areas. Microorganisms and their role in health and environment. Control and prevention measures against microorganisms/diseases. Introduction to eukaryotic and prokaryotic cells. Major groups of eukaryotes; fungi, algae and protozoa. Major groups of Prokaryotes; bacteria, archaebacteria, rickettsia and chlamydia. Preservation of microorganisms, Microbial repositories at national and international level. Bacterial growth. Metabolism in bacteria, ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation. Viruses and Bacteriophages, structure and properties, lytic and lysogenic cycles, viroids, prions. Beneficial microorganisms in Agriculture, Biofertilizers, Microbial pesticides. Microbes in composting and biodegradation. Microbiology of water and food.

PRACTICAL

Microscope and other instruments in a Microbiological Laboratory. Media preparation, sterilization and aseptic methods for isolation, identification, preservation and storage. Identification of bacteria by staining methods. Enumeration of bacteria by pour plate and spread plate methods. Micrometry.

TEACHING SCHEDULE

THEORY (BT-125)

Lect. No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	History of Microbiology and its Applied Areas	Milestones and Major events, Definition, Different concepts in Microbiology, Scope, Application(s), Prospects, Importance, Approach(es),	7
2	Microorganisms and their Role in Health and Environment	Roles of microorganisms in the environment, Roles of microorganisms in health, Types of different microorganisms playing important role in health and environment	6
3	Control and Prevention Measures against Microorganisms/ Diseases	Prevention and Control of microorganisms, Different diseases caused by microorganisms, Prevention and Control of infectious diseases,	6
4	Introduction to Eukaryotic and Prokaryotic cells	Definition, Differences between Prokaryotic and Eukaryotic cells	7
5	Major Groups of Eukaryotes and Prokaryotes	Definition, Uses and Types of Fungi, Algae and Protozoa of Eukaryotes Definitions, Uses and Types of Bacteria, Archaebacteria, Rickettsia and Chlamydia of Prokaryotes	6
6	Preservation of Microorganisms	Different methods of preservations of microbes, with Advantages and Disadvantages	7
7	National and International Microbial Repositories	Microbial culture collection centres at National and International levels	6
8	Bacterial Growth	Introduction of bacterial growths, Stages of bacterial growth	6
9	Metabolism in Bacteria	Definition, Function of microbial metabolism, Different types of bacterial metabolism	6
10	ATP Generation	Different methods of ATP generation, Importance of ATP generation	6
11	Chemoautotrophy	Definition, Concept and Application of Chemoheterotrophs	6
12	Photoautotrophy, Respiration	Definition, Concept and Application of Photoautotrophy, Differences between Photoautotrophy and Chemoautotrophy	6
13	Fermentation	Definition, Overview, Requirement	6
14	Viruses & Bacteriophages; their Structures and Properties	Definitions, Structure, Example, Properties Difference between Viruses and Bacteriophages	7
15	Lytic and Lysogenic Cycles	Properties, Definitions, Differences between Lysogenic and Lytic cycles	6
16	Viroids and Prions	Properties, Differences between Viroids and Prions	6
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL (BT-125)

Exercise No.	Exercise Title
1-2	Introduction to various instruments used and their working principles.
3	Study of general guidelines and safety measures for working in laboratory.
4	Calculation and preparation of molar solution and per cent solution.
5-6	Different sterilization techniques and aseptic methods for isolation.
7-8	Preparation of different media for microbes' growth.
9-10	Different staining methods for identification of bacteria.
11-12	Enumeration of bacteria by pour plate method.
13-14	Enumeration of bacteria by spread plate method.
15-16	Application of micrometry in Microbiology.

Suggested Reading [BT-125]:

Woolverton C.J., Sherwood L.M., and Willey J.M., 2016, Prescott's Microbiology, McGraw-Hill Education.

Semester	**:**	**II**		
Course No.	**:**	**PB-121**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Introduction to Plant Breeding**		

SYLLABUS

Objectives:

(i) To study the development and goals of Plant Breeding,

(ii) To study modes of reproduction,

(iii) To study the methods of Plant Breeding.

THEORY

History, aims and objectives of Plant Breeding. Role of related Sciences in Plant Breeding. Modes of reproduction - sexual, asexual, apomixes and significance in Plant Breeding. Modes of pollination, Genetic consequences, Differences between self- and cross-pollinated crops. Germplasm resources and their utilization. Methods of Plant Breeding: Introduction and Acclimatization. Selection: Mass selection, Johannsen's pure line theory, genetic basis, Pure line selection. Hybridization: aims and objectives, types of hybridization. Methods of handling segregating generations. Pedigree method, Bulk method, Backcross method. Heterosis, inbreeding depression, various theories of heterosis, exploitation of hybrid vigour. Hardy-Weinberg law. Selection in cross-pollinated crops. Population improvement programmes. Synthetics and Composites. Methods of breeding vegetatively propagated crops. Incompatibility and Male sterility and their utilization in crop improvement. Mutation Breeding. Ploidy Breeding. Wide hybridization and its significance in crop improvement. Procedure for release of New Varieties.

PRACTICAL

Classification of plants. Botanical description and floral biology of field crops: Rice, Sorghum, Maize, Wheat, Bajra, Sugarcane, Brassicas, Groundnut, Sunflower, Sesamum, Red gram, Bengal gram, Green gram, Soybean, Black gram, Cotton. Study of megasporogenesis and microsporogenesis. Fertilization and life cycle of an angiosperm plant. Hybridization techniques and precautions to be taken. Selfing, emasculation and crossing techniques. Study of male sterility and incompatibility.

TEACHING SCHEDULE

THEORY (PB-121)

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1-2	History, Aims and Objectives of Plant Breeding. Role of Related Sciences in Plant Breeding	Definition, History of Plant Breeding, Landmarks/ Achievements in Plant Breeding, Eminent Indian Plant Breeders; Aims and General objectives of Plant Breeding with suitable examples; Major achievements and Future prospects; Role of important Sciences/ Disciplines/ Areas in Plant Breeding to develop improved cultivars	6
3	Modes of Reproduction	Sexual reproduction, Asexual reproduction, Apomixis (its types) [Definitions with examples] and their Significance in Plant Breeding	3
4	Modes of Pollination	Types of pollination [Definitions with examples], Mechanisms promoting self-pollination and cross-pollination with suitable examples, Differences between self - and cross-pollinated crops (with their consequences in brief)	3
5	Germplasm Resources and their Utilization	Introduction, Kinds of germplasm, Gene pool system of Classification, Germplasm activities.	3
6-7	Methods of Plant Breeding: Introduction and Acclimatization	Plant Introduction- Definition, Purpose, Types i.e. Primary and Secondary Introduction; Advantages and Disadvantages; Acclimatization- Definition, Concept, Factors affecting acclimatization	5
8-9	Methods of Plant Breeding: Selection	Mass selection- Procedure, Merits, Demerits, Achievements; Pure line selection- Johannsen's pure line theory, Procedure, Merits, Demerits; Achievements	5
10	Hybridization	Definition, Aim and Objectives; Types of hybridization (Definitions and examples); Steps and procedure of hybridization programme	4
11-13	Methods of Handling Segregating Generations: Pedigree method, Bulk method, Back cross method	Detailed Procedure/ Scheme/ Flowchart, Merits, Demerits, Achievements (with Definitions as applicable therein) of ~ Pedigree method, Bulk method, Single seed descent method (SSD), Back cross method- [Procedure for transfer of recessive gene]	10
14-15	Heterosis and Inbreeding Depression	Definitions, Concept, Theories of heterosis, Factors affecting heterosis, Estimation of heterosis. Exploitation of hybrid vigour, Inbreeding depression	5

Continued…

16	Hardy-Weinberg Law	Law Statement, its validity, Factors affecting gene frequency	4
17-18	Selection in Cross-pollinated Crops	List of Plant Breeding methods for Cross-pollinated crops; Mass selection and Progeny selection: Procedure, Merits, Demerits, Achievements	5
19-21	Population Improvement Programme	Recurrent Selection, Disruptive selection, Diallel selective mating and Biparental mating, Procedure, Merits, Demerits, Achievements	6
22-23	Synthetics and Composites	Definition, Steps for development of Synthetics and Composites, Procedure, Merits, Demerits and Achievements	6
24	Methods of Breeding Vegetatively Propagated Crops	List of breeding methods for asexually propagated crops. Clonal selection- Procedure, Merits, Demerits, and Achievements	5
25	Self-Incompatibility	Definitions, Classification, Heteromorphic SI, its features, Distyly, Tristyly, Homomorphic SI, its types i.e. Gametophytic SI and Sporophytic SI, its features, Utilization of SI systems in crop improvement	5
26	Male Sterility	Definitions, Classification / Types with examples, Genetic Male Sterility (GMS), Thermosensitive GMS, Photosensitive GMS, Transgenic MS, Cytoplasmic Male Sterility (CMS), Cytoplasmic Genetic Male Sterility (CGMS); Chemical Hybridizing Agents; Utilization of MS in crop improvement.	5
27-28	Mutation Breeding	Definitions and Types of Mutation and Mutagens; Mutagens and their mode of action; Procedure of Mutation Breeding for seed and vegetatively propagated crops; Applications; its Merits, Demerits and Achievements	6
29	Ploidy Breeding	Definitions and Types of Polyploidy; Induction of polyploidy, its application in crop improvement, Effects of polyploidy and limitations.	5
30-31	Wide Hybridization	Definitions and Types, Main features, Interspecific and Intergeneric hybridization, its examples; Incompatibility barriers for wide hybridization, Techniques for overcoming barriers in wide hybridization; Achievements and its significance in crop improvement	5
32	Procedure for Release of New Varieties	Norms for release of New Variety, Institutions related with release of variety, Variety release procedure.	4
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL (PB-121)

Exercise No.	Exercise Title
1	Classification of plants.
2	Botanical description and Floral biology: Rice and Sorghum.
3	Botanical description and Floral biology: Maize and Wheat.
4	Botanical description and Floral biology: Pearl millet and Sugarcane.
5	Botanical description and Floral biology: Brassicas.
6	Botanical description and Floral biology: Groundnut, Sunflower and Sesame.
7	Botanical description and Floral biology: Red gram and Bengal gram.
8	Botanical description and Floral biology: Green gram and Black gram.
9	Botanical description and Floral biology: Soybean.
10	Botanical description and Floral biology: American cotton and *Desi* cotton.
11	Study of Megasporogenesis and Microsporogenesis.
12	Fertilization and Life Cycle of an Angiosperm plant.
13	Hybridization techniques and precautions to be taken.
14	Plant Breeder's Kit, selfing, emasculation and crossing techniques.
15	Study of Male sterility.
16	Study of Self-incompatibility.

Suggested Readings (PB-121):

1. **Allard R.W. 1960.** Principles of Plant Breeding, John Wiley and Sons.
2. **Chahal G.S and Gosal S.S, 2002.** Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches, Narosa Publishers.
3. **Singh P. 2014.** Essentials of Plant Breeding, Kalyani Publishers.
4. **Singh B.D. 2009.** Plant Breeding: Principles and Methods, Kalyani Publishers.

B.Tech. (Biotechnology)

#List/ Bouquet of Skill Enhancement Courses (SECs)
[in continuation of the SECs' Syllabi prescribed under I semester]

Sr. No.	Course No.	Course Title	Credit Hrs.
1.	SEC-111	Practices in Plant Tissue Culture	2(0+2)
2.	SEC-112	Laboratory Management and Instrumentation	2(0+2)
3.	SEC-123	Basic Techniques of Molecular Biology and Biotechnology	2(0+2)
4.	SEC-124	Bioinformatics and Biocomputation	2(0+2)

Note: (i) 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. However, the SEC courses are already prescribed and mentioned across specific Semesters in the Sixth Deans' Committee Report Deans' Committee Report Syllabus of B.Tech.(Biotech.) degree program.

(ii) Above list/ bouquet of SEC courses is an indicative list and subject to modification as applicable therein.

Semester	**:**	**II**		
Course No.	**:**	**SEC-123**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**:**	**Basic Techniques of Molecular Biology and Biotechnology**		

SYLLABUS

Objectives:

(i) To provide hands-on training on isolation, purification of DNA, measurement of nucleic acid concentration using spectrophotometer and gel electrophoresis, designing of PCR primers, DNA amplification using PCR, elution of PCR products, SDS PAGE, staining and de-staining of proteins and Western blot.

(ii) To study bacteriological media, preparation of media for bacterial culture, preparation of competent cells and transformation, isolation of plasmids from bacteria, and preservation of bacterial clones.

(iii) To study basic computing. Introduction to UNIX, LINUX. Nucleotide information resource: EMBL, GenBank, DDBJ, Unigene, Protein information resource: SwissProt, TrEMBL, Uniprot; Structure databases: PDB, MMDB. Search engines: Entrez, ARSA, SRS. Similarity searching: BLAST and interpreting results. Multiple sequence alignment: ClustalW; structure visualization of DNA and proteins using Rasmol.

PRACTICAL

Overview of molecular biology: DNA, RNA, Proteins. Laboratory safety and basic techniques. Nucleic acid extraction. Principles of DNA and RNA extraction from various sources. Extraction methods: Phenol-chloroform, silica-based columns, quality assessment and quantification of nucleic acids. Polymerase Chain Reaction (PCR), Optimization of PCR conditions and troubleshooting, Gel electrophoresis, Analysis of PCR products, Restriction digests and DNA/RNA samples. Molecular cloning, DNA sequencing. Principles of DNA sequencing: Sanger sequencing, DNA sequencing reaction setup and analysis, Interpretation of sequencing data and sequence alignment. Protein analysis techniques. Gene expression analysis. Practical project: Students to design and conduct a small-scale Molecular Biology Project. They will choose a specific technique or experiment, perform the necessary procedures, analyze data, and present their findings.

TEACHING SCHEDULE

PRACTICAL (SEC-123)

Exercise No.	Exercise Title
1	Introduction to Molecular Biology Laboratory and Safety guidelines.
2-3	Isolation of plant genomic DNA using different methods.
4	Quality and quantity determination of nucleic acid.
5	Isolation of total RNA from various sources.
6	Amplification of genomic DNA by PCR.
7	Agarose gel electrophoresis of PCR product.
8	Restriction digestion of DNA sample.
9-10	Preparation of competent cells and gene cloning.
11	Introduction of DNA sequencing methods.
12	DNA and Protein sequence analysis.
13	Introduction of gene expression analysis techniques.
14	Introduction of protein analysis techniques.
15-16	Practical project: Students to design and conduct a small-scale Molecular Biology Project*.
*** Project Work should be done from start to end of the semester with group of 10-20 students. They will choose a specific technique or experiment, perform the necessary procedures, analyse the data and present their findings.**	

Suggested Readings [SEC-123]:

1. **Green M.R and Sambrook J., 2012.** Molecular Cloning: A Laboratory Manual, 4th Edn, Cold Spring Harbor.
2. **Rapley R. and Whitehouse D. (Eds), 2015.** Molecular Biology and Biotechnology, Royal Society of Chemistry.
3. **Kreuzer H. and Massey A., 2008.** Molecular Biology and Biotechnology: A Guide For Students 3rd Edn, ASM Press.

Semester	**:**	**II**		
Course No.	**:**	**SEC-124**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**:**	**Bioinformatics and Biocomputation**		

SYLLABUS

Objectives:

(i) To expose the students to the construction and use of computers, special algorithms, new complexity theories, computing science and related mathematics.
(ii) To understand the scientific and economic impact of Bioinformatics.
(iii) To have a better understanding of organisms, their metabolism and their evolution.
(iv) To study their applications in healthcare and drug design, new (bio)materials and their engineering, food (engineering) and food production.

