SEMESTER III

Paper 9: Fermentation Technology (GMBT-301)

Course Objectives

"At the end of this course the students will be able to describe: 1. Enzyme and polysaccharide synthesis and industrial applications. 2. After completion of this course students will learn about the application of microbiology and bacteriology in the environment and living system. 3. Microbiology of air –Sources of microorganisms in air.

Course Contents

UNIT-1: Basics of Industrial fermentation and Sterilization of air, media & equipments

Medium formation & Raw material Isolation and screening of industrially useful microorganisms, Strain Improvement, Methods of measuring process variation

Control system, Computer application in fermentation technology

UNIT-2: Design of fermenter

Various Design and types of fermentors & Bioreactor, Aeration and agitation, oxygen transfer rate, heat control, Batch, fed-batch and continuous culture operations, Starter culture, its importance and preparation, Mass transfer bioprocess, Scale up bioprocess

UNIT-3: Product Recovery & Purification (Downstream Processing)

Extraction and separation techniques; Cell disruption – disintegration, Flocculation & Floatation, Filtration, Centrifugation, Distillation

Enrichment of product by: Thermal process, Membrane filtration and dialysis, Freeze concentration, Chromatographic methods, Purification: Crystallization and drying,Bioassay and fermentation economics

UNIT-4: Industrial production of chemicals

Alcohol Fermentation, Organic acids (Gluconic acid & Citric acid), Vitamins (Vit. B12), Amino acids (Lysine & Glutamic acid), Single cell protein, Antibiotics (Penicillin & streptomycin), Enzyme (Amylase, Protease & lipase)

UNIT-5: Food Technology

Food Spoilage & Preservation, Methods of Food Processing, Designer Foods, Nutraceuticals & Genetically Modified Foods

RECOMMENDED BOOKS:

1. Stanburry et al. (2011). Principle of fermentation technology Pergamon Press.
2. Reed G (2001). Industrial Microbiology CBS Publisher.
3. Cruger&Cruger, (2005), Microbial Biotechnology, Panima Press
4. Moo-Young M, Cooney CL &Humphery AE (1985). Comprehensive Biotechnology-The
1. Principles, Applications & Regulations of Biotechnology in Industry, Agriculture & Medicine,
2. Pergamon Press
5. Atlas RM, Park LC & Brown AL (1995).Laboratory Manual of Experimental Microbiology.
3. Mosby-YearBook,Inc.,Missouri

Paper 10: Biostatistics & Bioinformatics (GMBT-302)

Course Objectives: "(i) The course is designed to enhance student knowledge; the student will have a basic understanding on the type and management of biostatistical data. (ii) The student will understand how to analyse bio-statistical data, and its real-life examples in Biological Sciences (iii) The student will understand the basics of bioinformatics, various databases that can be used to analyse computational biological data and how to organize the database. (iv) The student will learn the use of bioinformatics tools in protein-biology and its association with in-vivo techniques. (v) The student will learn how to use bioinformatics databases to solve proteomics and genomics problems."

Course Contents

UNIT-I

Scope of computers in current biological research.Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer –Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications.

UNIT-II

Introduction to Bioinformatics – Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA.

UNIT-III

Multiple sequence alignment and Dynamic programming. Gene and Genome annotation – Tools used. Physical map of genomes.Molecular phylogeny - Concept methods of tree construction.Protein secondary structure prediction.Protein 3D structure prediction.Protein docking.Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery.

UNIT-IV

Brief description and tabulation of data and its graphical representation. Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance. Simple linear regression and correlation. Types of errors and level of significance. Tests of significance – F & t tests, chi-square tests, ANOVA.

