

**Mother Teresa Women's University
Kodaikanal - 624102**

1. Agriculture Biotechnology

Unit I

Soil management: Definition, Types of soil, Soil components (organic and inorganic), Soil microbes and Soil fertility. Bacteria, Fungi and Nematodes – Biology and their application in agro chemical industries. Mycorrhiza - Applications in agriculture and forestry.

Unit II

Seed Technology: Definition, Morphology, Seed physiology, Seed processing and certification, Seed testing, Seed pathology and Seed management. Cultivation practices of regional crops - Sugarcane, Cotton, Rice, Sunflower, Brinjal, Cabbage, Tomato and Potato.

Unit III

Weeds: classification, reproduction, mode of dispersal. Methods of weed management. Insect pests: General characteristics of insect pests - stem borer, pod borer, aphids, leaf roller, fruit borer and thrips. Plant pathogens: Bacterial and Fungal disease in crops of rice, sugarcane, pulses, oil-seeds, cotton, fruits and vegetables and stored grains.

Unit IV

Genetic engineering of plants: production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other abiotic stress resistance; quality parameters: Modification of nitrogen fixing capabilities; gene pyramiding. Molecular farming: Use of plants for production of nutraceuticals, edible vaccines and other desired products.

Unit V

Integrated pest management-concepts and components; Physical, chemical and biological methods for disease management. Genetic manipulation of insects for their control. Role of Intellectual property Rights (IPR) in pesticides development. Pesticides and application of formulations. Health hazards and environmental impacts of residential pesticides.

References

1. Plant Biotechnology & Agricultural, (2011). Arie Altman. Marcel Dekker, Inc. USA.
2. Plants, Genes and Crop Biotechnology, (2003), Chrispeels, M.J. & Sadava D.E 2nd Edition. Jones and Bartlett Publishers, USA.
3. Agricultural biotechnology, 3rd Edition, (2012), S.S. Purohit. Agrobios Publishers, India.
4. Introduction to Plant Biotechnology, 2nd Edition, (2004), H.S. Chawla, Science Publishers Inc., USA.

2. ANIMAL HANDLING AND STUDIES

Unit-I

Media and reagents and Laboratory requirements: Types of cell culture media, Preparation and sterilization of cell culture media. Sterile handling of media, Sterilization of different materials used in animal cell culture. Instrumentation and equipments for animal cell culture. History of cell culture. Primary and secondary cell culture.

Unit-II

Different types of cell cultures: Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture. Development of cell lines, Characterization and maintenance of cell lines, stem cells, Cryopreservation, Common cell culture contaminants.

Unit-III

Anatomy and Physiology of animal: Structure and functions of organs – Heart- Liver – lungs - Kidney- Brain. Reproductive system – Muscular System – Circulatory system - Histopathology –

Unit-IV

In-vivo Animal Handling Guidelines for Handling of animal, Maintenance of animal, Animal house, Laboratory, Administration of drugs, Routes of administration, dissection procedures, Safety procedures.

Unit-V

Toxicity and Advanced Research: Toxicity - Guidelines for Toxicity –Cytotoxicity - Ethical Clearance – Ethical issues. Stem cell research - Current status and application in medicine. Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

REFERENCES

Anatomy and Physiology of Farm Animals, 7th Edition, Rowen D. Frandson, W. Lee Wilke, Anna Dee Fails, June 2009, ©2009, Wiley-Blackwell

["The Animals \(Scientific Procedures\) Act \(Amendment\) Order 1993"](#). August 23, 1993. Retrieved February 22, 2013.

3. Applied Plant Biotechnology

UNIT I:

Conventional plant breeding (introductory), Introduction to cell and Tissue culture, Tissue culture media (composition and preparation), Callus and suspension cultures, initiation and maintenance of callus and suspension cultures, single cell clones, Organogenesis, Embryogenesis, transfer and establishment of whole plants in soil.

UNIT II:

Shoot tip culture: rapid clonal propagation and production of virus free plants. Embryo culture and embryo rescue. Hybrid plants: protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid, cybrid.

