IV SEMESTER

S. No.	Course code	Course Title	Credit load
1	PBG 201	Fundamentals of Genetics	2+1
2	AEX 201	Communication Skills and Personality Development	1+1
3	STA 211	Statistical Methods	1+1
4	PAT 202	Principles of integrated plant disease management	1+1
5	AEN 202	Management of beneficial and harmful insects	2+1
6	AGR 203	Crop Production Technology – II (*Rabi* crops)	1+1
7	AGR 204	Farming System & Sustainable Agriculture	1+1
8	SAC 202	Problematic soils and their management	2+0
9	HOR 212	Production Technology for Ornamental Crops, MAP and Landscaping	1+1
10	ANM 201	Introductory Nematology	0+1
11	NST 201	Fundamentals and Applications of nanotechnology	1+0
12	ERG 211	Renewable Energy and green technology	1+1
12	NSS/NCC 101	NSS/NCC	0+1*
13	PED 101	Physical Education	0+1*
		Total	**14+10=24**
		***Non-gradial courses compulsory courses**	

PBG 201. Fundamentals of Genetics (2+1)

THEORY

Unit I: Cytology

Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics.Physical basis of heredity. Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes.Cell division – mitosis- meiosis and their significance - Gametogenesis and syngamy in Plants- identical and fraternal twins. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, Bchromosomes, ring and isochromosomes.Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications.Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome; Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, triticale, cotton, tobacco, *Brassica*

Unit II: Mendelian laws and modifications of Mendelian laws

Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.Mendel's experiments and laws of inheritance.Rediscovery of Mendel's work.Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.Chromosomal theory of inheritance.Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance,threshold characters.Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1). ii.) Recessive epistasis(9:3:4) iii.) Duplicate and additive epistasis(9:6:1). iv.) Duplicate dominant epistasis(15:1). v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i)to (vi).Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in human, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.

Unit III: Quantitative inheritance, Linkage and Crossing over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Linkage - coupling and repulsion; Experiment on Bateson and Punnet. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage- Linkage group.Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment - Factors controlling crossing over.Strength of linkage and recombination; Two point and three point test cross.Double cross over, interference and coincidence; genetic map, physical map.

Unit IV: Sex determination, sex linkage and cytoplasmic inheritance

Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize.Genic balance theory of Bridges – Gynandromorphs.Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders.Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium

Unit V: Modern concept of genetics and mutation

DNA, the genetic material – Griffith's experiment, Avery, McCleod and McCarthy Experiment – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.Structure of DNA – Watson and Crick model. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA. Protein synthesis - Regulation of gene expression – Operon model of Jacob and Monad – Lac and Trp operons.Cistron,muton and recon.Mutation – characteristics of mutation – micro and macro mutation – ClB technique - molecular basis of mutation-Transition and transversion; major physical and chemical mutagens.

PRACTICAL

Study of microscopes – Preparation of fixatives and stains – pre treatment of materials for mitosis and meiosis – study of mitosis and meiosis. Study of genetic ratios of – monohybrid, dihybrid – incomplete dominance. Gene interaction - multiple alleles and multiple factors. Study of linkage, Estimation of strength of linkage and recombination frequency in three point test cross data and F_2 data – Drawing of genetic map – interference and coincidence.Studies on sex linked inheritance in Humans and Drosophila

Theory schedule

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics.
2. Physical basis of heredity: Structure and function of cell and cell organelles –
3. Differences between Prokaryotes and Eukaryotes.Cell division – mitosis
4. Cell division - meiosis and their significance
5. Gametogenesis and syngamy in Plants- identical and fraternal twins
6. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram
7. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, Bchromosomes, ring and isochromosomes.
8. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications.
9. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome;
10. Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, *Brassica*
11. Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.
12. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
13. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.
14. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance,threshold characters
15. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1)
16. ii.) Recessive epistasis(9:3:4) iii.) Duplicate and additive epistasis(9:6:1). iv.) Duplicate dominant epistasis(15:1)
17. **Mid Semester Examination**
18. v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i)to (vi).

19. Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.
20. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.
21. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers;
22. Linkage - coupling and repulsion; Experiment on Bateson and Punnet
23. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.
24. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
25. Strength of linkage and recombination; Two point and three point test cross.
26. Double cross over, interference and coincidence; genetic map, physical map.
27. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize.
28. Genic balance theory of Bridges - Gynandromorphs
29. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
30. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium
31. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
32. Structure of DNA – Watson and Crick model Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication.RNA types - mRNA, tRNA, rRNA – Protein synthesis
33. Regulation of gene expression – Operon model of Jacob and Monad – Lac and Trp operons. Cistron,muton and recon.
34. Mutation – characteristics of mutation – micro and macro mutation – ClB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

Practical Schedule

1. Use of microscopes
2. Principles of killing and fixing; preparation of stains and preservatives.
3. Study of behavior of chromosomes in mitosis.
4. Study of mitotic phases in root tips of onion / *Aloe sp*.
5. Procedure for fixing and observing different meiotic phases in the inflorescence of rice, maize
6. Procedure for fixing and observing different meiotic phases in the inflorescence in pearl millet, sorghum
7. Repetition of meiotic studies in maize/ sorghum/ pearl millet and making temporary and permanent slides.
8. Principles of dominance, recessive, back cross, test cross, incomplete dominance, codominance and lethal factor; Chi square test; Monohybrid genetic ratio with dominance, with incomplete dominance and test cross.
9. Dihybrid ratio with dominance, with incomplete dominance and test cross
10. Simple interaction of genes-comb character in fowls; Dominant epistasis.
11. Recessive epistasis, Duplicateand additive epistasis.
12. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
13. Multiple alleles and polygenic inheritance
14. Estimation of linkage with F_2 and test cross data; Coupling and repulsion.

15. Problems on three point test cross; Working out interference, coincidence and drawing genetic maps.
16. Studies on sex linked inheritance in Humans and Drosophila
17. **Final Practical examination.**

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4. Pundhansingh. 2014. Elements of Genetics.Kalyani Publishers
5. Benjamin Lewin. 2005. Genes IX Oxford University Press, Oxford.
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8. Strickberger. M.W. 1996. Genetics. Prentice-Hall of India Pvt. Ltd. New Delhi.
9. Singh, B.D. 2004. Fundamentals of Genetics, Kalyani Publishers, Chennai.