TEACHING SCHEDULE

PRACTICAL [SEC-124]

Exercise No.	Exercise Title
1-2	Information search and data retrieval: Introduction to Biological Databases (NCBI, EMBL, DDBJ, UNIPROT).
3	Data retrieval from Biological Databases (Nucleotide, Protein Sequence Data).
4	Genome analysis and gene mapping: Genome Browsers: Exploring genome browsers (UCSC Genome Browser, Ensembl).
5	Gene Mapping: Identifying gene loci on chromosome.
6	Analysing SNPs and their genomic context using dbSNP.
7-8	Alignment of pairs of sequences: Needle and Water, Tools for tools for similarity search and sequence alignment: BLAST, PSI-BLAST.
9-11	Multiple Sequence Alignment using ClustalW or ClustalOmega, Phylogenetic Tree Construction: Constructing trees using neighbour-joining and maximum likelihood methods, Tree Visualization: Visualizing phylogenetic trees using tools like MEGA.
12	ProfileHidden Markov Models: using HMMER for sequence analysis.
13-15	Gene identification and prediction: Gene prediction tools like GENSCAN, ORF Finder, Promoter prediction.
16-18	Gene expression analyses; Microarray data analysis, RNA-Seq Analysis, Pathway Analysis.
19-21	Protein classification, structure analysis and visualization: Protein Structure and Classification databases: CATH and SCOP, Visualization of protein structures: Cn3D, SPDViewer, RasTop etc.

Continued….

22-24	Protein structure prediction: Primary and secondary structure prediction, Tertiary structure prediction using Swiss-Model.
25-27	Computational methods for Pathway and Systems Biology: Pathway Databases exploring pathways using Reactome or KEGG, Network Analysis: Constructing and analyzing biological networks using Cytoscape, Systems Biology Models: Simulating metabolic pathways using tools like CellDesigner.
28-29	Technologies and strategies for drug discovery: Target Identification, Virtual Screening and QSAR Analysis.
30	Biomarkers in drug development.
31-32	Computer-aided drug design; Structure-based drug design (SBDD) & Ligand-based drug design (LBDD), Molecular Docking, Quantitative structure-activity relationship (QSAR).

Suggested Readings [SEC-124]:

1. **Altman R.B, Dunker A.K, Hunter L., Ritchie M.D, Murray T.A. and Klein T.E., 2017.** Biocomputing, https://doi.org/10.1142/10388.
2. **Laplante P.A. (Ed), 2004.** Biocomputing, Ova Biomedical.
3. **Neelakanta P.S. 2024.** A Textbook of Bioinformatics: Information - Theoretic Perspectives of Bioengineering and Biological Complexes.
4. **Jin Xiong. 2006.** Essential Bioinformatics, Texas A and M University, Cambridge University Press.
5. **Rastogi S.C., Mendiratta N., Rastogi P**. **2013.** Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery, Prentice Hall India, ©2013 New Delhi.

SEMESTERWISE COURSE LAYOUT FOR B.Tech. (BIOTECHNOLOGY)		
Semester I		
Course No.	**Course Title**	**Credit**
BOT-111/ MATH-111	Basic Botany/ Basic Mathematics – I	2+1/3+0
AGRO-111	Crop Production Technology	2+1
BT-111	Cell Biology	2+0
BT-112	Basic Genetics	2+1
BT-113	Introduction to Biotechnology	2+1
CSPD-111	Communication Skills and Personality development	1+1
ENV-111	Environmental Studies and Disaster Management	2+1
FT-111	Food Science and Processing	1+1
HD-111	Human Ethics	1+0
DEG-111	Democracy, Elections and Good Goverence	1+0 NC
NCC-111/ NSS-111	NCC/NSS	0+1 NC
	Total	**15+7 (22) +2 NC=24**

Semester II		
Course No.	**Course Title**	**Credit**
ZOO-121/ MATH-122	Basic Zoology/ Basic Mathematics-II	2+1/3+0
BT-124	Plant Tissue Culture	2+1
BT-125	Molecular Biology	2+1
BOT/ZOO-121	Biodiversity and its Conservation	2+0
MICRO-121	Microbiology	2+1
*HORT-121/ **AS-121	Production technologies for Horticultural Crops/ Anatomy and Physiology of Livestock	2+1/ 3+0
*PB -121/**AS-122	Principles of Plant Breeding/ Introduction to Animal Breeding	2+1/ 2+1
STAT-121	Basic Statistics	1+1
PHYEDN-111	Physical Education and Yoga	0+1 NC
NCC-122/ NSS-122	NCC/NSS	0+1 NC
Total		**15+7(22)+2 NC=24**

SEMESTER-I

Course No : BOT-111 Course Title : **Basic Botany**

Credits : 3(2+1) Semester : **I**

Syllabus: Theory

UNIT I

Plant kingdom and features of each group; Morphology, modifications and functions of root, stem, leaf, flower and inflorescence; Pollination and fertilization; Fruit types; Structure of dicot and monocot seed, seed germination.

UNIT II

Cell structure; DNA, chromosome and genes; Cell and tissue types; Internal structure of root, stem and leaf.

UNIT III

Plant taxonomy, systems of classification; Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

Practical

Description of one plant species from each group of plant kingdom; Study of morphology and modifications of root, stem, leaf, flower; Types of inflorescence; Structure of various types of seeds and fruits; Demonstration of cell structure, tissue types; Structure of monocot and dicot root, stem and leaf; One flower from each family.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (%)
UNIT I		
1	Plant kingdom : Introduction, Classification with examples-	2
2	Algae, Bryophytes, Pteriophytes	3
3	Angiosperm and Gynosperm	3
4	Morphology, modifications and functions of root	3
5	Morphology, modifications and functions of stem	3
6	Morphology, modifications and functions of leaf	2
7	Morphology, modifications and functions of flower	3
8	Morphology, modifications and functions of inflorescence	2
10	Pollination: Modes; Differences;	9
11	Mechanisms promoting self/ cross pollination ,	
12	Floral biology related terminology	
13	Modes of reproduction and fertilization	
14	Fruit types: Structure of dicot seed	3
15	Fruit types: Structure monocot seed	3
16	Seed germination: Types	6
UNIT II		
17	Cell structure: -	3
18	Cell and tissue types: -	3

19	DNA, chromosome and genes:-	6
20	Internal structure (Anatomy) of root	2
21	Internal structure (Anatomy) of stem	3
22	Internal structure (Anatomy) of leaf	3
UNIT III		
23-24	Plant taxonomy: Systems of classification	8
25	Characteristics and economic importance of Poaceae	6
26	Characteristics and economic importance of Fabaceae	6
27	Characteristics and economic importance of Malvaceae	3
28	Characteristics and economic importance of Rutaceae	3
29	Characteristics and economic importance of Rosaceae	3
30	Characteristics and economic importance of Asteraceae	3
31-32	Characteristics and economic importance of Solanaceae	6
	Total:	**100**

Practical Exercises

Exercise No.	Title
1-2	Description of one plant species from each group of plant kingdom
3	Study of morphology and modifications of root
4	Study of morphology and modifications of stem
5	Study of morphology and modifications of leaf
6	Study of morphology and modifications of flower
7-8	Types of inflorescence
9-10	Structure of various types of seeds and fruits
11-12	Demonstration of cell structure & tissue types
13	Structure of monocot and dicot root each family
14	Structure of monocot and dicot stem from each family
15	Structure of monocot and dicot leaf from each family& flower
16	Structure of monocot and dicot flower from each family& flower

Text Books:

1. Bendre A& Kumar A. 1999.*Textbook of Practical Botany.*Vol. 2, 7th Ed., Rastogi Publications.
2. Bendre AM & Pande PC. 2009. *Introduction to Botany*. Rastogi Publications.
3. Dutta A.C. 2016. *Botany for Degree Students*. Oxford University Press.

Reference books

4. Bendre A & Kumar A. 1999.*Textbook of Practical Botany.*Vol. 2, 7th Ed., Rastogi Publications.
5. Bendre AM & Pande PC. 2009. *Introduction to Botany*. Rastogi Publications.

Course No : **MATH-111** Course Title : **Basic Mathematics-I**

Credits : **3(3+0)** Semester : **I**

Syllabus- Theory

UNIT I

Complex numbers: Properties of real numbers, complex numbers, their addition, multiplication and division, square root of complex numbers, cube roots of unity and their properties, De-Moiré's theorem; Theory of equations: Solution of quadratic equation, equation reducible to quadratic equation, relation between roots and coefficients, nature of roots and formation of quadratic equation with given roots.

UNIT II

Geometric series: nth term of G.P. series, sum of G.P. series, geometric mean; Harmonic series, harmonic mean; Arithmetic geometric series and special series $\sum n$, $\sum n^2$, $\sum n^3$. Partial fractions; Logarithms; Binomial theorem for any index: Expansion, middle term, general term, terms independent of x.

Unit III

Trigonometry: Trigonometric ratios, allied angles, graphs of trigonometric functions; Addition and subtraction formulae; Product and sum formulae; Multiple and sub-multiple angles, sine, cosine and projection formulae; Area of a triangle.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (%)
Complex numbers		
1	Properties of real numbers.	20
2	Introduction to Complex numbers	
3	Addition of Complex number	
4	Multiplication of complex number	
5	Division of Complex number	
6- 7	Square root of Complex numbers	
8- 9	Cube roots of unity and their properties,	
10	De-Moivres theorem (Without proof)	
Theory of equations		
11	Definition of quadratic equation,	20
12 & 13	Solution of quadratic equation and its examples	
14	Equations reducible to quadratic equation,	
15	Relation between roots and coefficients	
16	Nature of roots	
17 & 18	Formation of quadratic equation with given roots.	
Geometric series		
19	Definition of G.P. and nth term of G.P. series	30
20	Sum of G.P. series	
21	Geometric mean	

22	Harmonic series	
23	Harmonic mean	
24	Arithmetic geometric series	
25 & 26	Special series $\sum n, \sum n^2, \sum n^3$	
27 & 28	Partial fractions	
29	Logarithm series	
30	Binomial theorem for any index	
31 & 32	Expanding a given expression using Binomial theorem	
33	Finding the Middle term using Binomial Expansion	
34	Finding the General term using Binomial Expansion	
35	Terms independent of Variable (x).	
Trigonometry		
36	Introduction Trigonometric ratios, Trigonometric identities	30
37 & 38	Trigonometric ratios of allied angles	
39	Graphs of trigonometric functions	
40 & 41	Addition and subtraction formulae	
42	Product and sum formulae	
43 & 44	Trigonometric ratios of Multiple and sub-multiple angles	
45 & 46	Sine and Cosine formulae	
47	Projection formulae	
48	Area of a triangle	
Total:		**100**

Text Books

1) A Text Book of Mathematics, 11th Part-I and Part II, Maharashtra State Board of Secondary and Higher secondary Education-Pune
2) NCERT 2012. *Mathematics of Class XI.* NCERT India.

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Reference Books:

1) Sharma RD. 2014. *Mathematics of Class XI.* Dhanpat Rai Publisher.
2) Hall HS and Knight SR. 2016. Higher Algebra. Arihant Publication.

Course No : **AGRO-111** Course Title : **Crop Production Technology**

Credits : **3(2+1)** Semester : **I**

Theory

UNIT I

Soil and its components; Soil morphological, physical, chemical and biological properties; Acidic, saline and alkali soils and their reclamation; Essential plant nutrients: Functions and deficiency symptoms; Soil micro-organisms; Rhizosphere and its domain in soil; Organic manures and inorganic fertilizers.

UNIT II

Agriculture; Agronomy and its relation with other sciences; Classification of crops; Tillage and tillage practices, concepts of tillage and objectives; Seed, its characteristics and different sowing methods; Weed management: definition of weed, losses and benefits of weeds, different weed control methods and their suitability under different conditions; Irrigation: Soil water classification, methods of irrigation, approaches for scheduling irrigation.

UNIT III

Soil fertility and productivity; Concept of essentiality of plant nutrients; Fertilizers, manures and their types, methods of fertilizer application; Concepts of crop rotation, multiple cropping and intercropping - their principles, advantages and limitations; Cropping intensity; Production technology of major crops: Rice, maize, cotton, soybean, mung bean, mash, wheat, rapeseed and mustard, gram and Egyptian clover.

Practical

Study of soil profile and its characteristics; Determination of soil particle size distribution, particle density and bulk density; Determination of soil pH, electrical conductivity and organic carbon; Isolation of soil micro-flora (bacteria, fungus and actinomycetes).

Land measurement; Practice in seed bed preparation and seeding methods; Identification of crop seeds, crops, weeds and fertilizers; Identification and use of hand tools and implements; Computation of fertilizer doses and their method of application.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (%)
	UNIT I	
1	Soil and its components.	**3**
2	Morphological and physical properties of soil.	**2**
3	Chemical and biological properties of soil.	**3**
4	Acidic, saline and alkali soils and their reclamation	**3**
5	Essential plant nutrients: Major, minor, primary and secondary plant nutrients	**4**
6	Functions of essential plant nutrients.	**3**

7	Deficiency symptoms of essential plant nutrients	**2**
8	Soil micro-organisms in Rhizosphere	**3**
9	Domain of Soil micro-organisms in soil	**2**
10	Organic manures: Meaning and their types, advantages and disadvantages of organic manures.	**3**
11	Inorganic fertilizers: Classification of inorganic fertilizers and methods of fertilizer application.	**4**
	UNIT II	
12	Agriculture; Agronomy and its relation with other sciences;	**3**
13	Classification of crops	**3**
14	Agroclimatic zones of Maharashtra	**2**
15	Tillage: definition and types of tillage, tilth, implements used for tillage.	**4**
16	Concepts of tillage and its objectives	**3**
17	Seed: classification of seed and its characteristics	**3**
18	Different methods of sowing	**2**
19	Weed management: definition of weed, losses caused by weeds and benefits of weeds	**3**
20	Different methods of weed control and their suitability under different conditions	**4**
21	Irrigation: Soil water classification, methods of irrigation.	**4**
22	Approaches for scheduling irrigation	**2**
	UNIT III	
23	Soil fertility and productivity.	**3**
24	Concepts of crop rotation: Types of cropping systems, multiple cropping and intercropping.	**3**
25	Principles, advantages and limitations of cropping system, cropping intensity	**3**
26	Production technology of major field crops (cereals): Jowar, maize, bajra.	**4**
27	Production technology of major field crops (cereals): Rice and wheat.	**4**
28	Production technology of major field crops (pulses): Red gram, green gram, black gram.	**4**
29	Production technology of major field crops (pulses): Bengal gram, pea, lentil.	**4**
30	Production technology of major field crops (oilseeds): Soybean, groundnut, sesame.	**4**
31	Production technology of major field crops (oilseeds): Sunflower, safflower, rapeseed and mustard.	**4**
32	Production technology of major cash crops: cotton and sugarcane.	**2**
	Total	**100%**

Practical Exercise

Exercise No.	Title
1	To study the soil profile.
2	Study of soil characteristics
3	Determination of soil particle size distribution: particle density
4	Determination of soil particle size distribution: bulk density.
5	Determination of soil pH.
6	Determination of electrical conductivity
7	Determination of organic carbon.
8	Isolation of soil micro-flora (bacteria)
9	Isolation of soil micro-flora (fungus)
10	Isolation of soil micro-flora (actinomycetes)
11	Land measurement; Practice in seedbed preparation
12	To study the methods of sowing
13	Identification of crop seeds and crops.
14	Identification of weeds and fertilizers.
15	Identification and use of hand tools and implements.
16	Computation of fertilizer doses and their method of application

Text Books:

1. Balasubrananiyan P & Palaniappan SP. 2010. *Principles and Practices of Agronomy*. Agrobios.
2. Chandrasekaran B, Annadural K & Samasundaram E. 2010. *A Text Book of Agronomy.* New Age International (P) Limited Publishers.
3. Acquaah G. 2005. *Principles of Crop Production: Theory, Techniques and Technology.* Prenice Hall.
4. Reddy SR. 2011. *Principles of Agronomy.* Kalyani Publishers.
5. Vaidya VG and Sahastrabuddhe KR.1979. .Introduction to Agronomy-Soil and Water Management. Continental Publication.

Reference Books:

i. Alexander M. 1977. *Introduction to Soil Microbiology,* 2nd Edition. John Wiley & Sons.

ii. Brady NC & Well RR. 2002. *The Nature and Properties of Soils,* Thirteenth Edition. Pearson Prentice Hall.

iii. Das DK. 2011. *Introductory Soil Science.* Third Revised Edition, Kalyani Publishers.

Course No : **BT-111** Course Title : **Cell Biology**

Credits : **2(2+0)** Semester : **I**

Theory

UNIT I

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, vacuoles.