UNIT III

Production of haploid plants: anther, pollen and ovary cultures for production of haploid plants and homozygous lines. Applications of plant transformation for productivity and performance: Herbicide resistance AND virus resistance.

UNIT IV

Transformation: DNA uptake by bacterial cells. Transfection: Chemical and physical methods, Viral vectors. Polyethylene glycol, DEAE-dextran, calcium phosphate coprecipitation, dimethyl sulfoxide, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection, Amplification of DNA: Polymerase chain.

UNIT V

Plant transformation technology: Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes.

References:

- Hamish A. Collin and Sue Edwards : Plant Cell Culture
- Peter M. Gresshoff : Plant Genome Analysis
- Razdan M. K : An Introduction to Plant Tissue Culture
- Jogdand S. N : Advances in Biotechnology
- An Introduction to Genetic Engineering Edited by: Desmond S. T. Nicholl
Cambridge, University Press February 2002.
- Shain- Dow Kung & Ray Wu (Ed) : Transgenic Plants

4. ENVIRONMENTAL BIOTECHNOLOGY

UNIT- I

Environmental issues: Environment – Basic Concepts and Issues. Environmental Pollution – types of pollution; sources and effect. Methods for the measurement of pollution; methodology of environmental management – Global environmental problems: Ozone depletion, UV-B, Green House Effect and Acid rain, their impact on biotechnological approaches for management.

UNIT -II

Biodiversity & conservation: Habitats and Ecosystem. Biological and species diversity. Phylogenetic relationship. Threats to biodiversity. Conservation and management. National parks and sanctuary, Biodiversity Bill 2002- patent Act. Environmental ethics.

UNIT -III

Environmental laws and policy: National and international laws. Indian legislation to protect the environment. The water act of 1974, the wildlife act of 1972, the air act of 1981, the Indian forest act of 1972, the forest (conservation) act of 1968, the atomic energy act of 1962, the factories act of 1948, the environmental protection act of 1986 and Biodiversity act of 2002. Case studies one each in the protection of forests, rivers and wildlife.

UNIT- IV

Environmental Education : Environmental Education, Sustainable development – concept, and growth of the idea, indicators of sustainability, Sustainability of Water Resources, Sustainable Management of Forests, Sustainability in Industry. Rural and Urban Environment. Current environmental issues in India – Case studies: Narmada Dam, There Dam, Almetti Dam.

UNIT- V

Intellectual Property rights (IPR), General agreement on tariff and trade (GATT), Trade related intellectual property (TRIP), Patents for plants, animals, transgenic organisms and DNA sequences. Plant breeder's and farmer's rights. Biosafety and ethical issues.

5. GENETIC EPIDEMIOLOGY

UNIT 1

Descriptive Epidemiology: Measures of Disease Occurrence, Estimates of Associations, Age Standardization, Cause of Disease, Descriptive Epidemiology in Public Health, Descriptive Epidemiology in Genetic Epidemiology, Descriptive Epidemiology in Clinical Epidemiology.

UNIT 2

Analytical Epidemiology: Design Options, Follow-Up Studies, Case–Control Studies, Cross-Sectional Study, Randomized Controlled Trial (RCT), Analytical Epidemiology in Public Health, Analytical Epidemiology in Genetic Epidemiology, Analytical Epidemiology in Clinical Epidemiology.

UNIT 3

Sources of Error: Confounding and Bias, Confounding, Information Bias, Selection Bias, Making Inference and Making Decisions, Sources of Error in Public Health Epidemiology, Sources of Error in Genetic Epidemiology, Sources of Error in Clinical Epidemiology.

UNIT 4

Disease Epidemiology: Cardiovascular Epidemiology, Epidemiology of Aging, Epidemiology of Cancer, Epidemiology of Infectious Disease, Psychiatric Epidemiology, Reproductive and Pre-natal Epidemiology.