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2. www.biology200.gsu.edu

AEX 201 Communication Skills and Personality Development (1+1)

Theory

Communication Skills: meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Unit I Communication Skills: meaning and process of communication, verbal and nonverbal communication

Unit II Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

Unit III Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting

Unit IV Individual and group presentations, impromptu presentation, public speaking **Unit V**
Group discussion. Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations

Theory Schedule

1. Communication – meaning and process –Functions and Types of communication
2. Communication models - Aristotle, Shannon and Weaver, Schramm, Berlo Westly and Maclean, Leagan, Rogers and Shoemaker, Littererls model and Dance's Helical Model – Elements of communication – communication barriers
3. Verbal and Non verbal communication – Verbal communication – definition and meaning – Verbal vs Oral communication – Types – Styles - Barriers to effective verbal communication ;
4. Non verbal communication – definition and meaning – Proxemics, Chronemics, Movement and body position, Posture, Facial Expression, Gestures and Eye Contact – importance of non verbal communication
5. Listening – Definition – Listening vs Hearing – Active listening – Types of listening –Guidelines for effective listening – Developing listening skills - Barriers to listening – Listening misconceptions
6. Writing skill – Importance – Effective writing - Components of writing : Introduction , Audience and format ,Composition and style, Structure, Grammatical errors , Proofing and Conclusion – Ways to improve writing skills – Technical writing
7. Oral presentation skills – Basics of effective oral presentation : Planning , preparing (Introduction, Body and conclusion), Delivery, Body language and Handling anxiety – Strategies for giving oral presentation
8. Field diary – Definition – Components to be included – Parts of field diary – Field diary in social sciences
9. Lab record : Definition –Importance of keeping a lab record - Features of a lab record - Contents of lab record – Guidelines for keeping a lab record
10. **Mid semester examination**
11. Indexing – Definition – Importance – Types of indexing with advantages and limitations
12. Footnote and Bibliographic procedure : Footnote system of citation ; Bibliographic procedures : Citation in Text, Citation in Journal, Citation from Book(One author / Multiple authors), Citation from an Edited Book, Citation of Seminar/Conference Proceedings, Citation from Institutional Publication, Citing Government Publications, Abbreviations for Names of Journals, Paraphrasing, Abbreviations in citations (Art of publication)

13. Reading skills – Definition – Kinds of reading skills – Critical reading skills – Reading readiness skills- Guidelines for effective reading- Extensive reading- Intensive reading. Comprehension : Definition and meaning – Comprehension skills-Readability Index
14. Precise writing – Derivation and Meaning – Skills required – Method or procedure – Guidelines; Summarising – Meaning- Steps to write a summary
15. Abstracting : Definition - Purpose of abstract – Types of abstract - Abstract Styles – Steps for Writing Effective Abstracts- Some Do's Don'ts in preparing abstracts
16. Individual presentation - Meaning –Steps for individual presentation; Group presentation – Meaning – Stages of group presentation ; Impromptu presentation
17. Public speaking : meaning – Points to be considered in public speaking – Effective public speaking: Group Discussion: Meaning –Procedure – Advantages – Limitations ;Seminar Conferences : Definition and meaning – Steps in organizing seminar / conferences / symposium / workshop

Practical Schedule

1. Practicing active listening
2. Exercise on note taking methods
3. Exercise on technical writing and practicing proof correction
4. Practicing oral presentation
5. Exercise on writing field diary and Lab record
6. Visit to library and learn indexing
7. Exercise on preparing foot notes and citations
8. Practice on effective reading skills
9. Comprehension of technical article
10. Comprehension of general article
11. Exercise on precise writing
12. Practice on summarizing articles
13. Practice on preparing abstracts

14&15 Developing skill on individual presentation

16. Developing skill on group presentation
17. **Practical Examination**

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G. L. Ray 2007 Extension Communication and Management , Kalyani publishers

Communication and Instructional Technology, By: Indu Grover, Shusma Kaushik, Lali Yadav, Deepak Grover & Shashikanta Verma

Indu Grover, Lali Yadav & Deepak Grover Extension Management, Agrotech

Everett Rogers, and Floyd Shoemaker, Communication of Innovation – a Cross Cultural Approach, New York Free Press.

Knapp, Mark L., & Hall, Judith A .(2007) Nonverbal Communication in Human Interaction. (8th ed.) Wadsworth: Thomas Learning.

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STA 201 Statistical Methods (1+1)

Theory

Unit I: Descriptive Statistics

Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency distribution tables.

Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode – merits and demerits. Measures of dispersion: range, quartile deviation, mean deviation, standard deviation, and coefficient of variation – skewness and kurtosis – merits and demerits.

Unit II: Probability Distributions and Sampling Theory

Probability – basic concepts – additive and multiplicative laws (without proof). Probability distributions – Discrete distributions: Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties.

Sampling theory – population – sample – parameter and statistic – sampling distribution – sampling vs complete enumeration – Types of sampling – simple random sampling – selection of simple random sample using random number tables.

Unit III: Testing of hypotheses

Null and alternative hypothesis – types of errors – critical region and level of significance – degrees of freedom. Large sample test – single proportion and difference between two proportions – single mean and difference between two means.

Small sample tests – F-test – t-test for testing the significance of single mean – independent t test and paired t test – chi square test for goodness of fit – chi square test for testing the association of attributes by m x n contingency table – 2 x 2 contingency table – Yates' correction for continuity.

Unit IV: Correlation and Regression

Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

Unit V: Analysis of Variance and Experimental Designs

Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) – lay out, analysis, merits and demerits of the above mentioned designs.

Practical

Formation of frequency distribution tables – Diagrammatic and graphical representation. Computation of different measures of central tendency and computation of various measures of dispersion for raw and grouped data – calculation of coefficient of variation (CV) – measures of skewness and kurtosis. Simple problems in Binomial distribution, Poisson and Normal distribution – Selection of simple random sampling. Large sample test for single proportion and difference between two proportions and Large sample test for single mean and difference between two means. t-test for single mean – t-test for testing the significance of two means for independent and paired samples – chi square test for goodness of fit and test for independence of two attributes in a contingency table – Yates correction for continuity

– calculation of the correlation coefficient – fitting of simple linear regression equation – One way and two way ANOVA – completely randomized design (CRD) – randomized block design (RBD) – Latin square design (LSD).

Theory Lecture Schedule

1. Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency distribution tables.
2. Measures of Central Tendency – meaning – limitations – properties – mean, median mode geometric mean and harmonic mean for ungrouped and grouped data.
3. Measures of Dispersion – meaning – limitations – properties – range and mean deviation, Quartile deviation, standard deviation, variance and coefficient of variation for ungrouped and grouped data. Skewness and kurtosis – types – uses.
4. Probability – basic concepts – axioms – mathematical and statistical probabilities – additive and multiplicative laws (without proof). Theoretical discrete distributions – Binomial and Poisson distribution and its applications.
5. Theoretical continuous distribution – Normal distribution and its properties and importance – standard normal distribution.
6. Sampling theory – population – sample – sampling vs complete enumeration – parameter and statistic – need for sampling – sampling distribution – standard error.
7. Sampling methods – probability sampling method – simple random sampling – Selection using random number tables and lottery method.
8. Tests of significance – basic concepts – null and alternative hypotheses – critical region – level of significance – degrees of freedom.
9. **Mid Semester Examination**
10 Large sample test – single proportion and difference between two proportions – single mean and difference between two means
11. Small sample tests – F-test – t-test for testing the significance of single mean independent t test and paired t test
12. Chi square test for goodness of fit – chi square test for testing the association of m x n contingency table – 2 x 2 contingency table – Yates' correction for continuity
13. Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties.
14. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.
15. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – randomization, replication and local control.
16. Completely Randomized Design (CRD) – Randomized Block Design (RBD).
17. Latin Square Design (LSD).