Practicals:

BOOKS RECOMMENDED:

1. Bioinformatics – D.Mount
2. Programming in C by Balaguru Swamy.
3. Introduction to Bioinformatics by Arthur M.Lesk, Oxford.
4. Biostatistics – Daniel. (Wiley).
5. Statistics by S.C. Gupta.
6. Statistical Methods by G.W.Snedecor & W.G.Cochran.
7. Fundamentals of Biostatistics – Khan & Khanum.
8. Let us C – Kanetkar.
9. Fundamentals of Biostatistics by U.B.Rastogi (Ame Books Ltd).

Paper 11: Animal Biotechnology (GMBT-303)

Course Objectives

The purpose of this course is to prepare the students for transferring genes in animals with different methods. Ø This course will enhance to gain the knowledge about transgenesis and need of biotechnology in day-to-day life. Ø This course will impart the knowledge in students about Artificial insemination, Clones and Animal propagation. Ø The course is designed to help the students to target and understand the stem cell technology and application. Ø After successful completion of this course, the students will be able to know about the molecular engineering, gene therapy and vectors of gene therapy."

Course Contents

UNIT-1: Basics of Animal Biotechnology

History of animal tissue culture, Equipments & media used for Animal cell culture technology, Primary & established cell line culture and culture media

Applications of animal cell cultures

UNIT-2: Media & culture preparation

Serum and serum free media; advantages and disadvantages, serum protein media, viability and cytotoxicity, Basic techniques of mammalian cell culture, Cryopreservation and trans-shipment of animal tissue and cell line, approval of animal tissue culture labs in India and related ethics.

UNIT-3: Stem cells

Erythrogenesis, Chondrogenesis,. Cell cycle analysis, cells synchronization, cells

separation, cells transformation in vitro, cells locomotion and cell cloning

Different types of stem cell Characteristics of stem cells. The methods for stem cells differentiations. Potential of stem cell research in treatment of different genetic, infectious diseases and drug targeting, Gene therapy and its application

UNIT-4: Transgenics

Objectives of transgenics, Methods of gene transfer in plants and animals, Expression of transgene in higher plants and animals for producing value based products, Application of transgenic plants and animals: Recombinant product produced through transgene viz. Edible Vaccine, Recombinant proteins, Hormone production etc.

Recommended Books:

1. Altman, A (1997), Agricultural Biotechnology
2. Bhojwani SS, MK Razdan (1983), Advanced immunology.
3. Blitterswiji, V.C. (2008). Tissue Engineering. Academic press, USA. Plant Tissue Culture: Theory and Practice, - elsevier.com
4. Clark,P.D. and Pazdernik, J.N. (2009). Biotechnology. Elsevier Academic press, London.
5. Freshney RI, JRW Masters, J Masters (2000), Animal Cell Culture: A Practical Approach, 5th edition, Wiley-Liss Publication
6. Goldsby RA, TJ Kindt, BA Osborne (2000), Kuby immunology, academicbooktrade.co.uk Houdebine, LM (2003), Animal Transgenesis and Cloning.
7. Krimsky DS, RP Wrubel (1996), Agricultural Biotechnology and the Environment: Science, Policy, and Social Issues.
8. Slater, A., Scott, W.N. and Flower, R.M. (2008). Plant Biotechnology. 2nd edition. Oxford University Press Inc., Newyork.

ELECTIVE PAPER (ANY ONE)

Paper 12: Environmental Biotechnology (GMBT-304)

Course Objectives

"On the completion of this course the students will be able to describe following subject matters: 1. Natural resources: Renewable and non-renewable resources: Forest resources; Water resources; Mineral resources; Food resources; Energy resource 2. Air pollution; Water pollution; Noise pollution; Waste Water treatment; Thermal Pollution; Marine pollution; Soil pollution; Global warming; Acid Rain; Ozone layer depletion."