UNIT 5

Critical Evaluation: The Research Hypothesis, Variables Studied, The Study Design, Sample Size, Completeness of the Data, Appropriate Descriptive Statistics, Appropriate Statistical Methods for Inferences, Logic of the Conclusions, Meta-analysis.

REFERENCES:

- Olsen J et al. An Introduction to Epidemiology for Health Professionals. 2010. Springer series on epidemiology and health. ISSN 1869-7933 e-ISSN 1869-7941. ISBN 978-1-4419-1496-5.

- Holland WW, Olsen J, Florey CDV. 2007. The Development of Modern Epidemiology. Oxford University Press, Oxford.
- Andreas Ziegler, Inke R. Koenig. 2006. A Statistical Approach to Genetic Epidemiology: Concepts and Applications. Wiley Blackwell Publications.
- Altman, D.G. 1980. Statistics and ethics in medical research: study design. British Medical Journal 281:1267-1269.
- Marks, R.G. 1982. Designing a Research Project: The Basics of Biomedical Research Methodology. Belmont, CA: Lifetime Learning.

6. INDUSTRIAL POLLUTION MANAGEMENT

UNIT-I

Water Pollution and its control: Sources of water pollution, Physico chemical and biological characteristics of water, National and international standards for Drinking water, standards for waste water disposal, Water and waste water treatment, primary, secondary and tertiary treatment. biotechnological approach for waste water treatment process.(up-flow anaerobic sludge blanket reactors) Treatment schemes for waste waters of Dyeing, Dairy, Distillery, Tannery, Sugar and Antibiotic Industries.

UNIT- II

Solid waste management: Sources, collection and disposal techniques. Composting, vermicomposting, incineration etc., Industrial solid waste management. Organic farming Soil and Manure analysis, Energy sources, Renewable energy sources, Bioenergy, Biogas production, biodiesel. Recycling of Wastes – Types – sources – composition of waste – recycling of waste for Industrial, Agricultural and Domestic Purposes; Recycling of Metals, Reuse, recovery and reduction of paper and plastics; medical waste management. Fly Ash utilization.

UNIT -III

Air pollution control:

Nanotechnological approaches for pollution control, Afforestation, air pollution control by equipments, Portable Gas Analysis – H₂S, CO₂, SO₂, O₃, HC, Particulate analysis, Stack monitoring, Meteorological equipments. Wind roses and plume behavior

UNIT -IV

Toxicology: Definitions, Classification, Origin and General Nature of Toxicants in Environment. – Toxicity, Acute, sub acute, chronic, dose effect, LD 50, LC 50 and response safe limits. Bioaccumulation – Bioconcentration – Biomagnifications – mechanisms in biota. Toxicity Testing Methods – Microbial, algal, invertebrates and alternative toxicity tests.

UNIT -V

Bioremediation: Types of bioremediation, Bioventing, microbes in biodegradation, Microbial degradation of Xenobiotics in Environment – Ecological consideration, decay behavior and degradative plasmids: Hydrocarbons, substituted Hydrocarbon, Oil pollution, Surfactants, pesticides Bioremediation of contaminated soils and waste land. Phytoremediation and its mechanism.

7. Microbial Biotechnology

Unit-I

Microbial biotechnology, scope and techniques, Bioprospecting of microbial diversity, Isolation and preservation of industrially important microorganisms. Genomics, Proteomics, Metabolomics, metagenomics.

Unit-II

Medical microbiology – methods of isolation of pathogenic organisms; Insulin production. Production of proteins and enzymes in bacteria, yeast and fungus, recombinant and synthetic vaccines. Microbial polysaccharides and polyesters.

Unit-III

Microbial biomass production, utilization of plant biomass by microorganisms (lignocellulose biodegradation), ethanol production, amino acids, antibiotics .Biotransformation of steroid and non steroid compounds, metabolic engineering.

Unit-IV

Biology of nitrogen fixation, preparation of different, Types of inoculants (nitrogen fixers phosphate solubilizers, plant growth promoting rhizobacteria, PGPR, composting.