Practical schedule

1. Construction of frequency distribution tables.

2. Diagrammatic representation – simple, multiple, component and percentage bar diagrams, pie diagram. Graphical representation – frequency polygon, frequency curve and histogram.
3. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode for ungrouped and grouped data.
4. Computation of range, standard deviation, variance, coefficient of variation for ungrouped and grouped data. Computation skewness and kurtosis for ungrouped and grouped data.
5. Simple problems in Binomial distribution and Poisson distribution.
6. Simple problems in Normal distribution.
7. Selection of simple random sample using simple random sampling method.
8. Large sample test – test for single proportion and difference between two proportions.
9. Large sample test – test for single mean and difference between two means.
10. Small samples test – t-test for single mean – independent t test for difference between two sample means (equal variances only) – Paired t-test.
11. Chi square test for goodness of fit – Chi square test for testing the association of attributes.
12. Computation of Karl Pearson's correlation coefficient.
13. Fitting of simple linear regression equation y on x.
14. One way ANOVA – analysis of experimental data using Completely Randomised Design (CRD) (for equal replications only).
15. Two way ANOVA – analysis of experimental data using Randomised Block Design (RBD).
16. Analysis of experimental data using Latin Square Design (LSD).
17. **Final Practical Examination**

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PAT 202 Principles of Integrated Plant Disease Management - 1+1

Theory:

UNIT I: Epidemiology and Diagnosis of Plant Diseases

Classification of plant diseases - Disease triangle/ Disease Pyramid - Epidemiology of plant diseases- role of weather factors in disease development - Disease surveillance, assessment and forecasting– Diagnosis of plant diseases- Seed health tests- chemodiagnosis, serodiagnosis and Molecular diagnosis

UNIT II: Principles - Avoidance & Exclusion

Avoidance- Role of cultural practices in plant disease management. Exclusion- Plant quarantine – domestic, International and Embargo - Phytosanitary certificate- Quarantine in India- Post Entry Quarantine- Exotic diseases introduced into India- Pest risk analysis.

UNIT III: Eradication

Eradication of pathogens from seed and Planting materials – Eradication of diseased plants- Surgery and Rouging – Eradication of Alternate and Collateral host- different methods of eradication- Mechanical, physical , chemical and Biological methods.

UNIT IV: Protection

Protection of crops from air borne, seed borne, soil borne and vector borne plant diseases-Physical methods- soil solarization, Hot water treatment, Incineration. Chemical control of plant diseases- fungicides- Different group of fungicides and antibiotics in plant disease management- Biological control of plant diseases - Plant products, Plant activators and Antiviral principles- method of application- plant protection appliances.

Unit V: Immunization, Biotechnological approaches and IPM module

Immunization - cross protection and host plant resistance – Types of resistance - vertical and horizontal resistance – resistance breeding and Resistant varieties. Mechanism of resistance- structural and bio chemical resistance in plants -Biotechnological approaches for crop disease management. Implementation and impact of IPM. IPM module for Soil borne, air borne, Seed borne and vector borne plant disease management

Practical

Survey and Assessment of important plant diseases- Diagnosis of Plant diseases- Classification and grouping of fungicides- Preparation of Bordeaux mixture (1%) and Bordeaux paste (10%), Calculation of fungicides quantity and methods of application of fungicides – Special methods of application. Mass multiplication of *Trichoderma asperellum*, *Pseudomons fluorescens* and *Bacillus subtilis* and method of application-Preparation of leaf extracts, oil emulsion of neem and antiviral principles. Cross protection-Tissue culture –meristem tip culture technique. Visit to commercial biocontrol production unit/seed Testing Laboratory and pesticide testing laboratory.

Theory

1. Plant diseases – abiotic , biotic diseases, classification based on mode of infection, multiplication of inoculum , spread, symptoms, occurrence & distribution
2. Epidemiology – disease triangle/ disease Pyramid - role of weather factors in plant disease development. Boom and bust cycle in disease outbreak
3. Disease surveillance –different methods- surveillance report-disease surveillance programme in Tamil Nadu.
4. Assessment of plant diseases- different methods- measurement of disease growth rate by Area Under Disease Progressive Curve (AUDPC)
5. Forecasting of plant diseases- forecasting models in plant disease management
6. Diagnosis of plant diseases-seed health tests, chemodiagnosis, serodiagnosis and molecular diagnosis

7. Avoidance and Exclusion- plant quarantine – domestic, international and embargo - phytosanitary certificate- Quarantine in India. Post entry quarantine in India. Exotic diseases introduced into India
8. Eradication: Role of cultural practices in plant disease management- different methods of eradication of plant diseases
9. **Mid semester examination**
10. Protection –physical methods of protection- chemical fungicides – ideal characters- formulations and adjuvants- safety measures to be followed while handling fungicides
11. Sulphur and copper fungicides,- classification -phytotoxicity, mode of action and uses
12. Mercury fungicides, Heterocyclic nitrogen compounds , Organo tin, Quinone, Benzene and Miscellaneous compounds , mode of action and uses
13. Systemic fungicides including antibiotics – classification – mode of action - uses.
    New generation fungicides, plant activators/ SAR inducing chemicals in plant disease management. Methods of application of fungicides: seed treatment, foliar spray, soil drenching and special methods of application.
14. Biological control – definition - mechanism of action – mass production of *Trichoderma asperellum* , *Pseudomonas fluorescens* & *Bacillus subtilis* - methods of application - plant products – antiviral principles – preparation – methods of application
15. Disease resistance- types- resistant varieties. methods of developing resistant varieties- Mechanisms of resistance- structural and bio chemical resistance in plants- cross protection
16. Biotechnological approaches in plant diseases management: Tissue culture techniques- meristem tip culture, somoclonal variation and transgenic plant production by genetic engineering.
17. IPM module for soil borne , Airborne , Seed borne and vector borne plant diseases

Practical Schedule

1. Survey and assessment of important plant diseases
2. Diagnosis of plant diseases: Tetrazolium test, Iodine test , ELISA test and ooze test, paraquat test
3. Seed health tests for diagnosis of seed borne pathogens - dry seed examination, seed washing, blotter tests
4. Classification and grouping of fungicides.
5. Preparation of Bordeaux mixture (1%) and Bordeaux paste (10%)
6. Calculation of spray fluid and methods of application of fungicides – seed (wet and dry) soil, foliar and post harvest dipping
7. Special methods of application: swabbing, acid delinting, pseudostem injection, capsule application
8. Special methods of application: corm injection, paring and prolinage, root feeding and trunk injection.
9. *In vitro* assay of fungicides against fungal pathogens
10. *In vitro* assay of biocontrol agents and their compatibility with agrochemicals
11. *Trichoderma viride* -mass production and methods of application
12. *Pseudomons fluorescens* and *Bacillus subtilis* -mass production & methods of application
13. Visit to commercial biocontrol production unit /seed and pesticide testing laboratories

14. Preparation of leaf extracts, oil emulsion of neem and antiviral principles.
15. Cross protection: production of pre immunized citrus seedlings against tristeza virus.
16. Tissue culture – Production of virus free plants through meristem tip culture technique.
17. Practical Examination

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1. Arjunan.G. Karthikeyan, G, Dinakaran ,D. Raguchander,T. 1999 Diseases of Horticultural Crops, AE Publications, Coimbatore.
2. Rangasawmi ,G and Mahadevan, A. 1998. Diseases of crop Plants in India, Prentice Hall of India Pvt. Ltd., New Delhi
3. Prakasam, V., Valluvaparidasan, V., Raguchander, T. and K.Prabakar. 1997. Field crop diseases, AE Publication, Coimbatore.