UNIT II

Structure and function of cytoskeleton and its role in motility; Cell membrane transport; Introduction to cell signalling; Cell growth, cell cycle and its control; Cell death and cell renewal.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightages (%)
	UNIT I	
1 -2	Origin and evolution of cell: a. Evolution of molecules & first cell	1
	b Evolution from Prokaryotes to Eukaryotes c.Evolution of single cells to multicellular organisms	2
3-5	Introduction to microscopy: a. Light microscopy principles and applications b. Compound microscopy c. Phase contrast microscopy	4
	d. Dark-field microscopy e. Fluorescence Microscopy f. Differential interference microscopy	4
	g. Confocal laser scanning microscopy h. Electron Microscopy	2
6	a. Sub-cellular structure of prokaryotic and eukaryotic cells b. Difference between prokaryotic and eukaryotic cells	2
7- 8	Membrane structure and function a. Lipid bilayer	2
	b. Membrane proteins c. Membrane functions	3
9 -10	Plasma membrane a. Origin of plasma membrane b. Different models of plasma membrane structure **c.** Functions of plasma membrane	5

11-12	Cell wall and extracellular matrix a. Cell wall composition & structure	2
	b. Functions of cell wall c. Cell-cell junctions, cell adhesion & extracellular matrix.	3
13	Structural organization and function of intracellular organelles and organelle biogenesis	2
14	Structure & Functions of Nucleus	3
15	Structure & Functions of plastids	3
16	Structure & Functions of mitochondria	3
17	Structure & Functions of endoplasmic reticulum	3
18	Structure & Functions of Golgi apparatus	3
19	Structure & Functions of lysosomes, peroxisomes, vacuoles.	3
UNIT II		
20 -21	Cytoskeleton: a. Origin & functions of cytoskeleton b. Actin & actin binding proteins c. Myosin & actin	4
	d. Microtubules, Microfilaments & Intermediate filaments e. Cilia & centrioles f. Role of cytoskeleton in mobility	4
22 - 24	Cell membrane transport: a. Principles of membrane transport	2
	b. Active & Passive transport	4
	c. Transporters & their functions d. Ion-channels	4
25 - 27	Introduction to cell signaling: a. General principles of signaling b. Signaling molecules & their receptors	4
	c. Functions of cell surface receptors d. G-protein coupled receptors	4
	e. Enzyme coupled receptors f. Pathways of intracellular signal transduction	4
28 - 30	Cell growth, cell cycle and its control: a. Overview of cell cycle	4
	b. Phase of cell cycle: G1, S phase, M phase, Mitosis & cytokinesis c. Meiosis	6
	d. Components of cell cycle control system e. Regulation of cell cycle	2
31 - 32	Cell death &cell renewal a. Programmed cell death/Apoptosis	3

	b. Cell renewal: stem cells & maintenance of adult tissues c. Embryonic stem cells	5
Total:		**100**

Text Books:

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K &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.

Course No : **BT-112** Course Title : **Basic Genetics**

Credits : **3(2+1)** Semester : **I**

Theory

UNIT I

History of Genetics; Mendel's principles and rediscovery; Cell division; Chromosomes structure and function; Chromosome theory of inheritance; Sex-linked, sex-limited and sex-influenced inheritance; Sex determination and sex differentiation.

UNIT II

Multiple allelism; Linkage and crossing-over; Gene-gene interaction; Genetic analysis in prokaryotes and eukaryotes; Extra chromosomal inheritance; Mutations; Hardy-Weinberg law; Quantitative inheritance; Introduction to Human genetics; Genetic basis of evolution.

Practical

Life cycle in model plants and animals; microscopy; Mitosis and meiosis; Monohybrid crosses (segregation); Dihybrid crosses (independent assortment); Probability and use of Chi-square; Sex-linked inheritance; Multiple allelism; Detection and estimation of linkage.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (marks)
	UNIT I	
1- 2	**History of Genetics** PreMendelian concept (500 BC – 1850 AD) Mendelian Era (1850-1900) Post Mendelian concept (1900 onwards)	4
3	**Mendel's principles and rediscovery** Mendel's laws of inheritance, reasons of Mendel's success. Mendelian deviation or exception	4
4- 5	**Cell Division** Mitosis, importance of mitosis, stages of mitosis, , significance of meiosis, stages of meiosis	4
6	**Chromosome** morphology and chemical composition	4
7	**Chromosome** : Structure and function, recent models of chromosomes structure, special chromosomes, functions of chromosomes	4
8	**Chromosomal theory of inheritance:** Inheritance of quantitative and qualitative traits, characters of quantitative and qualitative traits	4
9	Sex linked, sex limited and sex influenced inheritance	4
10	Sex determination and sex differentiation	4
	Unit II	
11	**Multiple alleles,** Some classical examples of multiple allele, characters of multiple allele	4
12	**Cytoplasmic inheritance:** Definition and character of cytoplasmic inheritance	4
13	Maternal effects, inheritance of structure and patterns, Role of cytoplasmic inheritance in parasites, symbionts and kappa particles in	4

	paramoecium	
14	**Mutation,** history, classification of mutation , spontaneous mutation, induced mutation	4
15-16	**Mutation**, molecular basis of mutation , mutator and anti mutator genes, mutable genes, suppressor mutation, mechanism of suppressor mutation	4
17	**Mutation** (induction and detection), physical mutagens, chemical mutagens, detection of mutation, applications of mutation	4
18-19	**Linkage** History, Types of linkage, detection of linkage, detection in test cross generation, detection in F_2 generation	4
20	**Crossing over**: Definition. factors affecting recombination frequency, cytological basis of crossing over	4
21	**Crossing over** : Crossing over in the four strand stage, relationship between chiasma and crossing over, molecular mechanisms of crossing over, linkage maps and linkage groups	4
22-23	**Gene interaction:** types of gene interaction, typical dihybrid ratio and its modifications	5
24	**Gene interaction** modification of gene interaction F_2 ratios partial dominance at an inhibitory locus (7:6:3), additive gene action (1:4:6:4:1), dominance modification of duplicate genes (11:5)	5
25	**Gene interaction** modifying genes, dominance modification, major and minor gene affecting character, suppression of mutant allele, molecular basis for gene interaction	4
26	**Hardy-Weinberg law** : Gene frequency genotype frequency, gene pool, random union of gametes, random mating among genotypes	4
27	**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
28-29	**Quantative inheritance**: Multiple factor hypothesis, transgressive segregation, effects of environment on qualitative traits	4
30	**Genetic basis of evolution and origin of species:** Theories of evolution: Lamarckism, Darwinism, Mutation theory, neo. darwinism.	3
31-32	**Introduction to human genetics:** Human the organism, Cytogenetics of man: chromosome banding, chromosome aberration. Genetics studies , genetics diseases , blood groups , Disputed Parentages	3
Total:		100

Practical Exercise

Exercise No.	Title
1	Study of life cycle in model plant and animals
2	Study of microscopes
3	Preparation of microscopic slides of mitosis in onion roots tips
4	Preparation of microscopic slides of meiosis in Tradescancia / onion /wheat inflorescence
5	Method of finding gametes
6	Problems on monohybrid ratio and its modification-I
7	Problems on monohybrid ratio and its modification-II
8	Problems on dihybrid ration and its modifications-I

9	Problems on dihybrid ration and its modifications-II
10	Problems on probability
11	Problems on chi-square test
12	Problems on multiple allele
13-14	Problems on linkage of genes
15	Problems on sex linked inheritance
16	Problems

Suggested Readings:

Text Book and Reference Books:

1. Gupta PK. 2014. Genetics 4th ed. Rastogi Publications.
2. Inbasekar P. 2009. Cell Biology and Genetics. Panima Publications.
3. Miglani GS. 2000. Basic Genetics. Narosa Publishing house, New Delhi.
4. Russell PJ. 2013. Genetics: Pearson New International Edition: A Molecular Approach. Pearson.
5. Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. Molecular Biology of the Gene. 6th Ed. Pearson Education International.
6. Gardner EJ, Simmons MJ, Snustad DP. 2006. Principles of Genetics. 8th Ed. John Wiley & Sons.
7. Singh BD. 2004. Fundamentals of Genetics, Kalyani Publication New Delhi.
8. Strickberger MW. 1985. Genetics, Pearson education, Inc.
9. Singh P., 2015. Elements of Genetics, Kalyani Publication New Delhi.
10. Elrod S. and Stansfield W. 2008. Genetics, Mc Graw Hill Publishing Company Limited , New Delhi.

Course No : **BT-113** Course Title : **Introduction to Biotechnology**

Credits : **3(2+1)** Semester : **I**

Theory

UNIT I

History, definitions, concepts, scope and importance of Biotechnology: Plant, microbial, animal, medical, environmental, industrial, Marine, Agricultural and food Biotechnology; Nanobiotechnology.

UNIT II

Introduction to recombinant DNA technology and its applications: Vectors, DNA restriction and modifying enzymes, gene cloning; Introduction to genomics and proteomics: Molecular markers, DNA sequencing; Genetic transformation and transgenic organisms; Bioinformatics. Biosafety guidelines.

Practical

Orientation to the laboratories: glass houses, screen houses, transgenic facilities and field area; General guidelines for working in Biotechnology laboratories; Familiarization with basic equipment's used in biotechnology; Selection of chemicals (different grade), buffer preparation, calculations and scientific notations used in laboratories.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightages (%)
	UNIT I	
1-2	**History and branches of biotechnology**: definitions and concepts	3
3	**Scope and importance of biotechnology**	3
4	**Plant and Agricultural biotechnology**: tissue culture, concept of totipotency and micro-propagation, applications	5
5	**Microbial biotechnology:** basic concepts, various techniques and industrial applications	3
6	**Medical and Animal biotechnology:** basic concepts, various techniques and industrial applications	3
7	**Environmental , Industrial and Marine biotechnology:** basic concepts, various techniques and industrial applications	3
8	**Agricultural and Food biotechnology:** basic concepts, various techniques and industrial applications	3
9	**Nanobiotechnology:** Nano-particles, nano-fertilizers and applications and future aspects of nano-biotechnology	5
	UNIT II	
10	**Recombinant DNA :** Introduction, Definition, requirements and evolution	3
11	**Gene clonining:** concept, importance and steps involved in gene cloning, transformation, transduction and Transfection	5
12-15	**Vectors:** Definition, properties of good vector, plasmid-	8

	pBR322, pUC18, pUC19: properties and physical maps. **Types of vectors:** Phage vector (lambda phage, M13), artificial chromosome vectors: BAC, YAC, MAC	
16-18	**Restriction endonuclease:** Types, nomenclature and characteristics of restriction enzymes, restriction site, unit of restriction enzyme, cleavage pattern and mapping	8
19	**The range of manipulative enzymes:** nucleases, ligases, polymerases, topoisomerase, alkaline phosphatase	5
20-21	**Introduction to genomics:** basics of genomics, methods to study genome using bioinformatics tools.	5
22	**Proteomics:** Basics of proteomics, methods of protein analysis using bioinformatics tools, concepts in protein structure prediction.	5
23	**Molecular markers:** Introduction and types- biochemical, morphological and molecular	5
24	**Types of markers:** RFLP, RAPD, AFLP, VNTR, SSR, STR, EST, micro-satellite marker and QTL (methods and applications)	5
25-26	**DNA sequencing:** Introduction, Maxam-Gilbert method, Sanger's method and automated sequencing.	5
27	Genetic transformation and transgenic organisms: methods and applications	5
28-29	**Bioinformatics:** Introduction, scope and importance, Biological databases, introductory programming, introduction to gene expression and microarrays.	5
30	**Biosafety guidelines:** Definition, Biosafety concerns,	2
31	Levels of biosafety, Guidelines in biotechnology,	3
32	Biosafety regulatory framework, Agencies and their role	3
	Total	**100**

Practical Exercise

Exercise No.	Title
1-2	Biotechnology laboratory specifications, organization of instruments and their use , general guidelines
3	Study of glass house and screen house
4	Study of basic equipments used in biotechnology laboratory
5	Different techniques in biotechnology: sterilization and aseptic manipulations.
6	Study of general guidelines and safety measures for working in biotechnology laboratory.
7	Calculation and preparation of molar solution, normal solution, percent solution.
8	Introduction to scientific notations in laboratory
9	Preparation of different buffers in laboratory with different pH
10	Isolation of genomic DNA from bacteria, animal and plant source.
11	Quantification of DNA
12	Gel electrophoresis technique
13-14	Study of gene transfer methods: direct methods

14-15	Gene transfer methods: indirect methods
16	Confirmation of genetic transformation by PCR method

Text Book:

1. Singh BD. 2003.Introduction to Biotechnology.
2. Chawla HS.2002.: Introduction to Plant Biotechnology. Science Pub. Inc.
3. Brown TA. 2017.*Genome4*.. New York: Wiley-Liss.

Reference Books:

1. Prave P, Faust U, Sittig W & Sukatsch DA. 1987. Basic Biotechnology: A Student's Guide. VCH Verlagsgesellschaft.
2. Prave P, Faust U & Sittig W. 1987 Fundamentals of Biotechnology.VCH Verlagsgesellschaft.
3. Renneberg R. 2008. Biotechnology for Beginners. Academic Press Publishers.

Course No: **CSPD-111** CourseTitle : **Communication Skills and Personality Development**

Credits : **2(1+1)** Semester : **I**

Theory

Definition and Basics of Personality; Analyzing Strength and Weakness; Theories on Personality Development; Body Language; Preparation of Self-Introduction; Communication Skills: Listening Skills; Communication Skills: Communication Barriers; Overcoming these barriers; Building Self-Esteem and Self- Confidence; Attitudes: Assertive, Aggressive and Submissive; Introduction to Leadership; Leadership Styles; Group Dynamics;Team Building; Interpersonal Communication and Relationship;Conflict Management: Introduction, Levels of Conflict and Managing Conflict. Time Management: a. Concept b. Importance and Need.c. Steps towards better Time Management. Public Speaking: a. Introduction b. Increasing Vocabulary c. Voice Modulation d. Social Graces and Email and Telephone Etiquettes.

Practicals

One-on-One Sessions for Individual Personality Traits; Role Play and Impromptu Conversation/Public Speaking Practice focusing on Body Language; Vocabulary Practices: Developing a repertoire of words in various fields like Agriculture, Politics, Economics, Family, Personal Grooming etc. Role Play for Self Introduction in the class; Listening to recorded Short Speeches, Lectures and Conversations Practicing Dialogues, Speeches and Conversations by Students in the Class to illustrate that Communication Barriers can be overcome; Lecture and Questionnaires for Building Self-Esteem and Self Confidence; Case Studies based on Development of Attitudes; Case Studies on Leadership Development; Case Studies on Leadership Development; Group Games, Ice breakers, Warm-ups and Energizers Team Building Activities and Exercises and Trust Building Activities; Psychological Self awareness Exercises; Practice of Non-Verbal Communication Skills: Dumb Charades and Dubsmash Practice; Mutually Acceptable Proximity; and Eye Contact; Time Management Games to Practice and Experience the Importance of Planning/ Delegating Work among them to properly manage time and complete the task in the shortest time possible; Public Speaking Games: (Introducing a friend with his/her life style; Describing a funny image provided by the teacher; Continuing a Story starting with one student and others try to continue with it and try to complete it. Take any object available and try to make a commercial for it; Practice of Emails].