Unit-V

Introduction to the use of microbes in environmental applications, Bioremediation, bioaugmentation, Bioemulsifiers, biosurfactants, Microbial Enhanced Oil Recovery (MEOR), Leaching of ores. Microbial fuels (Methane, Hydrogen)

References

1. Microbial Biotechnology (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA -Bernard R.
3. Molecular Biotechnology, Glick and Jack J. Pastemak ASM Press. Washington, D.C (1994).
4. Fungal Ecology and Biotechnology (1993) Rastogi Publications, Meerut.
5. Principles of Fermentation Technology (1999), Stanbury, P.F. and Whitaker, A., Pergamon Press, Oxford.

8. Mycology

Unit I

Introduction to Mycology or fungi - Life cycle – classification – Morphology
Ecology of Fungi – Replication – Genetics of Fungi - Fungal organelles and functions.
Mushroom – edible, poisonous , Cultivation. Antifungal Agents.

Unit II

Mycotoxin – Introduction to Systemic Mycology, Superficial,cutaneous,Sub- Cutaneous.
Fungal Disease in man and Animals.

Unit III

Fungal Guidelines – Handling of Fungal Strains – Maintenance – Subculture – Storage –
Sterilization of different materials used in animal cell culture, Aseptic concepts – Safety
Measures – Ethical issues.

Unit IV

Immunity to fungal infection – Yeast of Medicinal Importance – Newer methods in
Diagnostic Mycology.

Unit V

Fungal Metabolites – Novel Fungal Products – Secondary Metabolites – Pigments- Types
– Extraction – Somatic Hybridization – Protoplast Fusion in Fungi. Mutation in Fungi.

REFERANCES

- Petersen, Jens, *The Kingdom of Fungi*, Princeton University Press, Princeton, NJ, 2012
- Larone D.H. (2002). *Medically important fungi: a guide to identification*. ASM Press
- B.R. Vashista (2000)*Fungi*, Chand &co, New delhi
- Jawets medical microbiology, 2010

9. PHYTOCHEMISTRY AND NANOBIOSCIENCE

Unit I

Phytochemical techniques: Cold and hot extraction methods, liquid-liquid extraction techniques, liquid-carbon dioxide extraction, concentration and evaporation techniques, lyophilisation; TLC, preparative TLC, PC, column chromatography, gel-chromatography, affinity chromatography, ion-exchange chromatography, gas-liquid chromatography, high performance liquid chromatography, high performance thin layer chromatography

Unit II

Bioactive secondary metabolites: Steroids: Occurrence and distribution in plants, saponins, saponogenins and steroids; Isolation, structure elucidation and synthesis of bioactive steroids such as cholesterol, diosgenin, estrone, estradiol, etc.; Terpenoids: Occurrence and distribution in plants, essential oils, aroma chemicals, mono and sesquiterpenoids, their use in flavour and perfumery industry, diterpenes, triterpenes, isolation and characterization of terpenes, their synthesis;

Unit III

Alkaloids: occurrence and distribution in plants, bioactive alkaloids-isolation and structure elucidation of alkaloids such as atropine, quinine, papaverine, thebaine, vincristine, etc.; Anthocyanidin: occurrence and distribution in plants, isolation and characterization of anthocyanins, chalcones, flavones, isoflavones, chromones, coumarins; structure elucidation of quercetin, kaempferol, etc.

Unit IV

Nanobiology - Introduction - Bio-inspired nanomaterials - Interaction Between Biomolecules and Nanoparticle Surfaces - Different Types of Inorganic Materials Used for the Synthesis of Hybrid Nano-bio Assemblies - Applications of Nano in Biology - Nanoprobes for Analytical Applications - Current Status of Nanobiotechnology – Future Perspectives of Nanobiology.

Unit V

Nanosensors - Introduction - What is a Sensor? - Nanosensors - Order from Chaos - Characterization - Perception - Nanosensors Based on Quantum Size Effects - Electrochemical Sensors - Sensors Based on Physical Properties - Nanobiosensors - Smart Dust; Nanomedicines - Introduction - Approach to Developing Nanomedicines - Various Kinds of Nanosystems in Use - Protocols for Nanodrug Administration - Nanotechnology in Diagnostic Applications - Materials for Use in Diagnostic and Therapeutic Applications - Future Directions.