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1. Agrios, G.N. 2008. Plant Pathology, Academic Press, New York
2. Rangaswami, G. 2005. Diseases of Crop plants in India. Prentice Hall of India Pvt. Ltd., New Delhi
3. Thakur, B.R. 2006. Diseases of field crops and their management

AEN 202 MANAGEMENT OF BENEFICIAL AND HARMFUL INSECTS (2+1)

Theory

Unit I: Classification of insects based on economic importance - Apiculture - Bee species – comparison- castes of bees, bee behaviour and bee dance; Apiary management practices – bee pasturage, foraging, seasonal variations; Bee products – properties and uses; Effect of agricultural inputs on bee activity – pesticide poisoning.

Unit II: Moriculture; Silkworm rearing; Lac insect- biology-strains-natural enemies of lac insect and lac products; Weed killers, pollinators, scavengers and soil builders; Balance of life in nature – population dynamics – role of abiotic and biotic factors. Life table – interspecific and intraspecific relationships

Unit III: Pests – definition and categories – pest outbreak – factors governing pest outbreak– pest monitoring, surveillance and forecasting. Economic Threshold Level – Economic Injury Level- Integrated Pest Management – history, principles and strategies – requirements for successful pest management programme; Cultural, physical, mechanical, ecological engineering methods and host plant resistance in pest management

Unit IV: Parasitoids, predators and microbial agents in pest management. Legal methods – definition – pest introductions – quarantine – phytosanitary certificate – pest legislation. Pesticides – history, classification – mode of action of insecticides. Pesticides compatibility, safety and hazards in the use of pesticides – pesticide poisoning - impact of pesticides in agro-ecosystem.

Unit V: Insecticide act. Insecticides residues and resistance. Semiochemicals – allomones – kairomones – pheromones- semiochemicals in pest management. Sterile male technique – chemosterilants, insect growth regulators – moult inhibitors – Juvenile Hormone mimics – antifeedants and repellents. Natural pesticides. Biotechnology in pest management. Bio safety of transgenic plants. Impact of global warming on pests. Bio-intensive/Bio-rational/ Eco-friendly Integrated Pest Management – Indigenous/traditional technologies in Integrated Pest Management

Practical

Identification, morphology and structural adaptations in honey bees. Bee keeping appliances, bee enemies and diseases. Sericulture. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products. Study of useful insects- Pollinators, weed killers, scavengers and soil builders. Symptoms and types of damage caused by insect pests. Assessment of insect population and their damage in field crops. Cultural, mechanical and physical control of insects. Identification and mass culturing of different types of parasitoids, predators and entomopathogens. Behavioral approaches in pest management – Pheromone traps, light traps, sticky traps and others. Pesticide formulations and toxicity parameters. Pesticide application techniques. Preparation of spray fluids and botanicals for field application. Plant protection appliances.

Theory lecture schedule:

1. Economic classification of insects
2. Bee species – comparison – castes of bees – bee behaviour and bee dance
3. Apiary management practices – bee pasturage – foraging – seasonal variations.
4. Bee products – their properties and uses
5. Effect of agricultural inputs on bee activity – pesticide poisoning
6. Ecological requirements for mulberry cultivation – soil type – mulberry varieties – Methods of propagation – merits and demerits – selection of semi hard wood cuttings
7. Pests and diseases of mulberry
8. Types of silkworm - Mulberry silkworm – origin – classification based on voltinism, moultinism, geographical distribution and genetic nature – Characters of multivoltine races, bivoltine races, cross breeds and bivoltine hybrids – double hybrids– suitability for rearing in different seasons.
9. Morphology and biology of silkworm – sexual dimorphism in immature and adult stages – silkworm genetics – chromosome number – sex limited characters in egg, larva and cocoon for grainage use.
10. Lac insect- biology-strains-Natural enemies of lac insect and lac products

11. Weed killers, pollinators, scavengers and soil builders
12. Insect ecology – definition – balance of life in nature – reproductive potential and environmental resistance
13. Population dynamics – role of biotic factors – competition – parasitoids and predators. Life table – Interspecific and intraspecific relationship
14. Abiotic factors – physical, nutritional and host plant associated factors on insect population.
15. Pests – definition, categories and causes for outbreak of pests. Losses caused by pests
16. Pest monitoring – pest surveillance and forecasting – objectives, survey, sampling techniques and decision making. Economic Threshold Level and Economic Injury Level. Factors influencing Economic Injury Level and Economic Threshold Level
17. Midsemester examination
18. Integrated Pest Management – history, principles and strategies – requirements for successful pest management programme. Components of pest management
19. Cultural methods – definition – characteristics, requisites – farm level practices and community level practices, advantages and disadvantages- Ecological Engineering in pest management
20. Physical methods – definition – use of heat, moisture, light, electromagnetic energy and sound energy – Mechanical methods – definition – mechanical destruction and exclusion – merits and demerits
21. Host plant resistance – types and mechanisms of resistance and role of host plant resistance in pest management
22. Biological control – definition, parasitoids and predators and their role in pest management
23. Microbial control – viruses, bacteria, fungi, protozoa and nematodes and their role in pest management
24. Legal methods – definition – pest introductions – quarantine – phytosanitary certificate – pest legislation
25. Chemical control – definition – history of insecticide development – toxicity parameters – ideal qualities of an insecticide
26. Classification of insecticides based on mode of entry, mode of action and chemical nature
27. Mode of action of organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, diamides and avermectins
28. Pesticide compatibility, safety and hazards – pesticide poisoning - antidotes – safe handling – impact of pesticides on agroecosystems
29. Insecticides Act 1968 – insecticide residues and waiting periods, role of pesticides in pest management, insecticide resistance management
30. Semiochemicals – definition – intraspecific semiochemicals – allomone, kairomone, synomone and apneumone - Interspecific semiochemicals – pheromone, sex pheromone, alarm and trail marking pheromone. Pheromones in Integrated Pest Management
31. Sterility methods – definition – principles – methods – requirements and limitaitons
32. Insect growth regulators – moult inhibitors – Juvenile Hormone mimics – mode of action and uses. Insect antifeedants and repellents – mode of action, groups and uses
33. Botanicals and Biotechnological approaches in pest management – bio safety of transgenic plants
34. Impact of global warming on pests. Integrated Pest Management : Issues and options. Bio-intensive/Bio-rational/ Eco-friendly Integrated Pest Management – Indigenous/traditional technologies in Integrated Pest Management

