ANNAMALAI UNIVERSITY
FACULTY OF AGRICULTURE - DEPARTMENT OF MICROBIOLOGY
Ph.D. (AGRICULTURAL MICROBIOLOGY) SYLLABUS – 2010 – 2011,

Course No	Course Title	Credits
Major Courses		
AGM 811	Advances in Microbial Metabolism	2+1
AGM 812	Advances in Microbial Genetics	2+1
AGM 813	Environmental Biotechnology	2+0
AGM 821	Advances in Soil Microbiology	2+1
AGM 822	Advances in Food and Dairy Microbiology	2+1
	Total	**10+4 =14**
Minor Courses		
AGM 814	Biofertilizers and Biopesticides	2+1
AGM 823	Microbial Biotechnology	2+1
	Total	**4+2= 6**
AGM 081	Seminar	0+1
AGM 082	Seminar	0+1
	Computer Applications	1+1
	Biostatistics	2+1
AGM 806	Research	0+48
	Total	**14+6+55 = 75**

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ANNAMALAI UNIVERSITY
FACULTY OF AGRICULTURE - DEPARTMENT OF MICROBIOLOGY
Ph.D (AGRICULTURAL MICROBIOLOGY) SYLLABUS – 2010 – 2011, FULL TIME

Semester – 1		
Course No	**Course Title**	**Credits**
Major Courses		
AGM 811	Advances in Microbial Metabolism	2+1
AGM 812	Advances in Microbial Genetics	2+1
AGM 813	Environmental Biotechnology	2+0
Minor Courses		
AGM 814	Biofertilizers and Biopesticides	2+1
AGM 081	Seminar	0+1
	Computer Applications	1+1
AGM 801	Research	0+1
	Total	**9+6 = 15**

Semester – II		
Course No	**Course Title**	**Credits**
Major Courses		
AGM 821	Advances in Soil Microbiology	2+1
AGM 822	Advances in Food and Dairy Microbiology	2+1
Minor Courses		
AGM 823	Microbial Biotechnology	2+1
AGM 824	Seminar	0+1
	Biostatistics	2+1
AGM 802	Research	0+2
	Total	**8+7 = 15**

Semester – III		
Courses No	**Course Title**	**Credits**
Major Cores		
AGM 803	Research	0+12
Semester – IV		
AGM 804	Research	0+12
Semester – V		
AGM 805	Research	0+12
Semester – VI		
AGM 806	Research	0+9
	Total	**0+45**
		30+45 = 75

AGM 811 - ADVANCES IN MICROBIAL METABOLISM (2+1)

Objectives

The emphasis of the course will be to learn the physiological aspects of microbial cell and its metabolic activities. It also emphasis on the cell wall and transport mechanisms, reproduction and sporulation, photosynthesis, respiration and transformation of minerals.

Unit – I

Microbial nutrition – Chemical composition of microbial cell – Macro and Micro – nutrients and their physiological functions. Mechanisms of nutrient transport in bacteria – Passive diffusion – facilitated diffusion – unisym, Antiports – Chemiosmotic theory.

Unit – II

Microbial differentiation – Sporulation – Endo and Exospores – Endospore formation in *Bacillus Sp.* Exospore formation in *streptomyces* – Reproduction in fungi – Formation of specialized structures – akinetes, cysts and heterocysts.

Unit – III

Anaerobic respiration and fermentation - Anabolic and Catabolic processes of lipids. Mechanisms of inhibition of enzyme activity – Coenzymes and Prosthetic groups – Reproductive physiology of microorganisms.

Unit – IV

Glycolysis – Pentose phosphate pathway – Entner Doudroff pathway – Oxidation of pyruvate – TCA cycle – Assimilation of nitrogen and sulphur – Oxygenic and anoxygenic photosynthesis – Mechanisms of carbon dioxide fixation in prokaryotes. Glucogenesis – Biosynthesis of storage compounds and energy reserves in bacteria – Biosynthesis of amino acids, nucleotides, phospholipids, and isoprenoid compounds. Genetics and regulation of nitrogen fixation.

Unit – V

Regulation of metabolism, Control mechanisms operating at DNA level, transcriptional level, translation level, post – translation level and regulation of protein activity – Feed back control

mechanisms. Microbial growth – Nature and expression of growth – Measurement of growth – Effect of environmental fators on microbial growth - Response of microorganisms to stress – Sporulation bacteria.