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightages (%)
	Communication Skills	
1	Meaning and Process of Communication	5
2, 3	Verbal and Nonverbal Communication	8
4	Public Speaking, Impromptu Presentation	5
5	Individual Presentation, Group Discussion, Seminars and Conferences	10
6	Science of body language	5
	Writing Skills	
7	Precise Writing, Summarizing, Abstracting	7
8, 9	Listening and Note Taking, Field Diary and Lab Record	8
10	Indexing, Footnote and Bibliographic Procedures	5
	Personality Development	
11	Meaning and definition of Personality	3
12	Factors effecting Personality, Personality Traits	10
13	Voice modulation basics & their usage for meaningful impact on people	7
14	Attributes of an effective leader	5
15	Stress and conflict management,Time management	12
16	Prioritizing and balancing, Cosmopolitan culture, Role of team work	10
	Total:	**100**

Practical Exercise

1. Oral Presentation Skill
2. Individual and Group Presentation
3. Writing Skill
4. Field Diary and Lab Record
5. Indexing and Footnote and
6. Bibliographic Procedures
7. Precise Writing
8. Summarizing, Abstracting
9. Video recorded mock group discussions & interviews
10. Video recorded practical to evaluate change in confidence level
11. Attitude management
12. Setting & achieving a short term goal
13. Creating a personal vision statement of life
14. Voice modulation
15. Practicing conscious body postures & movements
16. Rapport building

Text Books:

1. Balasubramanian T. 1989. A Textbook of Phonetics for Indian Students. Orient Longman, New Delhi.
2. Balasubrmanyam M. 1985. Business Communication. Vani Educational Books, New Delhi.
3. Naterop JB and Rod R. 1997. Telephoning in English. Cambridge University Press, Cambridge.
4. Mohan Krishna and Banerjee M. 1990. Developing Communication Skills. Macmillan India Ltd. New Delhi.
5. Krishnaswamy N. and Sriraman T. 1995. Current English for Colleges. Macmillan India Ltd. Madras.
6. Narayanaswamy VR. 1979. Strengthen your writing. Orient Longman, New Delhi.
7. Sharma RC and Krishna Mohan. 1978. Business Correspondence. Tata Mc Graw Hill Publishing Company, New Delhi.
8. Dale C. 2012. How to Win Friends and Influence People in the Digital Age. Simon & Schuster.
9. Covey SR. 1989. The Seven Habits of Highly Successful People. Free Press.
10. Spitzberg B, Barge K & Morreale, Sherwyn P. 2006. Human Communication: Motivation, Knowledge & Skills. Wadsworth.
11. Verma KC. 2013. The Art of Communication. Kalpaz.
12. Bhatnagar M and Bhatnagar N. 2011. Effective Communication and Soft Skills. Person Education.
13. Meenakshi R and Sharma S. 2015. Technical Communication: Principles and Practice. Oxford Univ. Press, India.
14. Wallace HR and Masters LA. 2010. Personality Development for Life and Work. Cengage Learning.

15. Rutherford AJ. 2001. Basic Communication Skills for Technology. Pearson Education Inc. New Delhi
16. Carroll BJ. 1986. English for College, Macmillan India Ltd. New Delhi
17. Hahn H. 1996. "The Internet complete reference, Tata McGraw-Hill Edu. Pvt. Ltd.
18. Hornby AS. 1975. Guide to patterns and usage in English. Oxford University, NewDelhi.
19. Qurik R and GreenbaumS. 2002. A University Grammar of English. Longman Pub.

Course No : **ENV-111** Course Title : **Environmental Studies &Disaster Management**
Credits : **3(2+1)** Semester **: I**

Theory

ENVIRONMENTAL STUDIES

UNIT I

Multidisciplinary nature of environmental studies; Definition, scope and importance.

UNIT II

Natural Resources: Renewable and non-renewable resources; Natural resources and associated problems.

a) Forest resources: Use and over-exploitation; Deforestation; Case studies. Timber extraction, mining; Dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water; Floods; Drought; Conflicts over water; Dams-benefits and problems.

c) Mineral resources: Use and exploitation; Environmental effects of extracting and using mineral resources; Case studies.

d) Food resources: World food problems; Changes caused by agriculture and overgrazing; Effects of modern agriculture; Fertilizer-pesticide problems; Water logging; Salinity; Case studies.

e) Energy resources: Growing energy needs; Renewable and non-renewable energy sources; Use of alternate energy sources; Case studies.

f) Land resources: Land as a resource; Land degradation; Man induced landslides; Soil erosion and desertification.

Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT III

Ecosystems; Concept of an ecosystem; Structure and function of ecosystem; Producers, consumers and decomposers; Energy flow in ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT IV

Biodiversity and its conservation; Introduction, definition, genetic, species and ecosystem diversity and biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.

UNIT V

Environmental Pollution: definition, cause, effects and control measures air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear

hazards; Solid waste management: causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies.

UNIT VI

Social issues and the environment; From unsustainable to sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

UNIT VII

Human population and environment: population growth, variation among nations, population explosion, Family Welfare Programme; Environment and human health: human rights, value education, HIV/AIDS; Women and child welfare; Role of information technology in environment and human health; Case studies.

DISASTER MANAGEMENT

UNIT I

Natural disasters - Meaning and nature of natural disasters; their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves; Climatic change: global warming, sea level rise, ozone depletion.

UNIT II

Man-made disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster management - Effect to migrate natural disaster at national and global levels; International strategy for disaster reduction; Concept of disaster management; National disaster management framework; Financial arrangements; Role of NGOs, community-based organizations and media; Role of central, state, district and local administration; Armed forces, police and other organizations in disaster response.

Practical

Visit to a local area to document environmental assets: river/ forest/ grassland/ hill/ mountain; Visit to a local polluted site - urban/ rural/ industrial/ agricultural; Study of common plants, insects, birds and study of simple ecosystems - pond, river, hill slopes, etc.; Visit to disaster management organizations; Collection of statistics of national disasters occurred since 20^{th} century.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
1.	Environmental studies:- Nature, Definition, scope and importance	3
2.	Natural Resources:-Renewable and non-renewable resources, Natural resources and associated problems.	2
3.	a) Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.	3
4.	c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.	2
5.	d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.	3
6.	e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of non-conventional energy sources. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.	4
7.	Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	2
8.	Ecosystems: -Concept of an ecosystem,Structure and function.	3
9.	Study of Producers, Consumers and Decomposers,Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids.	5
10.	Types of Ecosystem Introduction, characteristic features, structure and function of Forest,Grassland, Desert and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	6
11-12.	Biodiversity: - Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India, Value of biodiversity.	6
13-14.	Biodiversity at global, national and local levels, india as a mega-diversity nation. Hot-spots of biodiversity, threats to biodiversity: Endangered and endemic species of Iindia., conservation of biodiversity:	6
15-17.	Environmental pollution:- types of pollution, definition, cause, effects and control measures ofair, water, soil, marine, noise, thermal pollutions and nuclear hazards.	7
18.	Solid waste management: causes, effects and control measures of urban and industrial wastes.Role of an individual in prevention of pollution.	7
19-20.	Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways.	3
21-22.	Environmental ethics: climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	5

23-24.	Environment (Protection) Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.	08
25.	Human Population and the Environment: Population growth, variation among nations, population explosion. Environment and human health: Human Rights, Value Education.	04
26-27.	Natural disasters- meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves.	7
28.	Climatic change: global warming, Sea level rise, ozone depletion.	3
29-30.	Man made disasters:- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.	08
31-32.	Disaster management:-concept, effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. National disaster management framework; financial arrangements. Role of ngos, community –based organizations and media.central, state, district and local administration; armed forces in disaster response; police and other organizations.	03
Total:		**100**

Practical Exercise

Exercise No.	Title
1	Study of collection, processing and storage of effluent samples.
2	Estimation of solids in water samples.
3	Measurement the dissolved O_2 content in pond water by Winkler's method.
4	Estimation of respirable and non respirable dust in the air by using portable dust sampler.
5	Determination of sound level by using sound level meter.
6	Study of community structure.
7	Study of ponds / river/ hill slopes ecosystem-abiotic and biotic components.
8	Study of grass land and agro-ecosystem and measurement of their productivity.
9	Crop adaptation to different ecosystems. A. Hydrophytes
10	Crop adaptation to different ecosystems. B. Mesophytes
11	Crop adaptation to different ecosystems. C. Xerophytes
12	Crop adaptation to different ecosystems. D. Halophytes
13	Study and Visit of flora and Fauna.
14	Visit to local polluted site - urban / rural: observations and remedial control measures.
15	Visit to local polluted site - Industrial: observations and remedial control measures.
16	Collection, identification, herbarium, maintenance and study of plants grown in various ecosystems.

Text Book:

1 Bharucha E. 2004. Text book of Environmental Studies for undergraduate courses. University Grants Commission, New Delhi.
2 Sharma PD. 2009. Ecology and Environment. Rastogi Publication, Meerut.
3 Purohit SS, Shammi QJ and Agrawal AK. 2004. Environmental Sciences: A new approach. Student Edition, Agrobios, Jodhpur.
4 Prasanthrajan M and Mahendran PP. 2013. A Text Book on Ecology and Environmental Science. Agrotech Publishing Academy, Udaipur
5 The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad.
6 Singh S. 2010. Disaster Management Oxford Book Company.
7 Khannna. BK. and Khanna N.. 2015. Disasters: Strengthening Community Mitigation and Preparedness. New India Publication Agency.
8 Kaur A. 2015. Laboratory Manual of Ecology and Environmental Studies. Goel Pub. House.

Course No : **FT-111** Course Title : **Food Science and Processing**

Credits : **2(1+1)** Semester : **I**

Theory

UNIT I

Definition: Food and nutrition; Food production and consumption trends in India; Major deficiencies of calories, proteins, vitamins and micronutrients; Food groups and concept of balanced diet; RDA.

UNIT II

Causes of food spoilage; Principles of processing and preservation of food by heat, low temperature, drying and dehydration, chemicals and fermentation; Preservation through ultraviolet and ionizing radiations.

UNIT III

Post-harvest handling and technology of fruits, vegetables, cereals, oilseeds, milk, meat and poultry; Food safety, adulteration and food laws; Status of food industry in India.

Practical

Physical and chemical quality assessment of cereals, fruits, vegetables, egg, meat and poultry; Value added products from cereals, millets, fruits, vegetables, milk, egg and meat; Visit to local processing units.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
1	Definition: Food and Nutrition	4
2	Food production and consumption trends in India	4
3	Major deficiencies of calories, proteins, vitamins and micronutrients	10
4	Food groups	4
5	Concept of balanced diet and recommended dietary allowance	8
6	Causes of food spoilage	4
7	Principles of processing and preservation of food by heat	8
8	Preservation of food by low temperature, drying and dehydration, chemicals and fermentation	12
9	Preservation through ultraviolet and ionizing radiations	4
10	Post-harvest handling and technology of fruits, vegetables and oilseeds	10
11	Post-harvest handling and technology of cereals	4
12	Post-harvest handling and technology of milk	4
13	Post-harvest handling and technology of meat and poultry	8
14	Food safety	4
15	Food adulteration and food laws	8
16	Status of food industry in India	4
Total		**100**

Practical Exercise

Exercise No.	Title
1	Determination of physico-chemical composition of cereals and meat.
2	Quantative determination of proteins by Micro-kjeldhal method
3	Quantative determination of proteins by Lowry's method
4	Quantative determination of carbohydrates by Anthorne reagent
5	Quantative determination of cellulose of fruits and vegetables.
6	Determination of physiological loss in weight (PLW),
7	Determination of total soluble solids and acidity of fruits and vegetables
8	Microbial examination of cereal flour
9	Microbial examination of canned foods.
10	Estimation of microbial count of milk
11	Estimation of microbial count of meat and poultry
12	Preparation of value added products from milk
13	Preparation of value added products from fruits and vegetables
14	Production of vinegar from fruit juices by fermention
15	Production of wine from fruit juices.
16	Visit to local processing units.

Text Books

1. Potter NN & Hotchkiss JH. 1995. *Food Science.*Chapman and Hall Publishers.
2. Swaminathan M. 2005. *Handbook of Foods and Nutrition.* Ganesh and Co. Pvt. Ltd.
3. Swaminathan M. 1990. *Food Science, Chemistry and Experimental Foods.*BAPPCO.

Reference Books

1. Vaclavik VA & Christian EW. 2003. Essentials of Food Science, 2nd Ed. Kluwer Academic/ Plenum Publishers, New York.
2. Marwaha K. ed. 2015.Food Process Engineering: Theory and Laboratory Experiments. ISBN: 9788189729943
3. Battcock M. and Ali SA, 2016. Fermented Fruits and Vegetables: A global Perspective. ISBN: 9788170352488

Course No : **HD-111** Course Title : **Human Ethics**

Credits : **1(1+0)** Semester : **I**

Theory

UNIT I

Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender.

UNIT II

Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
1	**Universal human aspirations:** Happiness and prosperity	6
2	**Human values and ethics:** Concept, definition	6
3	**Human values and ethics:** Significance and sources	6
4	**Fundamental values:** Right conduct, peace, truth, love and non-violence	8
5	**Ethics:** professional, environmental	6
6	**Ethics:** ICT	8
7	**Sensitization** towards others particularly senior citizens, developmentally challenged and gender	8
8-9	**Spirituality**, positive attitude and scientific temper	8
10-11	**Team work** and volunteering, Rights and responsibilities	8
12	**Road safety**; Human relations and family harmony	8
13	**Modern challenges** and value conflict,Sensitizationagainst drug abuse and other social evils	6
14	Developing personal code of conduct **(SWOT Analysis)**	8
15	**Management** of anger	6
16	**Stress Management**	8
Total:		**100**

Text Books:

Gaur RR, Sangal R &Bagaria GP. 2011. A *Foundation Course in Human Values and Professional Ethics.* Excel Books.

Nagrajan R. S. 2006. *Professional Ethics and Human Values.*Text book.New Age International (P) Ltd Publishers.

Sharma RA. 2011. *Human Values and Education -Axiology, Inculcation and Research.*R. Lall Book Depot.

Sharma RP & Sharma M. 2011.*Value Education and Professional Ethics.*Kanishka Publishers.

Srivastava S. 2011. *Human Values and Professional Ethics*.S K Kataria& Sons.

Srivastava S. 2011. *Environmental Science*.S K Kataria& Sons.

Tripathi A.N. 2009.*Human Values.*New Age International (P) Ltd Publishers.

Reference Books:

Mathur SS. 2010. *Education for Values, Environment and Human Rights.*RSA International.

Encyclopedia of Ethics, 2nd ed. D. H. Hill Ref. BJ63 .E45 2001 3 vols.

Course No : **DEG-111** Course Title : **Democracy, Elections and Good Goverence**

Credits : **1(1+0)** Semester : **I**

Theory

Unit No. 1

Democracy – Introduction meaning, classification, Principles of Democracy, Dimensions of democracy, Democracy and Diversity Decentralization : concept, features,Fundamental Rights in the Indian Constitution, Outcomes of Democracy and Challenges of Democracy

Unit No. 2

Independent Election Commission in India powers of election commission in India,Elections to local self Government Bodies, National level, State level,Institutions at the local level Municipal Cooperation, Municipal Council Nagar Panchayat, ZillaParishad, PanchayatSamiti, Gram Panchayat : powers duties, Constitutional Provision of 73 & 74 constitutional Amendment Act and Important features of 73 & 74 Constitutional Amendment Act

Unit No. 3

Good Governance : Concept, meaning,Government & Good Governance, , Good Governance and India, Nature of G.G. in India,Attributes of Poor Goverance1 and Steps taken for Good Governance in India.

