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