Practical schedule:

1. Identification, morphology and structural adaptations in honey bees
2. Bee keeping appliances, bee enemies and diseases
3. Mulberry nursery bed preparation – methods of planting - Pruning methods – leaf / shoot harvest– preservation of leaves.
4. Identification of damage symptoms of insects, diseases and nematodes of mulberry
5. Chawki rearing and shoot rearing
6. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products

7. Study of useful insects-Pollinators, weed killers, scavengers and soil builders
8. Symptoms and types of damage caused by insect pests , Assessment of insect population and their damage in rice, cotton and brinjal
9. Cultural, mechanical and physical control of insects
10. Identification and mass culturing of different types of parasitoids
11. Identification and mass culturing of different types of predators
12. Identification and mass production of entomopathogens
13. Behavioral approaches in pest management – Pheromone traps, light traps, sticky traps and others
14. Pesticide formulations and toxicity parameters
15. Pesticide application techniques, Preparation of spray fluids and botanicals for field application
16. Plant protection appliances
17. Final Practical examination

References:

1. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
1. Pedigo, L.P. and M.E.Rice.1996. *Entomology and Pest Management.* Prentice-Hall of Idia Pvt Ltd, New Delhi. 812p. {ISBN-978-8120338869}
2. Dhaliwal, G.S. and R.Arora. 2001. *Integrated Pest Management – Concepts and approaches*. Kalyani publishers, New Delhi. 427p. {ISBN: 81-7663-904-4}
3. Dandin, S.B., J.Jayaswal and K. Giridhar.2003. *Hand book of Sericulture Technologies*. Central Silk Board, Bangalore, 287 p.

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AGR 203 Crop Production Technology- II (Rabi crops) (1+1)

Theory

Unit I : Cereals

Wheat, barley, Oats **-** Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit II : Pulses

Chickpea, lentil, peas **-** Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit – III Oilseeds

Rapeseed, mustard and sunflower- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit -IV: Sugar Crops

Sugarcane - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit V: Forage crops

Berseem, Lucerne , Fodder maize : Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices.

Practical:

Identification of rabi cereals, pulses, oilseeds, sugarcane, and forage crops - nursery preparation and management for sugarcane - main field preparation; Seed treatment techniques - Sowing and manuring - Seeding equipment's - Estimation of population - After cultivation practices - Study of growth and yield parameters and yield estimation, harvesting of above crops; Fodder preservation techniques - Silage and hay making, Cost and returns - Visit to institutes and industries - Farmers' fields

Lecture Schedule:

1. Wheat- Origin, geographic distribution, economic importance, soil and climatic requirement,
2. Wheat - varieties, cultural practices and yield.
3. Barley and oats - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
4. Chickpea- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
5. Lentil and peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
6. Peas - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
7. Rapeseed and Mustard - Origin, geographic distribution, economic importance, Classification , soil and climatic requirement, varieties
8. Rapeseed and mustard - cultural practices, yield.
9. **Mid semester examination**
10. Sunflower- Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
11. Sugarcane - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties,
12. Sugarcane - cultural practices and yield.
13. Sugarcane- package of practices for SSI
14. Sugarcane - Crop logging, maturity and ripening
15. Sugarcane - Gur manufacture , Value addition and byproduct utilization.

16. Berseem and Lucerne - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.
17. Fodder maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

1. Identification of rabi crops and recording their importance in the crop cafeteria.
2. Acquiring skill in field preparation, sowing and manuring of rabi crops under pure and intercropping situations.
3. Acquiring skill in different seed treatment techniques and foliar nutrition of rabi crops.
4. Estimation of plant population per unit area for rabi crops.
5. Nursery preparation for Sugarcane.
6. Acquiring skill in after - cultivation practices in sugarcane - detrashing, and Propping.
7. Study on growth parameters of sugarcane.
8. Study on yield parameters and estimation of yield in sugarcane.
9. Study on yield parameters and estimation of yield in rabi crops.
10. Estimating Cost and returns of important rabi crops.
11. Visit to Sugarcane Breeding Institute/ Research Station to study cultivation of sugarcane and its by products.
12. Visit to - nearby sugar mill, for observing juice extraction, quality assessment, sugar manufacture and by products.
13. Silage making.
14. Practicing field preparation and sowing Lucerne.
15. Practicing field preparation and sowing for fodder maize.
16. Visit to Wheat research station, Wellington to study rabi crops – wheat, barley, rye, oats.
17. **Practical Examination.**

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Rajendra Prasad. 2012. Text Book on Field Crop Production, Indian Council of Agrl. Research, New Delhi.

Ahlawat,I.P.S., Om Prakash and G.S. Saini. 2010. Scientific Crop Production in India. Rama publishing House, Meerut

Chidda Singh, Prem Singh and Rajbir Singh. 2011. Modern Techniques of Raising Field Crops. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.

Reddy,S.R. 2012. Agronomy of field crops. Kalyani publishers, New Delhi.

Crop production guide.2012. Directorate of Agriculture, Chennai

ICAR 2015. Hand book of Agriculture. Indian Council of Agricuture, New Delhi

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AGR 204 Farming System and Sustainable Agriculture (1+1)

Theory :

Unit - I: Cropping System

Cropping systems - Definition - Principles - Concepts - Classification - mono cropping - intensive cropping - cropping systems of India and Tamil Nadu - Interaction between different cropping systems - Cropping system management - Resource management - land, nutrient, water and weed.

Unit - II: Evaluation of Cropping System

Index for evaluation of cropping systems - Land use - yield advantages - Economic evaluation - sustainability.

Unit - III: Farming System

Farming systems - Definition - Principles - Concepts - Enterprises selection and management - interaction between different enterprises with cropping - scope and advantages of Integrated Farming system - Integrated farming system models for different agro eco-systems - interaction between enterprises.

Unit - IV: Evaluation of Farming System

Resource recycling in IFS - Evaluation indicators of integrated farming system - LEISA & HEIA - concepts and principles - Conservation agriculture - principles, concept and scope.

Unit - V: Resource and labour management in farming system

Resource management under constraint situation - Cost reduction strategies in crop production - Non-monetary inputs and low cost technologies - Labour management - farming system and environment.

Practical:

Preparation of cropping scheme - working out input requirements for crops, cropping systems - preparation of calendar of operations for wetland, irrigated upland and dry land cropping system - visit to cropping system experiments - working out indices for evaluation of cropping systems - visit to different units: dairy, goat, poultry, fishery. Mushroom, sericulture and biogas - study on evaluation indicators on farming system - preparation of integrated farming system models for different eco-systems - on farm field visit - analysis of farming system models.