Teaching Schedule (Theory)

Lecture	Topic	Weightage (%)
1	Democracy – Introduction meaning, classification	4
2	Principles of Democracy, Dimensions of democracy	6
3	Democracy and Diversity Decentralization : concept, features,	6
4	Fundamental Rights in the Indian Constitution	10
5	Outcomes of Democracy, Challenges of Democracy	5
6	Independent Election Commission in India powers of election commission in India	8
7	Elections to local self-Government Bodies, National level, State level	8
8	Institutions at the local level Municipal Cooperation, Municipal Council Nagar Panchayat	8
9 & 10	ZillaParishad, PanchayatSamiti, Gram Panchayat : powers duties	10
11	Constitutional Provision of 73 & 74 constitutional Amendment Act	5

Lecture	Topic	Weightage (%)
12	Important features of 73 & 74 Constitutional Amendment Act	5
13	Good Governance : Concept, meaning	5
14	Government & Good Governance, , Good Governance and India, Nature of G.G. in India	5
15	Attributes of Poor Goverance1	5
16	Steps taken for Good Governance in India	10
	Total	**100**

Suggested Readings:

1) Development and Democrasy in India by Shailendra D Dharma, Publication : Publisher: Lynne Rienner, Boulder. Year: 2002

2) The Constitution of India, by P. M. Bakshi. Publication:Universal Law Publishing. Edn.: 14th, Year :2017

Course No	: **NSS-111**	Course Title	: **National Service Scheme I**
Credits	: **1(0+1)**	Semester	: **I**

Syllabus:

Introduction and basic components of NSS:

Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS, organizational structure of NSS, code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health

NSS programmes and activities

Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analysing guiding financial patterns of scheme, youth programme/ schemes of GOI, coordination with different agencies and maintenance of diary

Understanding youth

Definition, profile, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change

Community mobilisation

Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilisation 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 shramdan

Indian tradition of volunteerism, its need, importance, motivation and constraints; shramdan 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 rights to information

Family and society

Concept of family, community (PRIs and other community based organisations) and society

Practical Exercise

Exercise No.	Topic	Weightages (%)
1.	Introduction and basic components of NSS: Orientation: history, objectives, principles, symbol, badge; regular programmes under NSS, organizational structure of NSS,	7
2.	Code of conduct for NSS volunteers, points to be considered by NSS volunteers awareness about health	7
3.	NSS programmes and activities Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey,	7
4.	Analysing guiding financial patterns of scheme, youth programme/ schemes of GOI,	7
5.	Coordination with different agencies and maintenance of diary	6
6.	Understanding youth Definition, profile, profile, categories, issues and challenges of youth;	6

7.	Opportunities for youth who is agent of the social change	6
8.	Community mobilisation Mapping of community stakeholders, designing the message as per problems and their culture;	6
9.	Identifying methods of mobilisation involving youth-adult partnership	6
10.	Social harmony and national integration Indian history and culture,	6
11.	Role of youth in nation building, conflict resolution and peace-building	6
12.	Volunteerism and shramdan Indian tradition of volunteerism, its need, importance, motivation and constraints;	6
13.	Shramdan as part of volunteerism	6
14.	Citizenship, constitution and human rights Basic features of constitution of India, fundamental rights and duties,	6
15.	Human rights, consumer awareness and rights and rights to information	6
16.	Family and society Concept of family, community (PRIs and other community based organisations) and society	6
Total:		**100**

SEMESTER-II

Course No: **ZOO-121** Course Title: **Basic Zoology**

Credits: **3(2+1)** Semester : **II**

Theory

UNIT I

Introduction to Zoology; Structure and functions of cell and cell organelles; Difference between prokaryotic and eukaryotic cell; Cell division – mitosis and meiosis; Structure and function of biomolecules; Types of simple and compound tissues.

UNIT II

Binomial Nomenclature; Classification and general survey of animal kingdom; Functional organization of various systems of a mammal: digestive, circulatory, respiratory, excretory, nervous and reproductive; Laws of inheritance; Multipleallelism - blood groups; Genetic disorders in human and their inheritance.

Practical

Study of animal cell structure and cell division; Histological preparation of simple and compound tissues; General survey of animal kingdom up to phyla in invertebrates and up to classes in vertebrates; Demonstration of mammalian anatomy; Blood grouping.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
UNIT I		
1	Introduction to zoology	4
2-3	Animal cell: Structure and functions of Cell wall, plasma membrane, mitochondria, golgi apparatus, nucleus, lysosomes, ribosomes, endoplamic reticulum	8
4-5	Prokarotic Cell: Structure and functions of Cell wall, flagella, fimbriae, nucleoid, capsule, slime, mesosomes; Difference between prokaryotic and eukaryotic cell	8
6-7	Cell division-mitosis	8
8-9	Study of Meiosis-	8
10-11	Structure and function of proteins, carbohydrates, lipids, nucleic acid.	8
12-14	Study of simple epithelial tissue, connective tissue, muscular tissue and nervous tissue	8
UNIT II		
15-16	Binomial Nomenclature	4
17-18	Kingdom Animalia- Invertebrate, protozoa, porifera	4
19	Kingdom Annelida, Arthropoda, mollusca, echinodermata	4
20	Vertebrate-pisces, amphibian	3
21	Vertebrates- Reptiles, Aves, mammals	4
22-23	Functional organization of various systems of a mammal: digestive and circulatory system	5

24	Functional organization of various systems of a mammal: respiratory and excretory system	5
25-26	Functional organization of various systems of a mammal: nervous and reproductive system.	5
27-29	Laws of inheritance; Multiple allelism - blood groups; Study of Rh factor	8
30-32	Genetic disorders in human and their inheritance- Klinefelter syndrome, Downs syndrome etc.	6
Total		**100**

Practical Exercise

Exercise No.	Title
1-2	Study of animal cell structure
3-4	Study of animal cell division
5-6	Histological preparation of simple tissues
7-8	Histological preparation ofcompound tissues
9-10	General survey of animal kingdom up to phyla in invertebrates
11-12	General survey of animal kingdom up to classes in vertebrates
13-14	Demonstration of mammalian anatomy
15-16	Study of Blood grouping

Text Books:

1. Bhatia KN & Tyagi MP. 2012. *Trueman's Elementary Biology*. 24th ed. Trueman Book Company.
2. Dhami PS & Mahindru RC. 1996. *A Text Book of Biology for 10+2*.Pradeep Publications.

Course No : **MATH-122** Course Title **: Basic Mathematics**
Credits : **3(3+0)** Semester **: II**

Theory:

UNIT I

Functions, Types of functions, Limit: Introduction, left handed and right handed limits, general rules for calculation of limits Standard limits(Without proof) $\underset{x\to a}{Lt}\frac{x^n-a^n}{x-a}$, $\underset{x\to 0}{Lt}\frac{\sin x}{x}$, $\underset{x\to 0}{Lt}(1+x)^{\frac{1}{x}}$, $\underset{x\to 0}{Lt}\frac{a^x-1}{x}$, $\underset{x\to 0}{Lt}\frac{\log(1+x)}{x}$. Continuity: Definition of continuity, continuity of algebraic functions, Continuity of trigonometric and exponential functions.

UNIT II

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

UNIT III

Integration: Integration by substitution, integration by partial fractions, integration by parts.

UNIT IV

Matrices and Determinants: Definition of matrix, types of matrices, addition, subtraction and multiplication, inverse of matrix; Solution of linear equations: By Crammer's rule.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
Functions; Limit &Continuity:		
1	Definition of Functions, Types of functions, Limit Introduction	30
2	Left handed and right handed limits, General rules for calculation of limits	
3	**Standard limits of following types (Without proof) with examples**	
4& 5	$\underset{x\to a}{Lt}\frac{x^n-a^n}{x-a}$	
6	$\underset{x\to 0}{Lt}\frac{\sin x}{x}$	
7 & 8	$\underset{x\to 0}{Lt}(1+x)^{\frac{1}{x}}$	
9 & 10	$\underset{x\to 0}{Lt}\frac{a^x-1}{x}$	
11& 12	$\underset{x\to 0}{Lt}\frac{\log(1+x)}{x}$	
13	Definition of continuity, continuity of algebraic functions	
14	Continuity of trigonometricfunctions	
15	Continuity of exponential functions	
Differentiation:		
16 & 17	Definition of Differentiation, Differentiation by first principle	30

18	Differentiation using sum and difference formulae	
19 &20	Differentiation using product formula	
21	Differentiation using quotient formula	
22 &23	Differentiation using chain rule	
24	Differentiation of functions in parametric form	
25	Differentiation of functions in implicit form	
26 & 27	Logarithmic differentiation	
28	Successive differentiation	
29	Introduction to Maximum and Minimum values of a function on its domain, Local Maxima and minima	
30 & 31	Examples on maximum and minimum values of the function by first derivative and second derivative test	
32 & 33	Applied problems on Maxima and Minima	
Integration:		
34, 35	Definition of Integration of a function, fundamental Integral formulae, theorems on integration (without proof)	20
36, 37	Integration by substitution method	
38, 39	Integration by partial fractions	
40, 41	Integration by parts	
Matrices and Determinants;		
42	Definition of matrix, Types of Matrices	20
43	Addition and Subtraction of Matrices	
44, 45	Multiplication of Matrices	
46, 47	Inverse of matrix by Adjoint method	
48	Solution of linear equation by crammer's rule	
	Total:	**100**

Text Books

1) NCERT 2012. *Mathematics of Class XII.* NCERT India
2) A Text Book of Mathematics, 12th Part-I and Part-II-Maharashtra State Board of Secondary and Higher secondary Education-Pune.

Reference Book

1) Sharma RD. 2014. *Mathematics of Class XII.* Dhanpat Rai Publisher

Course No : **BT-124** Course Title : **Plant Tissue Culture**

Credits : **3(2+1)** Semester : **II**

Theory

UNIT I

History of plant tissue culture; concept of totipotency; Concept of aseptic culture practices; Components of *in vitro* culture media and role of different macro and micro nutrients, vitamins, plant growth regulators and growth supplements; Sterilization techniques.

UNIT II

Various plant cell, tissue and organ culture techniques and uses; Somatic cell cultures; morphogenesis: organogenesis and somatic embryogenesis; Micropropagation: *In vitro* grafting, meristem culture; Anther, pollen, embryo, ovule, ovary culture; Protoplast culture and somatic hybridization; Somaclonal variation.

Practical

Good laboratory practices;Media preparation and sterilization; Surface sterilization of explants; Establishment of callus/cell suspension cultures; Micropropagation; Embryo culture; Anther and pollen culture; Induction of plant regeneration; Hardening and transfer to soil.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
1	**History of plant tissue culture:** Concept of *in vitro* culture and micro-propagation,	06
2	Historical milestones.	
3	**Concept of totipotency:** Defination, expression and importance of totipotency in plant science.	10
4	Vascular Differentiation, Organogenic Differentiation,	
5	Totipotency of Epidermal Cells, Totipotency of Crown –gall Cells.	
6-7	**Concept of aseptic culture practices:** Need and importance of asepsis in plant tissue culture.	04
8	**Components of *in vitro* culture media**: Media Constituents, growth hormones, Gelling agent, pH of Media.	10
9	Different media used in plant tissue culture.	
10	**Role of different macro, micro nutrients and vitamins.**	
11, 12, 13	**Plant growth regulators and growth supplements:** Auxins, Cytokinins and Gibbrellins: Their role and ratio required in various stages of tissue culture.	10
14	**Sterilization techniques:** Dry heat sterilization, Steam sterilization, flame sterilization,	08
15	Surface sterilization, and filter sterilization etc.	
16	Different instruments used for sterilization.	
17	Various plant cell, tissue and organ culture techniques and uses. Somatic cell cultures:	04

18	**Morphogenesis organogenesis:** Organogenic differentiation, concept of dedifferentiation and re-differentiation of cells.	10
19	Pathways of organogenesis.	
20	**Somatic embryogenesis:** Pathways for somatic embryogenesis. Steps involved in somatic embryogenesis,	
21-22	**Micropropagation**: Concept of explant and steps of micro-propagation.	10
23	Commercial application of micropropagation.	
24	***In vitro* grafting** for production of virus free seedlings. **Meristem culture** for production of disease free seedlings.	
25	**Anther, pollen culture:** Technique of androgenesis,	14
26	Factors influencing anther culture, application to plant breeding.	
27	**Embryo Culture:** Culture of mature and immature embryos. Role of suspensor in embryo culture, Applications of embryo culture.	
28	**Ovule, ovary culture:** Ovule and ovary culture, In vitro pollination and its applications.	
29	**Protoplast culture and somatic hybridization**: Methods of isolation of protoplast, Sources of protoplast. Protoplast culture and regeneration.	8
30	Protoplast Fusion: Types of protoplast fusion. Selection of somatic hybrids and cybrids	
31	**Somaclonal variation:** Concept of somaclonal variation. Molecular basis of variation.	6
32	Applications of somaclonal variation in Plant Breeding.	
	Total:	**100**

Practical Exercise

Exercise No.	Title
1-2	Good laboratory practices
3-4	Media preparation and sterilization
5-6	Surface sterilization of explants
7-8	Establishment of callus/cell suspension cultures
9-10	Micropropagation
11-12	Embryo culture; Anther and pollen culture
13-14	Induction of plant regeneration
15-16	Hardening and transfer to soil

Text Books:

1. Bhojwani SS & Razdan MK. 1996. *Plant Tissue Culture: Theory and Practice*.Elsevier.
2. Bhojwani SS & Dantu PK. 2013. *Plant Tissue Culture: An Introductory Text*. Springer.
3. De K.. Plant Tissue Culture
4. Chawla HS. Introduction to Plant Biotechnology.

Reference Books:

1. Dixon RA & Gonzales RA. 2003. *Plant Cell Culture: A Practical Approach*. Oxford University press.
2. Helgason CD & Miller CL. 2005. *Basic Cell Culture Protocols*.3rd Ed. Humana Press.

Course No : **BT-125** Course Title : **Molecular Biology**

Credits : **3(2+1)** Semester : **II**

Theory

UNIT I

History of molecular biology; Central dogma of life; Structure of DNA and RNA; Gene structure and function; DNA replication; transcription; Genetic code and translation; Structure of prokaryotic and eukaryotic nuclear and organelle genomes; Gene regulation in prokaryotes: Lac operon concept, tryp concept.

UNIT II

Introduction to microbial genetics; conjugation, transformation and transduction; Tools in molecular biology: Role of enzymes in molecular biology; Principles of Polymerase Chain Reaction; Electrophoresis; PCR and hybridization based molecular markers.

Practical

Preparation of bacterial competent cells and transformation; Isolation and purification of plant and animal DNA; Measurement of nucleic acid concentration using spectrophotometer and gel electrophoresis; DNA amplification using RAPD, microsatellite primers and analysis; CAPS primers; Generation of linkage maps and mapping of qualitative genesgenes for Quantitative traits; Estimation of genetic similarities and generation of dendrograms.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
	UNIT I	
1	**History of molecular biology:** Concept, Historical evidences and prospects	4
2-3	**Central Dogma of Life:**Concept,direct evidences for DNA as the genetic material- the transformation experiments, identification of the "transforming" principle or substance, bacterial conjugation ; indirect evidences for DNA as the genetic material ; evidences for RNA as the genetic material.	5
4-5	**Structure of DNA and RNA:**History, DNA and RNA:Structure, types and function of nucleic acids (DNA & RNA), molar ratios of nitrogen bases, the equivalence rule, physical, molecular or geometrical organization of DNA, Watson and Crick's model of DNA, ploymorphism of DNA helix (or alternative forms of DNA double helices),	5
6-7	**Gene structure and function:** Gene: gene concept, unit of function, replication, recombination and mutation Fine structure of gene: bar locus, complex loci, rII locus and complementation analysis Gene function: one gene/one enzyme hypothesis, pathways of gene action.	5
8-10	**DNA Replication:** Outline of DNA replication, Crick's model for DNA replication, experimental evidence for semiconservative DNA replication in *E.coli*, Meselson and Stahl's experiment semi discontinuous replication, unidirectional and bidirectional DNA	8

	replication, enzymes of DNA metabolism, roles of RNA primers in DNA replication, mechanism of DNA replication in prokaryotes; DNA replication in eukaryotes, model's of DNA Replication, repair replication, Functions of DNA.	
11-12	**Transcription:** Protein Synthesis: Prokaryotic transcription, eukaryotic transcription, RNA polymerases, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, 5' Cap formation, Transcription termination, 3'end processing and polyadenylation, nuclear export of mRNA, mRNA stability RNA splicing: Nuclear splicing, spliceosome and small nuclear RNAs, group I and group II introns, *Cis*- and *Trans*- splicing reactions, tRNA splicing, alternate splicing.	8
13-15	**Genetic code and translation:** Amino acids involved in protein synthesis**,** characteristics of genetic code viz; triplet code, non-overlapping, commaless, polarity, codons and anticodons, initiation codons, termination codons, degenerate and universal, wobble hypothesistranslation, stages of polypeptide synthesis in eukaryotes, rate of protein synthesis, signal hypothesis, prokaryote and eukaryote protein synthesis, modification of released protein; antibiotics and protein synthesis.	8
16-18	**Prokaryote and Eukaryote nuclear and organelle genomes :**Genomeorganization: Genome organization in prokaryotes and eukaryotes special features of eukaryotic gene structure and organization, genome organization of mitochondria and chloroplast. Genome Anatomies; Overview of Genome Anatomies, Genomes of eukaryotes, Genomes of prokaryotes, the anatomy of the eukaryotic genome, Eukaryotic nuclear genomes, Eukaryotic organelle genomes their origin and genetic content, The Anatomy of the Prokaryotic Genome, physical structure of the prokaryotic genome, genetic organization of the prokaryotic genome	7
19-21	**Gene Regulation in Prokaryotes**: Regulation of gene expression: Induction and repression, operon theory, lac operon, trp operon, attenuation, ara operon, positive and negative control, catabolite repression, regulation of transcription by cAMP and CRP, and guanosine tetraphosphate, *Run off* transcription. Britten-Davidson and Mated models of gene regulation, regulation of gene expression in eukaryotes.,	12
UNIT II		
22-23	**Introduction to microbial genetics:** Scope and development of microbial genetics, Recombination in bacteria and viruses, Transformation: Competence factors,mechanism of transformation, Conjugation: Structure of F plasmid, Mechanism of transfer of F plasmid, Hfr, mechanism of integration of F plasmid into bacterial chromosome, circularization of chromosome, Transduction & Gene mapping, Transformation techniques Transduction-generalised and specialized transduction DNA transfer by transducing phages-transducing phages as cloning vectors.	6
24-26	**Tools in molecular biology:** **Role of enzymes in molecular biology:** Restriction endonucleases: Types and characteristics of restriction endonucleases and their uses.	10