Course Contents

UNIT – 1:

Biodegradation - Parameters influencing Biodegradation, Types of Biodegradation reactions; aerobia and anaerobic, Biodegradation of plant polysaccharides, Biodegradation Lignin, cellulose

UNIT – 2:

Biodegradation of pesticides, Biodegradation of PAHs

Biodegradation of nitroaromatics, Biodegradation of chloroaromatic

UNIT – 3:

Acid mine drainage, Microbial methylation of mercury, Microbial methylation of arsenic

UNIT – 4:

Bioremediation

Various strategies involving microbes

Genetically engineered microorganisms & Bioremediation

Recommended Books:

1. Gilbert S. Omen Environmental Biotechnology
2. Gray T.R.G.&S.T.Williams Soil Microorganisms
3. Gregory P.H. The Microbiology of Atmosphere
4. Lautit M.W&C.M.Eds.Keuin Microbial Ecology Proc.
5. Lynch J.M The Rhizosrphere
6. Lynch J.M and N.J. Poole Microbial Ecology: A conceptual approach
7. Michael S.Switzenbaury(Ed) Anaerobic Treatment of Sewage
8. Mishra R.R Soil Microbiology
9. Odum E.P. Fundamentals of Ecology
10. Omenn G.S.& M. Alexander Genetic control of Environmental Pollutants
11. Ralph Mitchell Environmental Microbiology
12. Ratledge C. Biochemistry of Microbial degradation
13. Spani J.C. Biodeterioration of non-aromatic compounds
14. Subba Rao N.S. Soil Microbiology
15. Thomas D. Brook Thermophiles
16. Tilak S.T Environmental Biopollution
17. Williams G.C Biofilms

Paper 12: Food Biotechnology (GMBT-304)

Course Objectives

"At the end of course, students will be able to describe following methods: 1. Enzyme and polysaccharide synthesis and industrial applications. 2. After completion of this course students will learn about the application of microbiology and biotechnology in the environment and living system."

Course Contents

Unit – 1

Starter cultures and their biochemical activities; production of alcoholic beverages; production of Single cell protein and Baker's yeast; Mushroom cultivation. Food and dairy products: Cheese, bread and yogurt. Fermented vegetables – Saurkraut; Fermented Meat – Sausages

Unit - 2

Novel microorganisms eg. LAB (Probiotics), Cyanobacteria, methylotrophs enzyme biotransformations

Role of Plant tissue culture for improvement of food additives; color and flavor

Genetic modifications of microorganisms; detection and rapid diagnosis, Genetically modified foods and crop

Unit-3

Food borne infections and intoxications; with examples of infective and toxic types –Clostridium, Salmonella, Staphylococcus

Mycotoxins in food with reference to Aspergillus species, Food preservation: canning, dehydration, ultrafiltration, sterilization, irradiation, Chemical and naturally occurring antimicrobials; Biosensors in food industry

Unit -4

Quality assurance: Microbiological quality standards of food Intellectual property rights and animal welfare Government regulatory practices and policies. FDA, EPA, HACCP, ISI, Risk analysis; consumer and industry perceptions

Recommended Books:

1. Stanburry et al. (2011). Principle of fermentation technology Pergamon Press.
2. Reed G (2001). Industrial Microbiology CBS Publisher.
3. Cruger&Cruger, (2005), Microbial Biotechnology, Panima Press
4. Moo-Young M, Cooney CL &Humphery AE (1985). Comprehensive Biotechnology-The Principles, Applications & Regulations of Biotechnology in Industry, Agriculture & Medicine, Pergamon Press
5. Atlas RM, Park LC & Brown AL (1995).Laboratory Manual of Experimental Microbiology. Mosby-Year Book,Inc.,Missouri

Paper 12: Cell Culture (GMBT-304)

Course Objective

"At the end of course, students will be able to describe following methods: - 1. Regarding cell division, Mitosis, meiosis, Comparison. 2. Regarding Movement across membranes- Passive transport: simple diffusion, facilitated diffusion-transporters (uniporters and co-transporters) and channel proteins. Active transport."

Course Content

UNIT-1: Plant Biotechnology

Culture media: - constituents and concepts of sterilization, Preparation, isolation and selection of, explant, Concepts of totipotency.