Lecture Schedule

1. Cropping system: Definition, Principles and basic concepts.
2. Classification of cropping system - Mono cropping, intensive cropping, multiple cropping, mixed cropping.
3 Major cropping systems prevailing in India and Tamil Nadu for different agro eco systems.
4. Complementary and competitive interaction in different cropping system - light, nutrient, water and weed.
5. Cropping system management: agronomic requirement for crops and cropping system selection of crops and varieties, tillage and land shaping, plant population and crop geometry.
6. Cropping system management: agronomic requirement for crops and cropping system - water management, soil fertility management and plant protection.
7. Indices for evaluation of cropping system - land use, yield advantage and economics.
8. Farming system: definition, principles and concepts and factors influencing choice and size of enterprises
9. **Mid Semester Examination.**
10. Scope and advantages of integrated farming system.
11. Allied enterprises for wetland, irrigated upland and dryland - selection and management and their interaction.
12. Resource recycling in integrated farming system.

13. Integrated Farming System evaluation indicators.
14. Integrated farming system - models for wetland, irrigated upland and dryland eco system.
15. LEISA and HEIA - principles and concepts and Labour management in integrated farming system.
16. Conservation agriculture and environmental impact of integrated farming system.
17. Cost reduction technologies and non monetary inputs in integrated farming system.

Practical Schedule:

1. Visit to cropping system experiments in wetland.
2. Visit to cropping system experiments in irrigated upland and dryland.
3. Preparation of cropping scheme for wetland and working out input requirement.
4. Preparation of cropping scheme for irrigated upland and working out input requirement.
5. Calendar of operations for wet land and irrigated upland cropping system.
6. Working out indices for evaluating the cropping system - land use, yield advantage.
7. Working out indices for evaluating the cropping system - Economics, sustainability.
8. Visit to dairy, goat and poultry units.
9. Visit to mushroom unit.
10. Visit to sericulture and biogas unit.
11. Preparation of integrated farming system models : wetland eco-system.
12. Preparation of integrated farming system models : irrigated upland and dryland eco systems.
13. Resource recycling in integrated farming system models of different eco systems.
14. Evaluation of integrated farming system models : wetland eco-system.
15. Evaluation of integrated farming system models : irrigated upland and dryland eco systems.
16. On-farm visit to cropping fields and integrated farming system units.
17. **Practical examination**.

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1. Palaniappan, SP and K. Sivaraman.1996. Cropping systems in the tropics Principles and management.
2. New Age International (P) Ltd., New Delhi.
3. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House.Delhi.
4. S.C. Panda. 2003. Cropping and Farming Systems. Agrobios Publishers. Jodhpur. Jana, B.L. 2014. Farming Systems. Agrotech Publishing Academy, Udaipur Shagufta. 2015. Cropping and Farming Systems. APH Publishing Corporation

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SAC 202 Problematic Soils and their Management (2+0)

Theory

Unit-I

Soil quality and health, Distribution of Waste land and problem soils in India and Tamil Nadu. Categorization of waste lands based on properties.

Unit-II

Characteristics, reclamation and management of soil physical and chemical constraints - Eroded and Compacted soils, Flooded soils, Saline and sodic soils, Acid soils, Acid Sulphate soils, degraded alkali soils and Polluted soils. Effect of salts on soil and plants.

Unit-III

Remote sensing and GIS in assessment and management of problem soils. Irrigation water – quality and standards. Utilization of saline water in agriculture.

Unit-IV

Multipurpose tree species, bio remediation of soils through MPTs, land capability classification, land suitability classification. Problematic soils under different Agro ecosystems - Soil fertility improvement through carbon build up.

Lecture Schedule:

1 Soil health - Definition - Soil Quality Indices – Physical indicators
2 Soil Quality Indices - Chemical and biological indicators
3 Distribution of waste lands and problem soils in India and Tamil Nadu
4 Categorization of waste lands based on properties
5 Soil physical constraints – slow permeable, excessively permeable soils and fluffy paddy soils - Characteristics and management
6 Soil crusting, soil compaction, sub soil hard pan, sand dunes and shallow soils – characteristics and management
7 Eroded soil – Genesis, types and characteristics: water- sheet, rill, gully, ravines, wind – Aeolian, loess, saltation, suspension , soil creep
7 Universal soil loss equation and erosion control measures
8 Flooded soils – Formation, characteristics and management
9 Acid soil and acid sulphate soil – Genesis and characteristics.
10 Lime requirement of acid soil, liming materials, reclamation and management of acid soil
11 Formation and classification of Saline, Sodic and saline sodic soils
12 Effects of Salts on soils- Physical: Clay swelling and Dispersion, permeability, Infiltration, Crust, Water
transmission. Chemical: pH and EC. Biological : Microbial activity.
13 Effects of Salts on plants – Plants response to saline and sodic conditions, Factors affecting salt tolerance, crop response to salinity, ratings of crop salt tolerance.
14 Salts and plant mineral nutrition- Salinity and nutritional effects: Salinity and N, P, K, Ca, Mg, S, and Micronutrients. Alkalinity and nutritional effects.
15 Saline, Sodic, saline sodic, and degraded alkali soils- characteristics and their management
16 Saline soil-reclamation – Leaching requirement. Sodic soil – reclamation -gypsum requirement – calculations.
17 **Mid semester examination**
18 Polluted soils- industrial effluent s- Characteristics, reclamation and management
19 Polluted soils- mine spoils- Characteristics, reclamation and management
20 Irrigation water – quality and standards - EC, SAR, RSC, RSBC SSP, PSI and PS
21 Irrigation water – quality and standards -USDA system and specific ion toxicity-USSL system

22 Factors affecting suitability of irrigation water and Management of poor quality water in agriculture

23 Remote sensing and GIS in assessment of wastelands and problem soils

24 Remote sensing and GIS in monitoring and management of wastelands and problem soils

25 Multipurpose tree species for waste lands and problem soils

26 Bio remediation through MPTs of soils

27 MPTs - Nutrient cycling under waste lands and problem soils

28 Land capability and classification

29 Land suitability classification

30 Problematic soils under different Agro ecosystems- coastal salinity, inland salinity

31 Problematic soils under different Agro ecosystems- marshy, swampy soils, red sand dunes (Theri soils) Tsunami affected soils.

32 Agricultural Ecosystem services- Soil fertility improvement in problem soils

33 Potential of agro forestry systems in management of problem soils

34 Carbon sequestration and its role in problem soil management

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4. Soil Survey Staff. 2006. Keys to Soil Taxonomy. United States Department of Agriculture, Natural Resources Conservation Service.
5. Maliwal, G.L. and L.L. Somani. 2010. Nature, Properties and Management of saline and alkali soils. Agrotech publishing academy, Udaipur.

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HOR 212 Production Technology for Ornamental Crops, MAPs and Landscaping (1+1)

Theory

Unit I: Landscaping

Importance and scope of ornamental crops landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers.

Unit II: Production technology of cut flower crops under protected conditions

Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions

Unit III: Production technology of flowers under open conditions and value addition in ornamental crops

Production technology of important cut flowers like gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Processing and value addition in ornamental crops.

Unit IV: Production technology of medicinal crops

Medicinal crops- importance and scope – current status - soil and climate – varieties – propagation– planting methods – nutrient, irrigation and organic practices – harvest – post-harvest handling – storage, packaging of Periwinkle, Asparagus, Aloe, Costus, Isabgol, Glory lily, extraction and value addition of medicinal crops.