	Restriction mapping, restriction pattern, DNA modifying enzymes, host, cloning vectors- Plasmid, Bacteriophage, other vectors,expression vectors, Construction of genomic and c-DNA libraries, cloning, Homo polymer tailing, cohesive and blunt end ligation, adaptors, linkers.	
27-28	**Principles of PCR:** Concept and components of PCR, procedure of PCR, variants of PCR, applications of PCR	8
29-30	**Principles of electrophoresis:** Principles and types of electrophoresis, viz;SDS-PAGE, Agarose Electrophoresis, procedure of electrophoresis2D Electrophoresis,	6
31-32	**PCR and Hybridization based markers:** Introduction to molecular markers, characteristic, types of molecular markers, RFLP; PCR based markers-RAPD, ISSR, AFLP, SSR, SNP, VNTR, ESTs, SCAR, CAPS advantages and applications of molecular markers etc.	8
	Total:	**100**

Practical Exercise

Exercise No.	Title
1-2	Preparation of bacterial competent Cell
3-4	Study of bacterial transformation
5-6	Isolation and purification of Plant DNA
7-8	Isolation and purification of Animal DNA
09	Study on measurement of Nucleic Acid & Concentration using spectrophotometer& Gel electrophoresis
10	Study of DNA amplification using RAPD Primers
11	Designing of Microsatellite primers designing & analysis
12	Analysis of CAPS markers
13	Construction of linkage Map
14	QTL mapping
15	Estimation of genetic similarities
16	Generation of dendrograms & its analysis

Suggested Readings:

Text Book:

1. Allison LA. 2011. *Fundamental Molecular Biology*. Wiley Global Education.
2. Carson S, Miller HB & Witherow DS. 2012. *Molecular Biology Techniques A Classroom Laboratory manual*. Elsevier.
3. Kreuzer H & Massey A. 2008.*Molecular Biology and Biotechnology: A Guide for Teachers*. ASM Press.
4. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A & Scott MP. 2012. *Molecular Cell Biology*. W. H. Freeman.

Reference Books:

1. Sambrook J & Russel D. 2001. *Molecular Cloning: A Laboratory Manual*. 3rd Ed Cold Spring Harbor Laboratory Press.
2. Surzycki S. 2000. *Basic Techniques in Molecular Biology*. Springer Berlin Heidelberg
3. Voet D, Voet JG & Pratt CM. 2004.*Fundamentals of Biochemistry*.2nd Ed. Wiley New York.
4. Walker JM & Rapley R. 2000.*Molecular Biology and Biotechnology*.4th Ed.The Royal Society of Chemistry.
5. Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*.6th Ed. Pearson Education International.

Course No **: BOT-ZOO-121** Course Title **: Biodiversity & its Conservation**

Credits **: 2(2+0)** Semester : **II**

Theory

UNIT I

Concepts of biodiversity, bioresource and wildlife management, conservation strategies: *in situ* and *ex situ* conservation; Wild life conservation projects in India; Protection of biodiversity for its suitable utilization; Threats to biodiversity; WCU Red data book; Biodiversity hotspots in India; National bureaus of genetic resources.

UNIT II

Sustainable development; Diversification of cropping system; Diversity of indigenous livestock; Vulnerability and extinction of flora and fauna; Endangered species in various ecosystems; Germplasm banks; Environmental impact assessment; Bioremediation and biosafety; Introduction to regulatory agencies and legislation.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (%)
	UNIT I	
1-2	**Concepts of biodiversity:** Meaning and concept, Example with importance.	2
3	**Bioresource and wildlife management:** Meaning expression and importance of Bioresources in Nature.-Genetic resources -Plant and animal biotechnology -GMO -Agriculture -Water technology/waste treatment -Bioresources in ecosystems (ecosystem services) - carbon cycles - pollinators & dispersal agents.	5
4	**Wildlife management**: Defination and types of wild life management.	4
5	**Conservation strategies: in situ and ex situ conservation:** Meaning, concept and example with importance and introduction, role in biodiversity conservation	5
6	**Wild life conservation projects in India:** Tiger Project,	2
7	Wild life conservation society WCS etc.	2
8	**Protection of biodiversity for its suitable utilization;** Conservation: Protection and restoration techniques,	2
9	Protected areas, National parks, Wildlife sanctuary,	3
10	Forest reserves, Steps to conserve the forest cover, Zoological parks, Botanical gardens	3
11	**Threats to biodiversity;** Habitat Loss and Sustainability.	2
12	Overharvesting. Exotic Species.	2
13	Climate Change and Biodiversity	2
14	**WCU Red data book:** Purpose,	2
15	Eight categories of species by RDB.	3

16	Eight categories of species by RDB.	3
17	**Biodiversity hotspots in India;** Meaning and concept and example with importance (Western Ghats, Eastern Himalayas).	3
18	**National bureaus of genetic resources:** Establishment , Research Network and activities of NBPGR, NBAGR, NBAIM, NBFGR, NBAII.	3
UNIT II		
19	**Sustainable development:** Meaning, Objectives-Economic development/ growth, social progress, environmental conservation and protection, Social progress.	5
20	**Diversification of cropping system:** Meaning and concept and importance.	4
21	**Diversity of indigenous livestock;** Meaning and importance of Livestock husbandry. Diversity of livestock.	5
22	**Vulnerability and extinction of flora and fauna;** Meaning and examples.	3
23	Concept of vulnerability	3
24	Importance of vulnerability of flora and fauna.	4
25-26	**Endangered species in various ecosystems;** Meaning and concept, example with importance	7
27-28	**Germplasm banks;** Meaning and concept, example with importance	7
29-30	**Environmental impact assessment;**Principles of Assessment, Meaning and concept, Methods Around the world and Trans-boundary application.	6
31	**Bioremediation and bio-safety;** Concept and meaning, introductory part of Bioremediation and bio-safety.	4
32	**Introduction to regulatory agencies and legislation:** policies and practices andRole of regulatory agencies and legislation	4
	Total:	**100**

Text Books

1. Das M.K & Choudhury B.P. 2008. *A Text book on Plant Nomenclature and Biodiversity Conservation.* Kalyani Publishers.

Reference Books

1 Hopsetti BB. & Venketashwarlaru M. 2001. *Trends in Wild Life Conservation and Management.*Vol. 2, Daya Publishing House, New Delhi.

2 Singh MP & Singh BS. 2002. *Plant Biodiversity and Taxonomy.* Daya Publishing House, New Delhi.

Course No **: HORT-121** Course Title : **Production Technologies forHorticultural Crops**

Credits **: 3(2+1)** Semester : **II**

Theory

UNIT I

Importance and scope of fruit cultivation; Classification of fruit crops; Climatic requirement; Selection of site; Fencing and wind break; Lay out and planting systems; Sexual and asexual methods of plant propagation; Production technology of important tropical, sub tropical and temperate fruit crops.

UNIT II

Importance of vegetable cultivation for nutritional security; Production technology of important vegetable crops: potato, brinjal, tomato, chilli, onion, okra, cabbage, cauliflower, musk melon, water melon, cucumber and leafy vegetables.

UNIT III

Status and scope of floriculture in India and abroad; Production technology of commercial flower crops: Rose, chrysanthemum, gladiolus, marigold, gerbera, carnation, lilium, jasmine, anthurium and orchids.

Practical

Identification of different fruit, vegetables, ornamental and flower crops; Lay out and planning for planting orchards; Preparation of seed beds; Raising of seeds, rootstocks, and propagation techniques of major fruit, vegetable and flower crops; Visit to commercial nurseries and orchards.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (%)
	UNIT I	
1	Definition and meaning of horticulture, Importance and scope of fruit cultivation.	3
2	Branches of horticulture	3
3	Classification of fruit crops, vegetables and flowers;	3
4	Climatic zones of Maharashtra and India in relation to horticultural crops.	3
5	Selection of site; Fencing and wind break;	3
6	Lay out and planting systems of horticultural crops;	3
7	Sexual and asexual methods of plant propagation; Its advantages and disadvantages.	3
8	Asexual propagation: Cutting, layering, grafting, budding, etc	4
9	Production technology of important fruit crops-Mango.	3
10	Banana, Guava	4
11	Pomegranate, Sapota	4
12	Grape	3
13	Citrus spp.	4
14	Ber, Fig	3
15	Aonla, Papaya	3

16	Coconut, Cashewnut	3
17	Arecanut, Jackfruit	3
	UNIT II	
18	Importance of vegetable cultivation for nutritional security	3
19	Production technology of important vegetable crops: potato, brinjal,	4
20	Tomato, Chilli,	4
21	Onion, Okra	3
22	Cabbage, cauliflower.	3
23	Musk melon, water melon, cucumber.	4
24	Leafy vegetables.	3
	UNIT III	
25	Status and scope of floriculture in India and abroad;	3
26	Production technology of commercial flower crops: Chrysanthemum, Rose	4
27	Gladiolus, Marigold	3
28	Gerbera, carnation.	3
29	Lilium, jasmine,	2
30	Anthurium, orchids	2
31	Major pests of horticultural crops and their control	2
32	Major diseases of horticultural crops and their control	2
	Total	**100**

Practical Exercise

Exercise No.	Title
1-2	Identification of different fruit and vegetables.
2	Identification of differentornamental and flower crops.
3-4	Lay out and planning for planting orchards.
5-6	Preparation of seed beds.
7-8	Raising of seeds of horticultural crops
9-10	Raising of rootstocks
11-12	Propagation techniques of major fruit crops
13-14	Propagation techniques of major vegetable and flower crops
15-16	Visit to commercial nurseries and orchards.

Suggested Readings

Arora JS. 2013. Introductory Ornamental Horticulture. Kalyani Publishers.

Bal JS. 2013. Fruit Growing. Kalyani Publishers.

Chadha KL. 2012. Handbook of Horticulture. ICAR, New Delhi

Dhaliwal MS. 2014. Handbook of Vegetable Crops. Kalyani Publishers

Course No **: AS-121** Course Title : **Anatomy and Physiology of Livestock**

Credits : **3(3+0)** Semester : **II**

Theory

UNIT I

Definition of terms used in Ceterinary Anatomy, topography, contour, landmarks and functional anatomy of various organs in cow, buffalo, sheep and goat structural and functional classification of muscles.

UNIT II

Structure of animal cell and tissues: study of microscopic structure of organs from digestive, urinary, respiratory, reproductive, nervous, cardiovascular and endocrine systems; Gametogenesis, fertilization, cleavage, gastrulation and the development of fetal membranes in livestock, structure and types of mammalian placenta; Development of the organs of digestive, urogenital, cardiovascular, nervous and endocrine glands.

UNIT III

Introduction to blood physiology; Genetic and endocrine control of reproductive system; maternal recognition of pregnancy; Introduction to physiology of mammary glands: structure and development, hormonal control of mammary growth, lactogenesis and lactation cycle.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightage (%)
1	**Definition of terms used in Veterinary Anatomy, Topography, Contour, Landmarks:-** Introduction, Anatomical organization, Musculoskeletal system, Gastrointestinal tract, Reproductive system, Cardiovascular system,	03
2-3	Respiratory tract, Hematology, Immunology, Endocrine system, Integumentary system, Nervous system, Eyes and Ears, Urinary system, Horse, Ruminants, Swine, exotics, Lab. Animals	03
4	**Functional anatomy of various organs in cow, buffalo, sheep and goat:** Study of anatomy of various organs	04
5-6	**Structural and functional classification of muscles:** Skeletal, Cardiac, Smooth. Classification of muscle according to shape and fascicular architecture	04
7	**Structure of animal cell:** -Animal Cells- Light Microscope -Animal Cells-Electron Microscope -All cell organelles of animal cell	03
8	**Types of tissues:** Epithelial, Connective/Supporting (Including blood), Muscular and Nervous	03
9-10	**Study of microscopic structure of organs of Digestive systems of animals:** Mouth, Tongue, Pharynx, Esophagus, Stomach : Simple and Ruminant stomachs, Small intestine, Large intestine, Anus, Liver,	04

	Pancreas, gall bladder,	
11	**Study of microscopic structure of organs of Urinary system:** Kidneys, Ureters, Bladder, Urethra	04
12	**Study of microscopic structure of organs from Respiratory: Nose,** Nasal cavity, Nostrils, Pharynx, Larynx, Trachea, Lungs,	04
13-14	**Study of microscopic structure of organs from Reproductive:** Functions of the reproductive system, Parts of the reproductive system: a. Female animals b. Male animals , Production of offspring,	04
15-16	**Study of microscopic structure of organs from Nervous:** The central and peripheral nervous system.	03
17-19	**Study of microscopic structure of organs from Cardiovascular:** Heart, Arteries, Veins Capillaries	03
20-21	**Study of microscopic structure of organs from Endocrine systems:** •Hormones and functions (Steroids, Peptides, Amines) •Lipids •Steroid hormones (Progesterone and Testosterone) •Peptides and hormones (Oxytocin, LH, Thyrotropin,)	03
22-25	•Amines [epinephrine, norepinephrine, T3 (triiodothyroxin), and T4 (tetraiodothyroxin)] •Hypothalamus gland •Pituitary gland •Thyroid gland •Parathyroid gland •Adrenal glands.	03
26-28	**Gametogenesis** Process of producing gametes, Spermatogenesis, Oogenesis, Meiotic cell division, Packaging of material into oocytes, Removal of cytoplasm from sperm	06
29-32	**Fertilization: 4 major steps:**	12
33-34	**Structure and types of mammalian placenta:-**	03
35-36	**Development of the organs of Digestive:** **The embryology of digestive system and the body cavities**	04
37	**The embryology of Urogenital system**	04
38	**The embryology of Cardiovascular System**	04
39-40	**The embryology of Nervous system**	04
41-42	**Introduction to blood physiology:** Blood composition and properties, Blood cells: Hematopoiesis, RBC: function, anemia, WBC, Platelet: function, coagulation and fibrinolysis. Blood grouping and transfusion	02
43	**Genetic and endocrine control of reproductive system:** **Genetic-** Animal cell, Cell division, Fertilization, chromosome, genes **Endocrine control of reproductive system-** Chemical signaling, Hormone from a neurosecretary cell, Antagonistic hormones and homeostatis, Feedback control loops regulating the secretion of thyroid hormones, Homeostasis	02
44	**Maternal recognition of pregnancy:** Luteal Regression, CL Status - Recognition of Pregnancy (Conceptus Secretions • Proteins • Steroids) -Recognition of Pregnancy in Bovine and Ovine (Mechanism • Antiluteolytic • Inhibit oxytocin receptor synthesis • Inhibit PGF2α synthesis)- Recognition of Pregnancy in the Porcine - Recognition of Pregnancy in the Mare	03
45	**Introduction to physiology of mammary glands:** Introduction, Lymph nodes, Adipose tissue, Areola, Nipple, Milk flow, Mammary gland development, Endocrine control, Factors affecting secretion	03

46-48	**Structure and development of mammary growth:** Mammary gland anatomy (4 glands, 2 halves, Fore and rear quarters of each half, 7 tissue of udder, teat, gland cistern, ducts), Secretary tissue, Lobes and lobules, Grandular tissue, Connective tissue/Stroma, Skin, Ligaments, Blood, Nerves. **Developmentof mammary growth:-**Rudimentary duct system-Ductal elongation/Bifurgation-Sidebranching-Alveologenesis/Lactogenic differentiation. **Hormonal control of mammary growth:**Estrogen (Puberty), Progesterone (Adulthood estrous cycle), Prolactin (Pregnancy, Lactation). **Lactogenesis:** Lactogenesis I, Lactogenesis II, Lactogenesis III,Lactogenesis IV **Lactation cycle:** Definition, Early lactation, Mid lactation, Late lactation, Dry period.	05
	Total:	**100**

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Suggested Readings:

Text Books:

1. Dyce K, Sack W & Wensing CJG. 2009. Textbook of Veterinary Anatomy, 4th Edition. Elsevier Health Sciences.
2. Frandson RD, Wilke WL & Fails AD. 2009. Anatomy and Physiology of Farm Animals. 7th Edition.Wiley–Blackwell.