Suspension cell culture, Callus culture, Protoplast Isolation, culture & fusion.

Anther & pollen culture for production, Somatic embryogenesis, Synthetic seeds.

Germplasm Conservation: Improvement, exploitation and conservation of plant genetic resources.

UNIT-2: Animal Biotechnology

Equipments & media used for Animal cell culture technology, Primary & established cell line culture and culture media

Applications of animal cell cultures, Serum protein media viability and cytotoxicity, Basic techniques of mammalian cell culture, Cryopreservation and transshipment of animal tissue and cell line

UNIT-3: Stem cells

Erythrogenesis, Chondrogenesis,. Cell cycle analysis, cells synchronization, cells separation, cells transformation in vitro, cells locomotion and cell cloning

Different types of stem cell Characteristics of stem cells. The methods for stem cells differentiations. Potential of stem cell research in treatment of different genetic, infectious diseases and drug targeting, Gene therapy and its application

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Objectives of transgenics, Methods of gene transfer in plants and animals

Expression of transgene in higher plants and animals for producing value based products. Application of transgenic plants and animals: Recombinant product produced through transgene viz. Edible Vaccine, Recombinant proteins, Hormone production etc.

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8. Slater, A., Scott, W.N. and Flower, R.M. (2008). Plant Biotechnology. 2nd edition. Oxford University Press Inc., Newyork.

List of practical based on theory papers (Semester-II)
GMMT LAB-301

1. Isolation of amylase producing bacteria from soil
2. Preparation of standard curve of reducing sugars by DNS method
3. Quantitative estimation of amylolytic potential of isolated bacterial culture
4. Isolation of yeasts from natural environment
5. To perform an experiment to show the Ethanol fermentation by yeast.
6. Quantitative estimation of ethanol by distillation method
7. Demonstration of surface fermentation
8. To isolate plasmid DNA from a given culture
9. To prepare agrose gel and to run the plasmid DNA samples
10. Isolation of chromosomal DNA
11. Plant DNA extraction by Phenol: Chlorophorm method
12. Demonstration of submerged fermentation
13. Demonstration of solid state fermentation
14. Searching Data from NCBI Database.
15. Working on EMBL.
16. Searching structural data from PDB.
17. Genome Map viewer from NCBI.
18. Database search using BLAST.
19. Sequence alignments.
20. Sequence and structure visualization

List of practical based on theory papers (Semester-III)
GMMT LAB-302

1. Preparation of tissue culture/medium, and phytomitogens,
2. Harvesting and counting of lymphocyte microcultures,
3. Viability testing of isolated lymphocytes,
4. Handling and culture of E.coli, plamid isolation,
5. Elution of DNA from agarose gels,
6. Restriction enzyme digestion, smear preparation for M. tuberculosis,
7. Polymerase Chain Reaction,
8. Validation of PCR products by agrose gel electrophoresis
9. Southern blot hybridization.
10. Isolation of amylase producing bacteria from soil
11. Preparation of standard curve of reducing sugars by DNS method
12. Quantitative estimation of amylolytic potential of isolated bacterial culture

13. Isolation of yeasts from natural environment
14. To perform an experiment to show the Ethanol fermentation by yeast.
15. Quantitative estimation of ethanol by distillation method
16. Demonstration of surface fermentation
17. To isolate plasmid DNA from a given culture
18. To prepare agrose gel and to run the plasmid DNA samples
19. Isolation of chromosomal DNA
20. Plant DNA extraction by Phenol: Chlorophorm method
21. Demonstration of submerged fermentation
22. Demonstration of solid state fermentation
23. Demonstration of instruments & calculations for making of stock and working solutions. Isolation of cellular DNA by rapid method / standard method.
24. Restriction digestion and electrophoresis and Demonstration of southern blotting. Ligation of DNA fragments and electrophoresis.
25. Demonstration of competent cell preparation and Transformation.
26. Isolation of recombinant DNA and electrophoresis.