Unit V: Production technology of aromatic crops

Aromatic crops - importance and scope – current status -- soil and climate – varieties – propagation– planting methods – nutrient, irrigation and organic practices – harvest – post-harvest handling – storage, packaging of Ocimum, Mint, Geranium, Citronella, Lemon grass, Palmarosa and Vetiver – Distillation of oil and value addition.

Practical

Identification of Ornamental plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Protected structures – care and maintenance. Intercultural operations in flowers. Harvesting and post harvest handling of cut and loose flowers. Visit to commercial flower unit.

Medicinal and Aromatic Plants

Identification of Medicinal and Aromatic Plants- varieties-propagation-special practices - nutrient management, extraction and distillation of essential oil - Periwinkle, Asparagus, Aloe, Costus, Isabgol, Glory lily, Ocimum, Mint, Geranium, Citronella, Lemon grass, ,Palmarosa and Vetiver – visit to commercial medicinal and aromatic plants fields and processing units

Theory lecture schedule

1. Importance and scope of ornamental crops and landscaping.
2. Principles of landscaping
3. Landscape uses of trees, shrubs and climbers.
4. Production technology of cut rose under protected conditions
5. Production technology of gerbera and carnation under protected conditions
6. Production technology of lilium and orchids under protected conditions
7. Production technology of gladiolus and tuberose under open conditions
8. Production technology of chrysanthemum and marigold under open conditions
9. **Mid Semester Examination**.

10. Production technology of jasmine under open conditions.
11. Processing and value addition in ornamental crops.
12. Scope and Importance of medicinal & aromatic crops– current status - conservation methods
13. Periwinkle, Asparagus and Aloe - varieties –- soil and climate – propagation- sowing and planting, nutrient, water management – harvest and processing
14. Costus, Isabgol and Glory lily - Propagation- soil and climate – propagation and planting- standards - pollination-nutrient, irrigation management – harvest, yield and processing
15. Ocimum, Mint, Geranium - varieties – soil and climate- propagation - planting - nutrient, water management – harvest - distillation of essential oil
16. Citronella, Lemon grass, Palmarosa and Vetiver - varieties – soil and climate- propagation - planting – nutrient- water and weed management – harvest- distillation of essential oil.
17. Processing and value addition in medicinal and aromatic plants.

Practical schedule

1. Identification, planting, care and maintenance of trees, shrubs and climbers used in garden
2. Identification of varieties in cut flowers under protected conditions.
3. Identification of varieties in flowers under open conditions.
4. Practices of nursery bed preparation, seed sowing in ornamental plants.
5. Training and pruning and intercultural operations in Ornamental plants
6. Planning and layout of garden.
7. Protected structures – care and maintenance.
8. Harvesting and post harvest handling of cut and loose flowers.
9. Identification of medicinal and aromatic plants –economic parts
10. Propagation techniques, planting, cultural operations in Periwinkle, Asparagus and Aloe.
11. Propagation techniques, planting, cultural operations in Costus, Isabgol and poppy.
12. Propagation techniques, planting, cultural operations in Ocimum, Mint, Geranium
13. Propagation techniques, planting, cultural operations in lemon grass, palmarosa, vetiver and citronella
14. Extraction and distillation of medicinal & Aromatic crops.
15. Visit to commercial floriculture and floral oil extraction units
16. Visit to commercial medicinal and aromatic crops field and extraction unit.

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6. http://www.indiaagronet.com/
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ANM 201 INTRODUCTORY NEMATOLOGY (0+1)
SYLLABUS

PRACTICAL

Usage and handling of microscopes (binocular, trinocular, zoom and compound microspores) -Soil and root sampling – Extraction of active nematodes and cysts from soil and roots (Cobb's sieving and decanting technique, Baermann funnel technique, conical flask technique, Sugar floatation technique, Fenwick can method, Incubation and Blender technique) – Nematode processing techniques (preservation, slow and rapid method of processing, making semi permanent and permanent slides) – Morpholoy of orders *Tylenchida* (*Hoplolaimus*), and *Dorylaimida* (*Xiphinema*) – Identification of important nematodes (*Tylenchorhynchus*, *Helicotylenchus*, *Pratylenchus, Hirschmanniella. Hemicriconemoides* / *Criconema Heterodera* / *Globodera, Tylenchulus*, and *Aphelenchoides*) – Life stages of sedentary and migratory endoparasites – symptoms of important nematode diseases – Nematicides and their application – Biocontrol agents-bacteria and fungi.

PRACTICAL

1. Soil and root sampling. Extraction of nematodes by Cobb's sieving method; Baermann funnel Technique and modified Baermann funnel technique.
2. Extraction of nematodes by sugar flotation technique; Extraction of cysts by conical flask technique and fenwick can method.
3. Extraction of nematodes from roots and staining of roots infested with endoparasitic and semi – endoparasitic nematodes.
4. Preservation of nematodes and preparation of temporary and permanent slides.
5. Observing morphology of the order Tylenchida (*Hoplolaimus*) and Dorylaimida (*Xiphinema*, *Longidorus*).
6. Identification of nematodes – *Tylenchorhynchus, Helicotylenchus*.
7. Identification of nematodes – *Pratylenchus*, *Hirschmanniella*.
8. Identification of nematodes – *Hemicriconemoides* – *Criconema*, *Heterodera* – *Globodera*.
9. Identification of nematodes – *Tylenchulus, Aphelenchoides*.
10. Study of life stages of *Meloidogyne, Rotylenchulus*.
11. Study of life stages of *Radopholus*.
12. Study of Entomopathogenic nematodes
13. Study of life stages of Nematodes diseases of rice (White tip and rice root nematode)
14. Damage caused by root – knot and reniform nematodes indifferent crops.
15. Symptoms of damage caused by citrus nematode; the lesion nematode and the burrowing nematode of banana.
16. Study of types of nematicides, application methods and calculation of dosages; study of biocontrol agents.
17. Practical examination.