References

- Agarwal, P.K., Thakur, R.S. and Bansal, C.M. 1989. Carbon-13 NMR of Flavonoids. Elsevier Science Publishers, Amsterdam
- Anderson. J.W. and Beardall. J. 1991. Molecular Activities of Plant Cells. Blackwell Scientific Publications, Oxford
- Apps, D.K. and Tipton, K.F. 1995. Essays in Biochemistry, Portland Press, London
- Athkins, P. and Jones, I. 1999. Chemical Principles the Quest for Insight. W.H Freeman and Co. New York.
- Atta-ur-Rahman. 1989. One and Two Dimensional NMR Spectroscopy (1st ed.). Elsevier, New York

Braithwaite, A. and Smith, F.J. 1996. *Chromatographic Methods* (5th ed) Blackie Academic & Professional London

Budzikiewicz, H., Djerassi, C. and Williams, D.H. 1968. *Mass Spectrometry of Organic Compounds*. Holden-Day, San Francisco, CA

Dey, P.M. and Harborne, J.B. (Eds.). 1997. *Plant Biochemistry*, Academic Press, New York

Harborne, J.B. 1984. *Phytochemical Methods* (2nd ed). Chapman and Hall, London.

Smith, P.M. 1976. *The Chemotaxonomy of Plants*. Edward Arnold, London

Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.

Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.

Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.

Nano:The Essentials: Understanding Nanoscience and Nanotechnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

10. STATISTICAL GENETICS

UNIT 1

Populations, Samples, Study Design: The Study of Cause and Effect, Populations, Target Populations and Study Units, Probability Samples and Randomization, Observational Studies, Family Studies, Experimental Studies, Quasi-Experimental Studies.

UNIT 2

Descriptive Statistics: Scales of Measurement, Tables, Graphs, Proportions and Rates, Relative Measures of Disease Frequency, Sensitivity, Specificity and Predictive Values, Measures of Central Tendency, Measures of Spread or Variability, Measures of Shape.

UNIT 3

Significance Tests and Tests Of Hypotheses: Principle of Significance Testing, Principle of Hypothesis Testing, Testing a Population Mean, One-Sided versus Two-Sided Tests, Testing a Proportion, Testing the Equality of Two Variances, Testing the Equality of Two Means, Testing the Equality of Two Medians, Validity and Power.

UNIT 4

Chi-Square: The Chi-Square Distribution, Goodness-of-Fit Tests, Contingency Tables, Inference about the Variance, Combining p -Values, Likelihood Ratio Tests.

Correlation And Regression: Simple Linear Regression, Correlation, Spearman's Rank Correlation, Multiple Regression, Multiple Correlation and Partial Correlation, Regression toward the Mean

UNIT 5

Analysis Of Variance and Linear Models: Multiple Treatment Groups, Completely Randomized Design with a Single Classification of Treatment Groups Data with Multiple Classifications, Analysis of Covariance, Assumptions Associated with the Analysis of Variance.

REFERENCES:

- Elston RC and Johnson WD. 2008. Basic Biostatistics for Geneticists and Epidemiologists – a practical approach. Wiley Publications.
- Nan M. Laird, Christoph Lange. 2011. The Fundamentals of Modern Statistical Genetics. Springer-Verlag, New York.
- Shili Lin and Hongyu Zhao (Edited). 2010. Handbook on Analyzing Human Genetic Data: Computational Approaches and Software. Springer-Verlag, New York.
- Kleinbaum, D.G., Kupper, L.L., Nizam, A., and Muller, K.E. 2008. Applied Regression and Other Multivariable Methods, 4th edn. Pacific Grove, CA: Duxbury.
- Kutner, M.H., Nachtsheim, C.J., Neter, J., and Li W. 2005. Applied Linear Statistical Models, 5th edn. Boston: McGraw-Hill Irwin.