Practical

Preparation of Liquid Media for cultivation of microorganisms - Solid media (Nutrient agar) for cultivation of microorganisms - Growth of selected species of bacteria on various carbon sources - various Nitrogen sources - Development of growth curve of bacteria based on colony forming units - turbidity measurements - protein content - Effect of pH. Temperature on growth and development of bacteria - microbial growth - Indole test - Methyl red Test - Voges proskauer test - Citrate test - Triple sugar iron test - Carbohydrate fermentation - Strach hydrolysis - Protein hydrolysis.

Reference Books

1. Sundaraja Rajan, S. 2003. Introduction to Bioenergetics, Ammol Publishers, New Delhi.
2. White more, G. 2002. Metabolism, Biosynthesis and Biochemical Emergencies, Swarun and sons, New Delhi.
3. Karp, G. 2002. Cell and Molecular Biology. John Wiley and Sons, New York.
4. Medigan, M.T., J.M. Marktinko and J. Parker, 2000. Biology of Microorganisms, Prentice Hall International (UK) Limited, London.
5. Moat, A.G. and Foster, J.W. 1998. Microbial Physiology, Second Edition, John Wiley & Sons.
6. Meenakumari, S. 2006. Microbial Physiology, MJP Publishers, Chennai.
7. Daniel R.Caldwell. Microbial physiology and Metabolism, Wm.C.Brown Publishers, England.

Theory Lecture Schedule

1. Introduction and Scope of Microbial Physiology.
2. Microbial Nutrition:-Chemical composition of a microbial cell.
3. Major and Micro nutrients and their physiological functions.
4. Mechanisms of Nutrient transport.
5. Mechanisms of Nutrient transport in bacteria.
6. Diffusion types and its importance.
7. Passive diffusion.
8. Facilitated diffusion.

9. Uniport , symport Antiports.
10. Chemiosmotic theory.
11. Microbial differentiation.
12. Sporulation in Microorganisms, Endospore formation in *Bacillus Sp.*
13. Exospore formation in Microorganisms, Exospore formation in *streptomyces.*
14. Reproduction in fungi.
15. Formation of specialized structures, akinetes, cysts and heterocysts.
16. Anaerobic respiration and fermentation.
17. Mid Semester Examination.
18. Anabolic and Catabolic processes of lipids.
19. Mechanisms of inhibition of enzyme activity
20. Coenzymes and Prosthetic groups.
21. Reproductive physiology of microorganisms.
22. Glycolysis, Pentose phosphate pathway.
23. Entner Doudroff pathway – Oxidation of pyruvate.
24. TCA cycle, Assimilation of nitrogen and sulphur.
25. Oxygenic and anoxygenic photosynthesis.
26. Mechanisms of carbon dioxide fixation in prokaryotes.
27. Glucogenesis, Biosynthesis of storage compounds and energy reserves in bacteria.
28. Biosynthesis of amino acids, nucleotides, phospholipids, and isoprenoid compounds.
29. Genetics and regulation of nitrogen fixation.
30. Regulation of metabolism.
31. Control mechanisms operating at DNA level, transcriptional level, translation level, post, translation level and regulation of protein activity.
32. Microbial growth – Nature and expression of growth, Measurement of growth.
33. Effect of environmental fators on microbial growth.
34. Response of microorganisms to stress – Sporulation bacteria.

Practical Schedule:

1. Preparation of Liquid Media for cultivation of microorganisms.
2. Preparation of Solid media (Nutrient agar) for cultivation of microorganisms.
3. Growth of selected species of bacteria on various carbon sources.
4. Growth of selected species of bacteria on various Nitrogen sources.

5. Development of growth curve of bacteria based on colony forming units.
6. Development of growth curve of bacteria based on turbidity measurements.
7. Development of growth curve of bacteria based on protein content.
8. Effect of pH. Temperature on growth and development of bacteria.
9. Effect of pesticides on microbial growth.
10. Indole test.
11. Methyl red Test.
12. Voges proskauer test.
13. Citrate test.
14. Triple sugar iron test.
15. Carbohydrate fermentation.
16. Strach hydrolysis.
17. Protein hydrolysis.

AGM 812 – ADVANCES IN MICROBIAL GENETICS (2+1)

Objective

To acquaint the learners regarding molecular concepts of bacteria and viruses and impact of gene cloning on human welfare.