Reference Books:

Reece WO. 2004. Duke's Physiology of Domestic Animals. 12th Edition.Comstock Publishing Associates.

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Course No : **MICRO-121** Course Title : **Microbiology**
Credits : **3(2+1)** Semester : **II**

Theory

UNIT I

History of Microbiology-its applied areas; Microorganisms and their role in fermentation; Germ theory of diseases and protection; Introduction to eukaryotic and prokaryotic cell; Major groups of eukaryotes- fungi, algae and protozoa; Major groups of prokaryotes – Actinomycetes, Cyanobacteria, Archaebacteria, Rickettsias and Chlamydia; Preservation of microorganisms; Microbial repositories at national and international level.

UNIT II

Bacterial growth; Metabolism in bacteria- ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation; Viruses: Bacteriophages - structure and properties, lytic and lysogenic cycles; viriods, prions.

UNIT III

Microbial groups in soil; Microbes in biotic and abiotic stressed environments; Microbial transformation of carbon, nitrogen and sulphur; Biological nitrogen fixation; Beneficial microorganisms in agriculture-biofertilizers, microbial pesticides; Plant microbe interaction; Microbes in composting and biodegradation; Microbiology of water and food.

Practical

Microscope and other instruments in a microbiological laboratory; Media preparation, sterilization and aseptic methods for isolation, identification, preservation and storage; Identification of bacteria by staining methods; Enumeration of bacteria by pour plate and spread plate methods; Micrometery.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
	UNIT I	
1-2	**History of Microbiology-its applied areas:** The microscope, spontaneous generation versus biogenesis, Fermentation, The germ theory of disease, Laboratory techniques and pure cultures, Protection against infection: Immunity, Widening horizons, Microbiology and society.	5
3	Microorganisms and their role in fermentation	5
4-5	**Germ theory of diseases and protection:** Germ theory of diseases, Laboratory techniques and pure cultures, Protection against infection: Immunity.	5
6-7	**Introduction to eukaryotic and prokaryotic cell:** Introduction, Organelle details and their functions in eukaryotic and prokaryotic	10
8-10	**Major groups of eukaryotes** **Fungi:** The importance of fungi, Distinguishing characteristics of fungi, Morphology, Reproduction, Physiology, Cultivation, Classification, Some	10

	fungi of special interest, Moulds and Association with other organisms **Algae:** Occurrence, The biological and economic importance, Characteristics, Classification, Lichens **Protozoa:**Occurrence, Ecology, Importance, Morphology, Reproduction, Classification, Characteristics of some major groups of protozoa.	
11-13	**Major groups of prokaryotes** **Actinomycetes:** Morphology, Occurrence **Cyanobacteria:** Occurrence, Characteristics, Importance **Archaebacteria:** Morphology, Characteristics, Categories (methanogens, halophiles and thermoacidophiles) **Rickettsias:** Morphology, Characteristics, Diseases caused by rickettsias **Chlamydia:** Characteristics, Diseases caused by Chlamydia Mycoplasma: Morphology, Characteristics, Diseases caused by Mycoplasma	10
14-15	**Preservation of microorganisms:**1)**Agar Slant Culture**2) **Agar Slant Culture Covered with Mineral Oil 3) Storage in Saline Suspension 4) Preservation by Drying in Vacuum 5) Cryo-preservation 6) Lyophilisation or Freeze-drying** **Microbial repositories at national and international level:** National- NCCS Pune, MTCC Chandigarh, NBAIM New Delhi, NCIM NCL Pune, International- NCTC England, ATCC America, BCCM/LMG Russia,	5
UNIT II		
16-18	**Bacterial growth:** normal growth cycle (growth curve) of bacteria, transitional periods between growth phases, synchronous growth, continuous culture **Metabolism in bacteria-** ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation **Viruses:** Bacteriophages - structure and properties, lytic and lysogenic cycles;viriods, prions.	10
UNIT III		
19-22	**Microbial groups in soil:** Bacteria, Fungi, Algae, Protozoa, Viruses, The Rhizosphere **Microbes in biotic and abiotic stressed environments: Microbial transformation of carbon:**Carbon dioxide fixation, organic carbon compound degradation, Microorganisms involved in carbon cycle **Microbial transformation of nitrogen:** Proteolysis, Ammonification, Nitrification, Reduction of nitrate to ammonia, Denitrification **Microbial transformation of sulphur:** sulphur cycle showing the role of microorganisms	10
23-24	**Biological nitrogen fixation:**Microorganisms involved in symbiotic nitrogen fixation, Mechanisms, Significance	5
25-27	**Beneficial microorganisms in agriculture** **Biofertilizers:**Definition, Microorganisms – Bacteria (*Rhizobium spp., Azospirillum, Azotobacter),* Fungi (Mycorrhizae*Glomus*), Blue green algae or Cyanobacteria(*Anabaena, Nostac*) and *Azolla*. Advantages and limitations of biofertilizers. **Microbial pesticides:** Definition,Biocontrol agents used against insect (viruses, bacteria, fungi, protozoa, mites), Weed (*Phytophthora, Palmivora, Colletotrichumgleospirodes*), disease (fungi, bacteria). Advantages and limitations of biopesticides.	10

28-30	**Plant microbe interaction:** **Microbes in composting and biodegradation:**	5
31-32	**Microbiology of water:** Water purification, Determining sanitary quality, Waste water, Microorganisms and waste water treatment procedures. **Food:** Microbial flora of fresh foods, Microbial spoilage of foods, Microbiological examination of foods, Preservation of foods, Fermented foods, Microorganisms as a food- single cell proteins.	10
Total:		**100**

Practical Exercise

Exercise No.	Title
1	Microscope and other instruments in a microbiological laboratory.
2	Micrometery.
3	Methods of sterilization
4	Nutritional media and their preparation,
5	Methods of isolation and purification of microbial culture
6	Preservation and storage of Microorganisms
7	Identification of bacteria by staining methods. Simple staining
8	Identification of bacteria by Gram staining
9	Identification of bacteria by flagella staining
10	Identification of bacteria by spore staining
11	Enumeration of bacteria by pour plate and spread plate methods.
12	Isolation of Rhizobium fromlegume root nodule
13	Isolation of Azotobacter from soil
14	Isolation of P and silica solubilizing microbes
15	Isolation of microorganisms from soil, food and drainage water.
16	Isolation of *E.coli* from milk

Reference Book:

1. Brock TD. 1961. *Milestones in Microbiology.*Infinity Books.
2. Pelczar M.J, Chan E.C.S & Kreig N.R. 1997.*Microbiology: Concepts and Application.*Tata McGraw Hill.
3. Stainier RY, Ingraham J.L, Wheelis M.L & Painter P.R. 2003. *General Microbiology.* MacMillan.
4. Tauro P, Kapoor K.K.& Yadav K.S. 1996. *Introduction to Microbiology.*Wiley Eastern.
5. Prescott, L.M. Harley, J.P. and Klein, D.A (5ed) 2002. *Microbiology*. Mc Graw Hill Publishers, Newyork.
6. Jamaluddin, M. Malvidya, N. and Sharma, A. 2006. *General Microbiology*. Scientific Publishers, Washington.
7. Sullia, S.B, and Shantaram 1998. *General Microbiology.* Oxford and IBH.
8. Madigan, M. Martinkoj, M. and Parker (10 ed.) 2003. *Biology of Microorganisms*. PrenticeHall of India Pvt. Ltd., New Delhi.
9. Borkar,S.G. 2015.Beneficial Microbes as Biofertilizers and its Production Technology Woodhead Publisher,India,New Delhi

Course No : **PB-121** Course Title **: Principles of Plant Breeding**

Credits : **3(2+1)** Semester **: II**

Theory

UNIT I

History, aims and objectives of Plant breeding; Role of related sciences in plant breeding; Modes of reproduction - sexual, asexual, apomixes: Significance in plant breeding; Modes of pollination, genetic consequences, differences between self- and cross pollinated crops; Germplasm resources and their utilization.

UNIT II

Methods of breeding: Introduction and Acclimatization; Selection: Mass selection, Johannesen's pure-line theory, genetic basis, pure-line selection; Hybridization: Aims and objectives, types of hybridization; Methods of handling segregating generations: Pedigree method, bulk method, back cross method; Heterosis, inbreeding depression, various theories of heterosis, exploitation of hybrid vigor, Hardy Weinberg law, selection in cross pollinated crops; Population improvement programmes; Synthetics and composites; Methods of breeding vegetatively propagated crops.

UNIT III

Incompatibility and male sterility and their utilization in crop improvement; Mutation breeding; Ploidy breeding; wide hybridization and its significance in crop improvement; Procedure for release of new varieties.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
	UNIT I	
1	Definition of Plant Breeding, history of Plant Breeding	4
2	Aims and objective of Plant Breeding	4
3	Role of related sciences in Plant Breeding	4
4	Modes of reproduction, sexual and asexual reproduction	5
5	Apomixis types of apomixes, Applications of apomixis	5
6	Modes of pollinations, types of pollination, difference between self and cross pollination	5
7	Genetic consequences (mechanisms for self and cross pollination in crop plants)	4
8	Germplasm: Definition, Different methods of collection and conservation. National institutes for germplasm conservation	4
	UNIT II	
9	Methods of breeding in self pollinated crops	4
10	Methods of breeding in cross pollinated crops	4
11	Johnson's pure line theory, Genetic basis, Pure line selection method	4
12	Hybridization: Aims and objectives, Types of hybridization	4
13	Methods of handling segregating generation (Pedigree method)	2
14	Methods of handling segregating generation (Bulk method)	2
15	Methods of handling segregating generation (Back cross methods)	2
16	Heterosis : Definition, Types of heterosis, different theories of	3

	heterosis	
17	Inbreeding depression, Exploitation of Hybrid vigour/heterosis in crop plants	3
18	Hardy-Weinberg law, selection in cross pollinated crops	2
19	Population improvement programme :Synthetic, definitions and procedure of development of Synthetic	3
20	Composite : Definition and procedure of development of composite	3
21	Breeding method in asexually propagated crop : Clonal selection procedure of clonal selection	3
UNIT III		
22-23	Male sterility : Definition: types and use of male sterility in crop improvement	4
23-24	Self incompatibility, definition, types and use of self incompatibility in crop impartment	4
25-26	Mutation : Definition, classification of mutation, mutagenic agents and induction of mutation	4
27-28	Ploidy Breeding : Definition of polyploidy, types of polyploidy , application of polyploidy in crop improvement	4
29	Wide hybridization : Definition, types of wide hybridization ,	3
30	Incompatibility barriers for wide hybridization, Technique to over come incompatibility barriers	3
31-32	Procedure for release of new varieties	4
	Total	**100**

Practical Exercise

Exercise No.	Title
1.	Classification of crop plants
2.	Botanical description and floral biology of Rice and Wheat
3.	Botanical description and floral biology of Sorghum and Maize
4	Botanical description and floral biology of Bajra and Sugarcane
5	Botanical description and floral biology of Brassica and Groundnut
6	Botanical description and floral biology of Sunflower and Sesamum
7	Botanical description and floral biology of Red gram and Bengal gram
8	Botanical description and floral biology of Green gram and Black gram
9	Botanical description and floral biology of Soybean and Cotton
10	Study of megasporogenesis and microsporogenesis
11	Study of magagametogenesis and microgametogenesis
12	Fertilizations and life cycle of angiosperm plant
13	Hybridization techniques and precautions to be taken
14	Study of selfing techniques
15	Study of emasculation and crossing techniques
16	Study of male sterility and self incompatibility

Suggested reading:

1. Singh BD. 2015. Plant Breeding Principles and Methods. Kalyani Publishers, New Delhi.
2. Singh P. 2015. Essentials of Plant Breeding. 5th Kalyani Publishers, New Delhi.
3. Sharma JR. 1994. Principles and Practices ofPlant Breeding. Tata McGraw Hill Publishing Company Limited, New Delhi.
4. Chopra VL. 1989. Plant Breeding: Theory and Practices. Oxford and IBH. Publishing CompanyNew Delhi.
5. Chaudhary RC. 1994. Introduction to Plant Breeding. Oxford and IBH. Publishing Company , New Delhi.
6. Chaudhary HK. 1971. Elementary Principles of Plant Breeding.Oxford and IBH. Publishing Company, New Delhi.

Course No : **AS-122** Course Title **: Introduction to Animal Breeding**

Credits : **3(2+1)** Semester : **II**

Theory

UNIT I

Population and Population Genetics; Hardy- Weinberg Law; Hardy Weinberg Equilibrium; Approaching to Equilibrium for sex linked trait; Linkage Equilibrium; Effect of linkage on HW-equilibrium; Stochastic and Deterministic Forces acting on Population; Mutation; Migration; Selection.

UNIT II

Dissection of Phenotype into its components; Transmitting Ability, Substitution effect of allele; Breeding Value: Definition, concept; Heritability: Definition, Concept, Estimation of heritability from regression of offspring to parents; Repeatability: Definition, Concept and estimation; Correlated traits: Phenotypic and Genetic correlation, Environmental correlation; Selection Index: Basic concept and types; Bases of selection.

UNIT III

Breeding strategies in large ruminants (cattle, buffalo), small ruminants (sheep, goat) and swine; Poultry breeding; Lab animal breeding; Breed improvement programs conducted in India; Molecular breeding: complementation of traditional breeding strategies with molecular genetics.