NST 201 Fundamentals and Applications of Nanotechnology (1+0)

Theory

Unit I - Principles of Nanoscience (4 Lecture) : History, definition, terminologies in nanoscience - Importance of Moore's law- Introduction to nanomaterials – Semiconductor – Diode – Quantum Dots- Buckyball - CNT - Polymers- types – PLGA – coreshell nanoparticles - micelle - Introduction to nanobiosensor- types- properties and applications

Unit II - Synthesis of Nanomaterials (3 Lectures): Top-down and bottom-up approaches - Physical, Mechanical, Chemical and Biological synthesis of nanomaterials

Unit III - Properties and Characterization of Nanomaterials (4 Lectures)**:** Physical, Mechanical, optical, magnetic, thermal and electrical properties – Characterization – SEM, TEM, AFM, FT-IR, XRD

Unit IV - Application of Nanotechnology (2 Lectures) **:** Agriculture and Food Systems

Unit V - Application of Nanotechnology (3 Lectures): Energy, Environment, Health – Social, Economic and Ethical issues – Nanotoxicology

Lecture schedule

Unit 1 Principles of Nanoscience (4 lectures)

1. History, definition, terminology in nanoscience and importance of Moore's law.
2. Nanomaterials – Semiconductor – Diode – Quantum Dots - Buckyball - CNT – - characteristics – Applications
3. Polymers - Types – PLGA – Coreshell nanoparticles - Micelles - characteristics – Applications
4. Biosensors – Principle, Components, Types, Applications

Unit 2 Synthesis of Nanomaterials (3 lectures)

5. Top down and Bottom up approaches - Physical method, Physical Vapour Deposition (PVD), Etching - Molecular Beam Epitoxy – Sputtering – Lithography - Mechanical synthesis - Ball milling – Types - Mechanical alloying
6. Chemical synthesis – Sol-gel Method – Chemical Vapour Deposition (CVD) – electro-deposition- thin film
7. Biological synthesis using Microorganisms and Plants

Unit 3 Properties and Characterization of Nanomaterials (4 lectures)

8. Mechanical, magnetic and thermal properties of nanomaterials
9. Optical and electrical properties of nanomaterials
10. *Principle, components and application of nanotechnology equipments*: Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM)
11. *Principle, components and application of nanotechnology equipments*: X-ray Diffraction (XRD) – Fourier Transform Infra Red Spectroscopy (FT-IR) – Atomic Force Microscope (AFM)

Unit 4 Applications of Nanotechnology in Agriculture & Food Systems (2 Lectures)

12. Agriculture – Nano fertilizers – Nano-herbicides – Nano-pesticides – Seed technology
13. Nanotechnology in Food Systems – Nano foods, Nano-encapsulation of functional foods, Nano-packaging, Quality assessment.

Unit 5 Applications of Nanotechnology in Energy, Environment, Health (3 Lectures)

14. Nanotechnology applications in Energy and Environment
15. Applications in Health Sciences and Nanotoxicology
16.Social, Economic and Ethical Issues in Nanotechnology

References:

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2. Nano materials - B.Viswanathan - 2009 -Narosa.
3. Introduction to nanotechnology - Charles P. Poole; Frank J. Owens – 2008 – Wiley.
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5. Instrumental methods of analysis - Hobart H. Willam; Lynne L. Merrit – 2006 -CBS.
6. Fundamentals of physics - David Halliday; Robert Resnick – 2007 – Willey.
7. Chemistry Raymond Chang – 2009 - Tata Mcgraw Hill.
8. Nanomaterial chemistry - C.N. Rao, A. K . Chettam, A. Muller – 2007 – Wiley – VCH.
9. Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

ERG 211 RENEWABLE ENERGY AND GREEN TECHNOLOGY (1+1)

THEORY

Unit I- Introduction to Renewable energy Sources

Energy crisis – classification of energy sources – renewable energy – significance – potential - achievements in India. Biomass – methods of energy conversion.

Unit-II Biochemical Energy Conversion

Biofuels – importance – biodiesel and bioethanol production method – flowchart – by products utilization. Biogas technology – classification - types - factors affecting biogas plants- alternate feedstocks – applications - biodigested slurry and enrichment.

Unit III – Thermochemical Energy Conversion

Briquetting –methods- advantages and disadvantages -combustion –definition- Improved chulhas – types – construction features - applications. Pyrolysis – methods for charcoal /biochar production- comparion of slow and fast pyrolysis. Gasification – chemistry – types – updraft gasifier -downdraft gasifier – working principles – operation and applications.

Unit IV – Solar Energy Conversion

Solar Energy – characteristics - types of radiation – solar constant-solar thermal devices – solar water heater – solar cooker – solar pond – solar distillation – working principles and applications. Solar PV systems – principle – solar lantern - water pumping. Solar driers – natural and forced convection types – solar tunnel drier – working principles and operation.

Unit V- Wind and other Renewable Energy Sources

Wind – formations - Wind mills – types – horizontal and vertical axis – components – working principles – applications. Geothermal energy – wave energy – tidal energy – ocean energy – principle and operation - types – advantages and disadvantages

PRACTICAL

Familiarization with renewable energy gadgets. To study biogas plants, To study gasifier, To study the production process of biodiesel, To study briquetting machine, To study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, solar fencing. To study solar cooker, To study solar drying system. To study solar distillation and solar pond.

Lecture Schedule

1.	Energy crisis – renewable energy sources – significance – potential and achievements in India – energy requirements of agricultural and horticultural crops.	**TB-1**: 1-10
2.	Biomass – methods of energy conversion – biochemical conversion methods – thermochemical conversion methods.	**TB-1**: 12-26
3.	Biofuels – importance – biodiesel and bioethanol production method – flowchart – by products utilization	**TB-1**: 164-177; 182-183
4.	Biogas technology – classification - types of biogas plants – KVIC and Deenabandhu model biogas plants – factors affecting biogas plants.	**TB-1**: 30-43
5.	Alternate feedstocks for biogas production – applications of biogas cooking, lighting and engine operations - biodigested slurry and enrichment.	**TB-1**: 45-49
6.	Briquetting – MED – VED – methods – need for briquetting - benefits of biomass briquettes.	**TB-1**: 92-99
7.	Combustion – improved chulha – single pot – double pot – conventional chulha – biomass gas stove – constructional features – principles and applications.	**TB-1**: 52-57; 64-67
8.	Pyrolysis – methods for charcoal production –biochar production– comparison between slow and fast pyrolysis.	**TB-1**: 67-73
9.	Mid semester examination	
10.	Gasification – chemistry – types – updraft gasifier – working principles	**TB-2**: 395-411

operations – application

11. Downdraft gasifier – working principles – operation and applications.
12. Solar energy – characteristics of solar radiation - types of radiation – solar constant **TB-1**: 101-105
13. Solar thermal devices – solar water heater – solar cooker – solar pond – solar distillation – working principles and applications. **TB-1**: 105-114 **TB-2**: 138-142, 195-197
14. Solar PV systems – principle – solar lantern - water pumping applications. **TB-1**: 117-123
15. Solar driers – natural and forced convection types – solar tunnel drier – working principles and operation. **TB-1:** 115-117
16. Wind mills – types – horizontal and vertical axis – components – working principles – applications. **TB-1**: 136 - 144
17. Energy from ocean, waves, tides. Geothermal energy sources – principles and operation. **TB-1**: 189-205

Practical schedule

1. Basic principles of working of renewable energy gadgets
2. Experiments on biodiesel production
3. Experiments on bioethanol production process
4. Construction and working principle of KVIC biogas plant
5. Construction and working principle of deenbandhu biogas plant
6. Experiments on biogas applications
7. Experiments on briquetting technology
8. Performance evaluation of improved chulha
9. Evaluation of biochar production systems
10. Experiments on biooil production method
11. Performance evaluation of producer gas production system
12. Performance evaluation of solar dryers
13. Experiments on solar cookers and distillation systems
14. Performance evaluation of solar water heaters
15. Experiments on solar water pumping system
16. Performance assessment of solar street light and fencing
17. Final practical examination

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