UNIT I

Prokaryotic, eukaryotic and viral genome. Replication of eukaryotic, prokaryotic and viral DNA. Structure, classification and replication of plasmids.

UNIT II

Molecular basis of mutation. Biochemical genetics and gene mapping by recombination and complementation. Fine gene structure analysis.

UNIT III

Fungal genetics – Genetics of *Neurospora crassa*, *Aspergillus nidulans* and Yeast.

UNIT IV

Gene transfer in bacteria through transformation, conjugation and transduction; Transposable elements.

UNIT V

Gene cloning and gene sequencing. Impact of gene cloning on human welfare. Regulation of gene expression. Recent advances in DNA repair and mutagenesis. Genetic basis of cancer and cell death.

PRACTICAL

Inactivation of microorganisms by different mutagens. Production, isolation and characterization of mutants. Determination of mutation rate. Isolation, characterization and curing of plasmids. Transfer of plasmid by conjugation, electroporation. Tetrad and random spore analysis.

Reference Books

1. Birge EA. 1981. *Bacterial and bacteriophage genetics*. Springer Verlag.
2. Gardner JE, Simmons MJ & Snustad DP. 1991. *Principles of genetics*. John wiley & Sons.
3. Maloy A, & Freifelder D. 1994. *Microbial Genetics.* Narosa.
4. Scaife J, Leach D & galizzi A. 1985. *Genetics of bacteria.* Academic Press.
5. David P. Clark. Molecular Biology. 2005. Elsevier Publication.

Theory Lecture Schedule

1	Evolution of microbial genetics.
2	Comparison between prokaryotic, eukaryotic and viral genomes.
3	Replication of viral DNA.
4	Replication of prokaryotic DNA.
5	Replication of eukaryotic DNA.
6	Structure, classification and replication of plasmids.
7	Mutation; types and uses.
8	Mutagenic agents, Molecular basis of mutagenesis.
9	Detection of mutants, Reverse mutation and mutation rates.
10	Concept of biochemical genetics.
11	Gene mapping by recombination and complementation.
12	Fine structure of gene.
13	Brief introduction to fungal genetics.
14	Genetics of *Neurospora crassa*, *Aspergillus nidulans.*
15	Genetics of Yeast.
16	Exchange of genetic characteristics between bacteria.
17	MID TERM EXAMINATION.
18	Bacterial recombination and their mechanisms.
19	Cellular competence for transformation.
20	Mechanisms of transformation.
21	Conjugation mechanism.
22	Transduction, types of transduction.
23	Transposons and their classes / types.
25	Detailed mechanism of gene cloning.
25	Modern applications of microbial gene cloning.
26	Gene sequencing technique.

27 Automated gene sequencing.
28 Impact of gene cloning on human welfare.
29 Regulation of gene expression.
30 DNA damage and repair.
31 DNA repair mechanisms (Part 1).
32 DNA repair mechanisms (Part 2).
33 Genetic basis of cancer and cell death.
34 MODEL EXAMINATION.

Practical Schedule

1. LD50 Value of UV ray on Bacteria.
2. LD50 Value of chemical mutagen EMS/MMS/ NTG on Bacteria.
3. Induction of mutation in bacteria by EMS/MMS/ NTG. & Isolation of mutants for antibiotic resistance Part – I.
4. Induction of mutation in bacteria by EMS/MMS/ NTG. & Isolation of mutants for antibiotic resistance Part – II.
5. Development of auxotrophic mutants – Part I .
6. Development of auxotrophic mutants – Part II.
7. Determination of mutation rates in bacteria.
8. Isolation of plasmids, DNA from bacteria.
9. Mid Semester practical Examination.
10. Bacterial conjugation.
11. Preparation of competence cells.
12. Bacterial transformation.
13. Plasmid DNA transfer by electroporation.
14. Isolation of bacteriophage.
15. Transfer of DNA through Bacteriophage.
16. Bacterial transduction.
17. Model practical Examination.

AGM 813 - ENVIRONMENTAL BIOTECHNOLOGY (2+0)

Theory

Objective

To study the pollution management practices industrial effluent treatment and waste disposal by adopting biotechnological methods

Unit –I

Water pollution and its management

Surface water resources – Water pollution – measurement of pollution – control of pollution Aerobic processes aeration equipment and performance – site and process selection- rotary biological contactors –Deep shaft treatment – tertiary treatment-sludge thickening – Dewatering – Digestion – application to land

UNIT-II

Anaerobic treatments of effluents and its management

Anaerobic treatment of effluents – process option –Disinfection use of ozone hydrogen peroxide chloride- other disinfectants – Waste water treatment in developing countries – Waste stabilization ponds – aerated lagoons, oxidation ditches, biomethanation.