Practical

Chi-square test for determining goodness of fit for HW-equilibrium; Estimation of effect of allelic substitution; Estimation of heritability: regression of offspring on parents; Estimation of repeatability; Phenotypic correlation, genetic correlation, environmental correlation; Chi-square test for determining goodness of fit for HW-equilibrium; Linkage analysis from pedigree data ; Selection index.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topics	Weightages (%)
	UNIT – I	
1	**Population and Population Genetics**: Mendelian Population / Random Mating population, sample	4
2	Gene, genotype, gene and genotype frequency, Gene pool, Random drift	3
3	**Hardy-Weinberg Law**: Random Union of Gametes, Random mating among genotypes,	3
4	**Hardy- Weinberg Lawof Equilibrium**; Approaching to Equilibrium for sex linked trait	3
5	Linkage Equilibrium	2
6	Effect of linkage on HW-equilibrium;	2
7	Equilibrium for one gene	2
8	Two gene and Equilibrium for genes showing dominance	2
9	Stochastic and Deterministic Forces acting on Population	2
10	**Mutation**: Def, Type: Recurrent and non recurrent , significance and	2

	non significances	
11	**Migration:** Definition and its significances	2
12	**Selection:** Definition, types and basis for selection: Gametic and zygotic selection, selection against recessive and dominant phenotypes	2
	UNIT – II	
13	**Dissection of Phenotype into its components**:	4
14	**Transmitting Ability**: Definition, types: Predicted	4
15	Estimated transmitting ability	3
18	**Substitution effect of allele**: Def, Allele shuffling, concept of substitution: Gene effects and genotype substitution, expectation,	3
19	Deviation, additive genetic variance: Genic variance and Quasi dominance variance, other types of variance	4
20	**Breeding Value**: Definition, concept of breeding, dominance	3
21	Effects of environmental factors	2
22	**Heritability**: Definition, Concept and estimation from regression of offspring to parents	3
23	**Repeatability**: Definition, Concept and estimation;	3
24-25	**Correlated traits**: Phenotypic and Genetic correlation,	6
26	**Environmental correlation**: effects of environmental factors on expression of genes	3
27	**Selection Index**: Basic concept and types of selection. **Bases of selection**: Basic principle, selection tools, methods of selection for single and multiple traits, significance	3
	UNIT - III	
28	**Breeding strategies in large ruminants (Cattle, Buffalo)**: Definitions, Strategies: Pedigree and Performance Recording Scheme (PPRS) and Progeny Testing Program, Inbreeding, Outbreeding, Applications , Open nucleus breeding system.	5
29	**Small ruminants (sheep, goat) and swine:** Breeding strategies: Screening and selection, Crossbreeding and inbreeding, Upgrading local breeds, applications	5
30	**Poultry breeding**: **strategies in upgrading the native chicken: Introduction of purebred hatching eggs, Introduction of purebred chicks, Cockerel exchange program,** Local farmers buying male purebred broiler from small broiler raisers,	4
31	**Lab animal breeding**: various breeding strategies like gathering and culturing embryos and the possibilities of *in vitro* breeding of Mouse, Rabbit, Zebrafish, etc.	4
	Breed improvement programs conducted in India: concept, history and Advantages	4
32	**Molecular breeding**: Definition, content: Association mapping /QTL mapping or gene discovery Marker assisted selection and genomic selection, Genetic engineering Genetic transformation, Advantages, Complementation of traditional breeding strategies with molecular genetics.	8
	Total	**100**

Practical Exercise

Exercise No.	Title
1-2	Chi-squared test for determining goodness of fit for HW-equilibrium
3	Estimation of effect of allelic substitution
4	Estimation of heritability
5-6	Regression of offspring on parents
7	Estimation of repeatability
8-9	Phenotypic correlation, genetic correlation, environmental correlation
10-11	Chi-squared test for determining goodness of fit for HW-equilibrium
12-14	Linkage analysis from pedigree data
15-16	Selection index

Text Books:

1. Brah GS. 2014. Animal Genetics: Concepts and Implications. 2nd Ed. Kalyani Publishers.
2. Bourdon RM. 1999. Understanding Animal Breeding. 2nd Ed. Prentice Hall.

Reference Books:

1. Nicholas FW. 2010. Introduction to Veterinary Genetics. 3rd Ed. Wiley-Blackwell Publication.

Course No : **STAT-121** Course Title : **Basic Statistics**

Credits : **2(1+1)** Semester : **II**

Theory

UNIT I

Definition of statistics, its use and limitations; Frequency distribution and frequency curve and cumulative frequency curve; Measures of central tendency; Measures of dispersion; Probability: Definition, additive and multiplicative law for two events; Normal distribution and its properties; Introduction to sampling; Sampling techniques.

UNIT II

Tests of significance: Null hypothesis, alternate hypothesis, Type I & II Error, one and two tail tests, level of significance and confidence interval; SND test for means: Single sample and two samples Z-test; Student's t-test for means, single sample, two samples and paired t-test; F-test;

UNIT III

Chi-square test in 2x2 contingency table; Yate's correction for continuity; Correlation: Scatter diagram and Karl Pearson's coefficient of correlation for ungrouped data and its testing; Linear regression and its properties; Analysis of variance and its assumptions, Analysis of CRD and RBD; Analysis of Latin Square Design.

Practical

Construction of frequency distribution tables and frequency curves; Computation of Arithmetic: Mean, median, mode; Standard deviation; Variance and coefficient of variation for ungrouped and grouped data; SND test for means; Student's t-test; F-test and Chi-square test; Correlation coefficient 'r' and its testing; Fitting of regression equations; Analysis of CRD, RBD and LSD.

Teaching Schedule- Theory with weightage (%)

Lecture No.	Topic	Weightage (%)
1	**Introduction**: Definition of Statistics and its applications in biotechnology, limitations, Type's ofdata, classifications and frequency distribution, **Graphical presentation:** Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve).	10
2	**Measures of central tendency**: Arithmetic mean, median, mode, GM, HM, weighted average,quartiles, percentiles and deciles,Characteristics of ideal measure its merits and demerits (grouped and ungrouped data).	08
3- 4	**Measures of Dispersion:** Range, mean deviation, quartile deviation, standard deviation and variance and respective relative measures (grouped and ungrouped Data),Concept of measures of skewness& kurtosis.	05
5	**Sampling:** Definitions of population, sample, parameter, statistic, need of sampling, sampling versus complete enumeration and introduction to simple random, stratified and multistage sampling methods. Simple random sampling with and without replacement, Use of random number tables for selection of simple random sampling.	08

6	**Probability:** Random experiment, events (simple, compound, equally likely, complementary, independent) Definitions of probability (mathematical, statistical and axiomatic), additionand multiplication theorem (without proof). Simple problems based on probability.	08
7	**Probability distributions:** Random variable, discrete and continuous random variable, probability mass and density function, definition and properties of Normal distributions.	08
8	**Test of Significance:** Null and alternate hypothesis, types of errors, degrees of freedom, level of significance, one and two tailed tests, critical region, steps in testing of hypothesis, confidence interval.	05
9	**Large sample tests:** One sample and two samples Z-test for mean and proportion.	05
10	**Small sample test:** One sample, two sample and paired 't' test.	05
11	Chi-square test of goodness of fit,Chi-square test of independence of attributes in 2 ×2 contingency table, Yate's correction for continuity, F test for equality of variance.	08
12	**Correlation:** Definition of correlation, types, scatter diagram. Karl Pearson's coefficient of correlation and its test of significance. Spearman's rank correlation coefficient.	07
13	**Regression**: Linear regression equations, definition & properties of regression coefficient, constant, fitting of regression lines with test of significance, comparison of regression and correlation coefficients.	08
14	**Analysis of Variance and Experimental Designs:**Introduction to analysis of variance, assumptions of ANOVA, Principles of design of experiments, analysis of one way classification Completely Randomized Design(CRD).	05
15	Analysis of two way classification Randomized Block Design (RBD).	05
16	Analysis of Latin Square Design.	05
Total		**100**

Practical Exercise

Exercise No.	Name of the Practical Exercise
1	**Graphical presentation:** Histogram, frequency curve, frequency polygon, cumulative frequency curve (ogive curve).
2, 3	**Measures of central tendency**: Computations of arithmetic mean, mode, median, GM and HM, quartiles, deciles & percentiles (grouped and ungrouped data).
4,5	**Measures of Dispersion:** Computations of range, mean deviation, quartile deviation, standard deviation, variance and respective relative measures (grouped and ungrouped Data).
6, 7	**Test of Significance**: One sample, two sample 'Z' test for mean and proportion.
8	**Student's 't' test and F test** : One sample, two sample 't' test, paired t-test and its uses applications, F test for equality of variance.
9,10	Chi-Square test of Goodness of Fit, Chi-square test of independence of Attributes for 2 ×2 contingency table, Yate's correction for continuity.
11	**Correlation:** Computations of Karl Pearson's coefficient of correlation with its test

	of significance.
12	Computation of Spearman's rank correlation coefficient.
13	**Regression**: Fitting of linear regression equation with test of significance of regression coefficient.
14	**Design of Experiment :**Analysis of Completely Randomized Design.
15	Analysis of Randomized Block Design.
16	Analysis of Latin Square Design.

Text books :

1. Rangaswami R. 2009. A Text book of Agriculture Statistics. New Age International Pvt. Limited, Hyderabad.
2. Rao NG. 2007. Statistics for Agricultural Sciences. . New Delhi: BS Publications.
3. Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publication, NewDelhi.

Reference books:

1. Panse VG and Sukhatme PV. 1985. Statistical methods for Agricultural workers.Indian Council of Agricultural Research New Delhi
2. Snedecor GW. and Cochran WG. 1989. Statistical Methods. Iowa State University Press.
3. Das MN and Giri NC. 1986. Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi.
4. Gomez AA and Gomez AA. 1984. Statistical Procedures for Agricultural Research.John Wiley and Sons. New York.
5. Roger PG. 1994. Agricultural Field Experiments Design and Analysis. Marcel Dekker, NewYork.
6. Gupta SC. 2016. Fundamentals of Statistics. Himalaya Publishing House Mumbai.
7. Kapoor VK. 2007. Fundamentals of Applied Statistics. Sultan Chand and Sons, New Delhi.

Course No	: **NSS-122**	Course Title	: **National Service Scheme II**
Credits	: **1(0+1)**	Semester	: **II**

Syllabus:

Importance and role of youth leadership
Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership

Life competencies
Definition and importance of life competencies, problem-solving and decision-making, inter personal communication

Youth development programmes
Development of youth programmes and policy at the national level, state level and voluntary sector; youth-focused and youth-led organstions

Health, hygiene and sanitation
Definition needs and scope of health education; role of food, nutrition, safe drinking water, water born diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programmes and reproductive health.

Youth health, lifestyle, HIV AIDS and first aid
Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid

Youth and yoga
History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method

Practical Exercise

Exercise No.	Topic	Weightages (%)
1.	**Importance and role of youth leadership** Meaning, types and traits of leadership,	7
2.	Qualities of good leaders;	6
3.	Importance and roles of youth leadership	6
4.	**Life competencies** Definition and importance of life competencies, ,	6
5.	**Life competencies** Problem-solving and decision-making	6
6.	**Life competencies** Inter personal communication	6
7.	**Youth development programmes** Development of youth programmes and policy at the national level,	7
8.	**Youth development programmes** state level and voluntary sector; youth-focused and youth-led organstions	6
9.	**Health, hygiene and sanitation** Definition needs and scope of health education;	6
10.	Role of food, nutrition,	6

11.	Safe drinking water, Water born diseases and sanitation (Swachh Bharat Abhiyan) for health;	7
12.	National health programmes and reproductive health.	6
13.	**Youth health, lifestyle, HIV AIDS and first aid** Healthy lifestyles, HIV AIDS, drugs and substance abuse,	7
14.	Home nursing and first aid	6
15.	**Youth and yoga** History, philosophy, concept, myths and misconceptions about yoga;	6
16.	**Youth and yoga** yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method	6
Total		**100**

Course No : **PHYEDN-111** Course Title : **Physical Education and Yoga**

Credits : **1(0+1)** Semester : **II**

Syllabus:

Physical Education (Practical)

Introduction to physical education definition, objectives, scope, and importance; physical culture; Warming up - Need and requirement of first aid.Meaning and importance of Physical Fitness and Wellness; Physical fitness components -speed, strength, endurance, power, flexibility, agility, coordination and balance;Methods of Training; aerobic and anaerobic exercises; weight training, circuit training, Interval training, Fartlek training;

Skill of Volleyball, Rules & Regulation, Advance Skill of Volleyball, Specific Warming up,Skill of Football Rules & Regulations, Advance Skill of Foot ball& Specific Warming up, Skill of Kabaddi Rules & Regulations. Advance Skill of Kabaddi, Skill of Kho-Kho, Rules & Regulations. Advance Skill of Kho-Kho, & Specific Warming up,

Yoga (Practical)

Yoga- History, Meaning and importance, Role of yoga in life.Asans and indigenous way for physical fitness, and curative exercise.Introduction to asanas and its importance, pranayama, meditation and yogickriya.Omkar, Yogic Suksmavyayamas,

Yogasan- Asanas in Standing posture (Tadasana, Vrikshasana, Padahastasana, Ardha-Chakrasana, Trikonasana), Sitting postures (Asanasviz: Bhadrasana, Vjrasana, Ardha-Ustrasana, Ushtrasana, sasakasana and Vakrasana), Prone postures (Makarasana, Bhujangasana and Salabhasana) and Supine posture (Setubandhasana, uttanapadasana, Ardha-halasana, and Pavanamuktasana, Shavasana),

Suryanamaskar, Yognidra, Kapalbhati, Pranayam, Meditation in different mudras

Teaching Schedule (Practical)

Exercise	Topic	Weightage (%)
1	Introduction to physical education definition, objectives, scope, and importance; physical culture; Warming up - Need and requirement of first aid.	04
2	Meaning and importance of Physical Fitness and Wellness; Physical fitness components -speed, strength, endurance, power, flexibility, agility, coordination and balance; Methods of Training; aerobic and anaerobic exercises; weight training, circuit training, Interval training, Fartlek training;	06
3	Skill of Volleyball, Rules & Regulation, Advance Skill of	06

Exercise	Topic	Weightage (%)
	Volleyball, Specific Warming up,	
4	Skill of Football Rules & Regulations, Advance Skill of Foot ball& Specific Warming up	06
5	Skill of Kabaddi Rules& Regulations. Advance Skill of Kabaddi, Skill of Kho-Kho, Rules & Regulations. Advance Skill of Kho-Kho, & Specific Warming up	10
6	Skill of Basket ball Rules & Regulation, Advance skill of Basket ball& Specific warming up	06
7	Skill of Table tennis, Rules & Regulations, Advance skill of Table tennis. Sikll of Badminton, Rules & Regulations. Advance skill of Badminton, Specific Warming up.	06
8	Skill of Athletics, Long and Short Distance running, Sill of Athletics Jumping events, Throwing events	06
9	Yoga- History, Meaning and importance, Role of yoga in life	06
10	Omkar, Yogickriya, Yogic Suksmavyayamas	06
11	Yogasana- in Standing posture (Tadasana, Vrikshasana, Padahastasana, Ardha-Chakrasana, Trikonasana),	06
12	Yogasana- in Sitting postures (Asanasviz: Bhadrasana, Vjrasana, Ardha-Ustrasana, Ushtrasana, sasakasana and Vakrasana)	07
13	Yogasana- in Prone postures (Makarasana, Bhujangasana and Salabhasana)	06
14	Yogasana- in Supine posture (Setubandhasana, Uttanapadasana, Ardha-halasana, and Pavanamuktasana, Shavasana)	06
15	Suryananskars, Yognidra	06
16	Kapalbhati,Pranayam, Meditation in different mudras,	07
	Total	**100**

Suggested Reading:

1) O.P. Aneja. Encyclopedia of Physical education, sports and exercise science (4 volumes).
2) Anil Sharma. Encyclopedia of Health and Physical Education (7 Volumes).
3) N V Chaudhery, R Jain. Encyclopedia of Yoga Health and Physical Education (7 Volumes).
4) PintuModak, O P Sharma, Deepak Jain. Encyclopedia of Sports and Games with latest rules and regulations (8 volumes).

5) Physical Education And Recreational Activities by Deepak Jain, Year of Pub.: 2011
6) Dimensions of Physical Education by Anil Sharma, Year of Pub.: 2011
7) Physical Fitness by Vijaya Lakshmi Year of Pub.: 2005
8) Research Process In Physical Education And Sports: An Introduction by K. G. Jadhav, Sachin B. Pagare and Sinku Kumar Singh, Year of Pub.: 2011
9) Sports Training And Biomechanics In Physical Education by Sinku Kumar Singh Year of Pub.: 2011
10) Test, Measurement and Evaluation in Physical Education by P. L. KaradYearof Pub.: 2011
11) Foundations of Physical Education, Exercise Science, and Sport by Deborah A. Wuest,Charles A. Bucher
12) Light on Yoga by B. K. S Iyangar, Publication:Schocken, Edn. 31st : 1995,
13) The Key Muscles of Hatha Yoga by Ray Long, Publication: Bandh Yoga, Edn.; 3rd : 2006
14) Hatha YogasPradipika by Yogi Swatmarama, Publishcation: Bihar School of Yoga, Edn. 26th :1998
15) Yoganidraby swami saraswati, pblication, yoga publication trust, munger, edn 3rd 1976
16) YogDarshan of Patanjali by Harikrishna Das Goyenka, Publication: Geeta Press Gorakhpur, Year: 2013
17) PatanjaliYogasutras by Swami Premeshanand, Publication: AdvaitaAsharm, Edn.: 2015