Unit-III

Solid wastes and municipal waste management

Industrial treatment – solid waste – municipal refuse composition – landfill sites and refuse emplacement strategies – refuse degradation – landfill products and site exploitation – toxic and hazardous wastes exploitation of landfill gas. Composition- straw decomposition – probiotic organisms – role of the lactic acid bacteria in silage additives

Unit – IV

Mineral leaching by microorganisms

Mineral leaching by bacteria – microorganisms involved in the sulphide mineral leaching chemistry of sulifide mineral oxidation by bacteria – exploitation of dump and heap leaching – in situ bacterial leaching of ore – mineral concerntrate leaching – utilization of bacterially generated soivents – heavy metal pollutants removal by bioaccumulation

Unit –V

Microbial control of environmental pollution

Microbial control of environmental pollution catabolic plasmids as natural vectors- physical and genetic overviews – genetic engineering of genes for augmenting pollution abatement-use of immobilized microbes for waste recycling – immobilized enzymes in pollution abatement.

Lecture Schedule

1. Surface water resources
2. Water pollution – measurement of pollution and its control
3. Aerobic process treatment – oxygen transfer and aeration equipments
4. Aeration process site selection and process selection
5. Rotary biological contactors Deep shaft treatment.

6. Teritary treatment –sludge thickening Dewatering
7. Digestion and application to land
8. Aerobic treatment of effluents sprocess option
9. Disinfectants of anaerobic treatment effluent
10. Waste stabilization ponds – aerated lagoons
11. Oxidation ditches and biomethanation
12. Industrial treatments
13. Solid waste management
14. Municipal waste management
15. Landfill sites and refuse emplacement strategies
16. Landfill products and site exploitation
17. Toxic and hazardon wastes exploitation
18.Mid semester
19. Composting and types of composting
20. Probiotic organisms
21. Role of lactic acid bacteria in silage additives
22. Mineral leaching by bacteria
23. Microorganism involved in sulphide mineral
24. Mechanism of Bioleaching
25. Biochemical reaction involved in Bioleaching
26. Bioleaching fores for metal recovery
27. Chemistry of sulphide mineral oxidation by bacteria
28. Dump and heap leaching – insitu bacterial leaching of ore
29. Utilization of bacterially generated solvents – heavy metal pollution removal by bioaccumulation
30. Microbial control of environmental pollution; catabolic plasmids as natural vectors
31. Microbial control of environmental pollution by physical and genetics overviews
32. Gnetic engineering of genes for augmenting pollution abatement.
33. Use of immobilized microbes for waste recycling
34. Immobilized enzymes in pollution abatment
35. Review of lectures

Reference

1. Murry Moo-Young, 2004. Comprehensive Biotechnology Vol. 1 to Vol. 4, Panima Book Publication New Delhi.

2. Kaul, S.N.2004. Waste water treatment technologies and environment. Daya publishing House, New Delhi.

3. Kumar and Aravind. 2004. water pollution; Assessment and management Daya publishing House New Delhi.

AGM 821 – ADVANCES IN SOIL MICROBIOLOGY (2+1)

Objective

Objective of this course is to teach students regarding basics of microbiology related to soil including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities.

UNIT I

Soil biota, Soil microbial ecology, types of organisms in different soils; Soil microbial biomass; Role of Micro organisms in soil ferlity - soil and environnemental factors on microbes

UNIT II

Microbiology and biochemistry of Nitrogen Fixation root-soil interface; Rhizosphere phyllosphere, Biofertilizers, soil enzyme activities and their importance.

UNIT III

Signal transduction - Plant and microbial gene expression and signal exchange, global and specific regulators for different interactions. Molecular diversity of microbes, plants and their interactions including transgenic microbes and plants.

UNIT IV

Biogeochemical Cycles - Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil. Siderophores and antimicrobials. Biochemical composition and biodegradation of soil organic matter and crop residues.

UNIT V

Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures: Biotic factors in soil development. Microbial Intractions in soil

Practical

Determination of soil microbial population; Soil microbial biomass; Decomposition studies in soil, Soil enzymes; Measurement of important soil microbial processes such as ammonification, nitrification. N_2 fixation, S - oxidation, P - solubilization and mineralization of other micro nutrients; Study of rhizosphere effect.

Reference Books

1. Martin Alexander. 1977. Introduction to *Soil Microbiology*. John Wiley Publication New Delhi.
2. Paul, EA. 2007. *Soil Microbiology, Ecology and Biochemistry*. 3rd Ed. Academic Press.
3. Sylvia *et al.* 2005. *Principles and Applications of Soil Microbiology*. 2nd Ed.

Theory Lecture Schedule

1. Soil Biota, Soil Microbial ecology. Types of organisms in different soils.
2. Soil microbial biomass; Role of Microorganisms in soil fertility.
3. Environmental factors influencing the activates of microbes in soil.
4. Microbiology and biochemistry of Nitrogen fixation, root soil interface.
5. Rhizosphere and its importance to crop plants and R : S ratio.
6. Phyllosphere and its importance.
7. Bacterial Biofertilizer – *Rhizobium, Azospirillum, Azotobacter and Glucanoacetobacter.*
8. Fungal Biofertilizers and Phosphobacteria.
9. Algal Biofertiliuzers – BGA, Azolla. Method of Biofertilizer production.
10. Quality control of Biofertilizers. Method of Biofertilizer applications.
11. Soil Enzyme activities and their importance.
12. Signal transduction. Plant and microbial gene expression and signal exchange.
13. Global and specific regulators for different interactions.
14. Molecular diversity of Microbes , Plant and their interactions.
15. Transgenic microbes and plant interaction.
16. Microbial transformation of N2 in Soil, Nitrogen cycle.
17. Mid Semester Examination.
18. Microbial transformation of Phosphorous in soil – Phosphorous cycle.
19. Microbial transformation of sulphure in soil – Sulphure cycle.
20. Microbial transformation of Iron in soil – Iron cycle.
21. Microbial transformation of Manganese in soil – Manganese cycle.
22. Siderophores and antimicrobials.
23. Biochemical composition of soil organic matter and crop residues.
24. Biodegradation of soil organic matter and crop residues.
25. Biodegradation of Pesticides – Insecticides.
26. Biodegradation of Pesticides – Herbicides.
27. Biodegradation of Pesticides – Fungicides.
28. Organic wastes and its degradation.
29. Composting and vermicomposting.
30. Organic wastes for production of biogas.
31. Organic wastes as manures.
32. Biotic factors in soil development.
33. Microbial interactions in soil – Positive interactions.
34. Microbial interactions in soil – Negative interactions.

Practical Schedule

1. Conn's Direct microscopic count for estimating soil microbial population.
2. Standard plant count of estimating soil microbial population.
3. Most probable number method for estimating soil microbial population.
4. Buried slide techniques.
5. Determination of soil microbial biomass.
6. Amylase production test (Demostration of starch hydrolysis).
7. Cellulase production test (Degradation of cellulose).
8. Production of pectiolytic enzymes (Degradation of pectin).
9. Isolation of root nodule bacterium *Rhizobium*.
10. Isolation and purification of *Azobacter*.
11. Isolation and purification of *Acetobacter diazotrophicus.*
12. Isolation and purification of Phosphobacteria .
13. Identification of Endomycorrhizal fruiting bodies.
14. Isolation and purification of blue green algae.
15. Bio fertilizer inoculants production.
16. Methods of application of biofertilizer and quality control.
17. Rhizosphere study.

AGM 822 – ADVANCES IN FOOD AND DAIRY MICROBIOLOGY(2+1)

Objectives

The emphasis of the course will be on food microflora and preservation, food quality control, microbial foods, food spoilage and food poisoning.

Unit - I

Introduction and importance of food microbiology – Incidence and behavior of microorganisms in food – Primary sources of contamination in food – Intrinsic and extrinsic parameters of food affecting microbial growth – Assessing microbial load in foods.

Unit - II

Principles of food preservation – Methods of preservation Physical methods – High temperature Low temperature, drying, osmotic pressure, irradiation, modification of atmosphere , chemical methods – Class I and II chemicals. Food manufacturing practices – HACCP – Quality control in food process industries. Food Quality control and standards. Genetically modified foods.

Unit – III

Microbial spoilage of different types of food – spoilage of cereals and cereal products, fruits and vegetables , meat, egg and poultry, sea foods, canned foods. Food poisoning - botulism – Food borne infections – Food pathogens –mycotoxins - prevention of food poisoning.

Unit - IV

Fementation of pickles, sauerkraut, bread , vinegar , idli , and traditional fermented foods, microorganisms as food – single cell proteins spirilina – Applications of microbial enzymes in food industries.

Unit - V

Microorganismsm of milk, milk and products – Preservation of dairy products – pasteurization – Microbial spoilage of dairy products – fermented dairy products

Practical

Microbiological examination of normal fruits and vegetables - spoiled fruits and vegetables - Normal cereal and sugar products - spoiled cereal and sugar products - Milk and water samples- Food preservation with chemicals , low temperature, high temperature - 'D' value calculations - Microbiological examination of spoiled canned foods - Microbiological examination of spoiled meat and fish - Microbiological survey of utensils and processing plants - Methylene blue reduction test - Assessing the load of *coliform* bacteria as indicator organisms - Visit to coffee and tea fermentation industries - Visit to cheese manufacturing units - Practical examination.

Reference Books

1. Adams, M.R and M.O. Moss., 1995. *Food Microbiology.* The Royal Society of Chemistry, Cambridge.
2. Doyle, M.P. 2001. *Food Microbiology.* 2nd Edn. Panima Book Company Limited, New Delhi.
3. Frazier, W.C. and Westhoff D.C. 1988. *Food Microbiology.* TATA McGraw Hill Publishing Company Ltd. New Delhi.
4. Jay, J.M. 2000. *Modern Food Microbiology.,* 4th Edn. CBS Publishers and Distributors, New Delhi.
5. Ramanathan.N, 2009. A Text Book of Food Microbiology , Omsakthi publication, Annamalai nagar.
6. Stanbury, P.F. Whitaker and Hall. S.J. 1995. *Principles of Fermentation Technology, 2nd edition,* Pergaman Press.
7. Thomas E. Barman, 1969. *Enzyme HandBook Vol.5* Springer-Verlag Berlin Heidgeberg. Newyork.

Lecture Schedule

1. Introduction and importance of food microbiology.
2. Incidence and behaviour of microorganisms in food.
3. Sources of microorganisms found in food.
4. Intrinsic and extrinsic parameters of food affecting microbial growth.
5. Assessing microbial load in food.
6. Principles of food preservation.
7. Physical methods of preservation – heat processing .
8. Chilling and freezing, drying.
9. Osmotic pressure, irradiation and modification of atmosphere.
10. Chemicals used as preservatives in food.
11. Food manufacturing practices.
12. HACCP.
13. Quality control in food process industries.
14. Food quality control and food standards.
15. Microbial spoilage of cereal and cereal products.
16. Spoilage of fruit and vegetables .
17. **Mid Semester.**
18. Spoilage of meat egg and poultry.
19. Spoilage of sea foods.
20. Spoilage of canned foods.
21. Food poisoning – Botulism.
22. Food bourne infection – Food pathogens.
23. Mycotoxins.
24. Fermented foods pickles , sauerkraut.
25. Bread, Vinegar and idli fermentations.
26. Single cell proteins.
27. Application of microbial enzymes.
28. Microorganisms of milk and milk products.

29. Preservation of dairy products.
30. Pasteurization methods.
31. Microbial spolage of dairy products.
32. Fermented dairy products.
33. Diseases spread by microorganisms through milk.
34. Review of Lecture.

Practical Schedule

1. Microbiological examination of normal fruits and vegetables.
2. Microbiological examination of spoiled fruits and vegetables.
3. Microbiological examination of normal cereal and sugar products.
4. Microbiological examination of spoiled cereal and sugar products
5. Microbiological examination of milk and water samples.
6. Microbiological examination of cereal a nd sugar products.
7. Food preservation with chemicals.
8. Food preservation with low temperature.
9. Food preservation with high temperature - 'D' value calculations .
10. Microbiological examination of spoiled canned foods.
11. Microbiological examination of spoiled meat and fish.
12. Microbiological survey of utensils and processing plants.
13. Methylene blue reduction test.
14. Assessing the load of *coliform* bacteria as indicator organisms.
15. Visit to coffee and tea fermentation industries.
16. Visit to cheese manufacturing units.
17. Practical examination.

AGM – 814 . BIOFERTILIZERS AND BIOPESTICIDES (2+1)

Objective

To study the production techniques. Formulations and usages of different biofertilizers and biopesticides in Agriculture and Horticulture.

Unit – I

Biofertilizers – Development and its concept – contribution of microorganisms to soil fertility – groups of biofertilizers – The organisms that fixes atmospheric nitrogen – Free – Living, aerobic. Symbiotic bacteria.

Unit – II

Bacterial Biofertilizers .*Rhizobium* , *Azotobacter*, *Azosprillium*, *Acetobacter*, Phosphobacteria, potash mobilifiz bacteria, silicate socializing bacteria and Frankia . Algal fertilizer – Blue green algae, *Azolla* – Importance – fungal fertilizers – Mycorrhizas – ectomycorrhizae , endomycorrhizae – Role of mychorrizae and importance mechanism of nodulation – Biochemical and Genetics of nitrogen fixation.

Unit – III

Principles of mass production – Growth characteristics of different groups of organisms – fermentation and other inoculam preparation – Carrier material – Types and quality – Mixing of carrier – Broth – Population dynamic during storage methods. Shellife .Quality control of biofertilizers ISI standard – Economics of biofertilizer application . Mass production of mycorrhizae.

Unit – IV

Role of biotechnology in pest and diseases management – Genetic improvement of natural enemies . Mass production techniques – Invitro production of entomopathagens in cell lines. Genetic engineering with Baculoviruses and *Bacillus thuringiensis.* Recombinant DNA technology and genetic control of insects . Transgenic plants – BT ,toxin gene – trypsin inhibitor gene. Manipulation of biological rhythm in insects for their control .

Unit – V

Chitinase gene – cloning of chitinase from microorganisms to another to increases biocontrol efficiency – development of biocontrol produces bacteriocin – pseudobactin – Development of mild strain for cross protection. Field performance of biofertilizers ,biopesticides. Method of application problems and prospects.

Practical

Isolation and testing efficiencies of Rhizobium biofertilizers - *Azotobacter* biofertilizer - *Azospirillum* biofertilizer - Biofertilizer for sugar cane - Algal biofertilizer - Phosphate solubilizing biofertilizers - Mass production techniques of bacterial biofertilizers – Mycorrhizae - Technology for mass production of Arbuscualr mycorrhizal fungi - Quality assessment test for biofertilizers - Method of application of biofertilizers - Isolation of fungi from healthy and diseased insects - entomopathogenic bacteria and fungi from commercial Formulations - Mass production techniques and application of *Trichoderma viride* - Pseudomonas fluoresecens - Field and pot culture testing of biofertilizers - Practical exams.

Reference Books

1. Subbarao N.S .1998. Biofertilizers in Agriculture .Oxford and IBM Publication co., New Delhi.
2. Bergersen ,F.J and J.R Postgate 1987. A Century of nitrogen fixation research, present status and future prospects . The royal society London.
3. Motsara,M.R, P. Bhattacharyya and B.Srivastava 1995. Biofertilizer technology marketing and usage – A source cum glossary – FDCO .New Delhi.
4. Subbarao, N.S 1993. Biofertilizers in Agriculture and forestry. Oxford and IBH Publication co.New Delhi.
5. Burges , M.D. 1981. Microbial control of pests and plant diseases . Academic press London.

Lecturer Schedule.

1. Biofertilizers – Development and concepts.
2. Contributions of microorganisms to soil fertility.
3. Group of biofertilizers.
4. Bacterial biofertilizers.
5. *Rhizobium.*
6. Atosprillum , *Azotobacter.*
7. *Actobacter* diazotrophicus and phosphobacteria.
8. Frankia.
9. Algal Biofertilizers.
10. Fungal biofertilizers.
11. Biochemistry and genitics of nitrogen fixation.
12. Principles of mass production.
13. Growth characteristic of different groups of organisms.
14. Fermentation technique.
15. inoculant production and quality control.
16. Economics of biofertilizer production.
17. Mid semester.
18. Mass production of mycorrhizae.
19. Role of biotechnology in pest and disease management.
20. Invitro production techniques of entomopathogenes.

21. Mass production techniques of entomopathegenes.
22. *Bacillus thuriengiensis.*
23. Transgenic plants.
24. Botinical pesticides.
25. Chitinase gene.
26. Development of biocontrol agents.
27. Bacteriocin and pseudobactin.
28. Development of mild strains for cross protection.
29. Tissue culture.
30. Somaclonal variation.
31. Field performance of biofertilizers.
32. Field performance of biopesticides.
33. Methods of application.
34. Problems and prospects.
35. Review of Lecture.

Practical Schedule.

1.Isolation and testing efficiencies Rhizobium biofertilizers.
2. *Azotobacter* biofertilizer.
3. *Azospirillum* biofertilizer.
4. Biofertilizer for sugar cane.
5. Algal biofertilizer.
6. Phosphate solubilizing biofertilizers.
7. Mass production techniques of bacterial biofertilizers.
8. Mycorrhizae.
9. Technology for mass production of Arbuscualr mycorrhizal fungi.
10. Quality assessment test for biofertilizers.
11. Method of application of biofertilizers.
12. Isolation of fungi from healthy and diseased insects.
13. Isolation of entomopathogenic bacteria and fungi from commercial. Formulations.
14. Mass production techniques and application of *Trichoderma viride*.
15. Mass production techniques and application of Pseudomonas fluoresecens.
16. Field and pot culture testing of biofertilizers.
17. Practical exams.

AGM 823 - MICROBIAL BIOTECHNOLOGY (2+1)

Objective

To teach students about industrially useful microorganisms and use of fermentor for the production of various primary and secondary metabolites.

UNIT I

Introduction, scope and historical development; Isolation, screening and genetic improvement of industrially important microorganisms.

UNIT II

Types of fermentation systems; production of various primary and secondary metabolities, e.g. amino acids, organic acids, alcohols, enzymes, organic solvents, antibiotics, etc.

UNIT III

Process scale up steps: laboratory, pilot plant and industrial scales. Down stream processing; Over-production of metabolities; Bioreactor operations, process control.

UNIT IV

Fermented beverages; Production of single cell protein; Steroid transformation; Immobilization of cells/enzymes; Silage production; Waste water treatment.

UNIT V

Use of genetically-engineered microorganisms in biotechnology; Bioinsecticides, biofertilizers, etc. Microbiologically-produced food colours and flavours. Retting of flax.

Practical

Isolation of industrially important microorganisms, their maintenance and improvement. Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery; Study of bio-reactors and their operation: Production of biofertilizers.

Reference Books

1. Cruger W & Cruger A. 2004. *Biotechnology - A Textbook of Industrial Microbiology*. 2nd Ed. Panima.
2. Ward OP. 1989. *Fermentation Biotechnology*. Prentice Hall.
3. Wiseman A. 1983. *Principles of Biotechnology*. Chapman & Hall.
4. Karthikeyan.B and R.Elango. 2010. Fermentation Technology. Velan Pathipagam, Chidambaram.

Lecture Schedule:

1. Introduction, Scope of Microbial biotechnology.
2. Historical Development of Microbial Biotechnology.
3. Isolation and screening of industrially Important Microorganisms.
4. (4-7)Genetic improvement of industrially improvement Microorganisms.
8. Types of fermentation systems.
9. Production of various primary metabolites.

10. Production of various Secondary metabolites.
11. Production of amino acids.
12. Production of organic acid .
13. Production of alcohols.
14. Production of enzymes.
15. Production of organic solvents.
16. Production of Antibiotics.
17. **Mid Semester Exam.**
18. Process scale up for pilot plant study.
19. Process scale up for Laboratory study.
20. Process scale up for industries.
21. Down stream processing methods.
22. Over – Production of Metabolites.
23. Bioreactor operations and process control.
24. Production of steroid transformation.
25. Immobilization of cells.
26. Silage production.
27. Silage production.
28. Waste water treatment .
29. Use of genetically engineered microorganisms in biotechnology.
30. Bioinsecticides.
31. Biofertilizers.
32. Microbiologically production of food colours.
33. Microbiologically production of flavours.
34. Retting of flax**.**
35. Review of Lecture.

Practical Schedule

1. Isolation and screening of industrially Important Microorganisms.
2. Genetic improvement of industrially improvement Microorganisms.
3. Study of Bio-reactors
4. Scale up of fermentation process
5. Production of Alcohol
6. Production of Lactic acid
7. Production of Citric acid
8. Production of Single cell protein
9. Production of Antibiotics
10. Antibiotic assay methods
11. Production of Amylase
12. Immobilization cells techniques

13. Production of Bioinsecticide
14. Production of Azospirillum
15. Production of PGPR
16. Waste water treatment by microorganisms
17. Practical Exam