SEMESTER V

GBMB-501 INDUSTRIAL MICROBIOLOGY& FERMENTATION TECHNOLOGY

Course Objective:

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 4. Biotechnological applications in Environmental 5. The use of microorganisms and enzymes for production of compounds which have application in the energy, material, pharmaceutical, chemical and the food industry

Course Contents

Unit-I

Introduction: Basic concept of microbesin industry: screening, selection and identification. Maintenance and preservation of industriallyimportant microbial cultures.Differences between microbial industrial processes andchemical industrial processes.

Unit 2 Introduction to Industrial microbiology

Brief history and developments in industrial microbiology
Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous
Types of fermenters – laboratory, pilot-scale and production fermenters
Components of a typical continuously stirred tank bioreactor

Unit 3 Isolation of Industrial Strains and Fermentation Medium

Primary and secondary screening
Preservation and maintenance of industrial strains
Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract

Unit 4 Microbial fermentation processes

Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.
Microbial production of industrial products - citric acid, ethanol and penicillin.
Industrial production and uses of the enzymes - amylases, proteases, lipases and cellulases.

Unit 5 Enzyme immobilization

Methods of immobilization, advantages and applications of immobilization, large scale applications ofimmobilized enzymes (glucose isomerase and penicillin acylase)

SUGGESTED READINGS:

1. Plant Biotechnology In Agriculture- **K. Lindsey and M.G.K. Jones**
2. Biotechnology : A Text Book of Industrial Microbiology-**T.D. Brock**
3. Industrial Microbiology-**L.E. Casida**
4. Industrial Microbiology-**Prescott & Dunn**
5. Biotechnology-A Hand Book of Industrial Microbiology-**W. Crueger and A. Crueger**
6. Microbial Biotechnology-**A. N. Glazer and H. Nikaids.**

GBMB-502 BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS

Course Objective

"At the end of this course the students will be able to describe: 1. What is Indian patent law, WTO and how it is related with IPR. 2. Ethical and depository considerations in biotechnology. 3. What entrepreneurship, how training in it help to select a product, and could have impact on bio economics of the product. 4. What bioethics are and why those are needed in research, national and international issues associated with these. 5. What is biosafety and guidelines for it, and concept of GLP and GMP."

Course Contents

Unit 1

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types;Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms

Unit 2

Biosafety Guidelines: Biosafety guidelines and regulations (National and International);GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM,GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; RiskAnalysis; Risk Assessment; Risk management and communication; Overview of InternationalAgreements - Cartagena Protocol.

Unit 3

AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions.

Unit 4

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights,Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR -patentable and non patentables – patenting life – legal protection of biotechnological inventions -World Intellectual Property Rights Organization (WIPO).

Unit 5

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional,Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing andagreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patentowner.

Unit 6

Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement;WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms;UPOV&Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 &recentamendments.

Suggested Reading

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.
5. Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

GBMB-503 MEDICAL MICROBIOLOGY

Course Objectives

"At the end of this course the students will be able to "1) The course is designed to enhance student knowledge on morphology, pathogenesis, symptoms, laboratory diagnosis, and preventive measures of different gram-positive bacteria. 2) The students will get an insight on normal microflora of human body and infections caused by them. 3) On completion of this course, students' knowledge on morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy with regards to gram negative bacteria will be increased."

Course Contents

Unit I

Introduction: Normal microflora of human body, nosocomial infections,carriers, Oral cavity infections, septic shock, septicemia, food poisoning, pathogenicity, virulence factors, toxins,biosafety levels.

Unit II

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventivemeasures and chemotherapy caused by Gram Positive and Gram negative bacteria, UTI, Meningitis.

Unit III

Diseases caused by viruses- Picornavirus, Orthomyxoviruses,Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus,Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses, Pyrexia of unknown origin (PUO), STDs.

Unit IV

Fungal and Protozoan infections; Dermatophytoses ,Subcutaneous infection, systemic infection, opportunistic fungal infections, Gastrointestinal infections,Blood-borne infections.

Practicals:

1.Microbial Examination of normal flora
2. Microbial examination of respiratory tract infections.
3. Examination and analysis of food poisoning.
4. Studies of microbes associated with Urinary tract infections.
5. Microbial analysis of sexually transmitted diseases.
6. Microbial slide preparations from wounds, skin and eye.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, UniversityPress Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, MelnickandAdelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4thedition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ.(2013) Prescott, Harley and Klein'sMicrobiology.9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition

GBMB 504 INSTRUMENTATION & BIOTECHNIQUES

Course Objectives

"At the end of course, students will be able to describe following methods: - • Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy. • Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration. • HPLC, SDS-PAGE, electrophoresis, Western blotting"

Course Contents

Unit 1 Microscopy

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy,Confocal Microscopy, Electron Microscopy (Scanning and Transmission ElectronMicroscopy) andMicrometry.

Unit 2 Chromatography

Principles and applications of paper chromatography (including Descending and 2-D), Thinlayerchromatography.Column packing and fraction collection. Gel filtrationchromatography, ionexchangechromatography and affinity chromatography, GLC, HPLC.

Unit 3 Electrophoresis

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gelelectrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gelelectrophoresis.

Unit 4 Spectrophotometry

Principle and use of study of absorption spectra of biomolecules.Analysis of biomolecules using UVand visible range.Colorimetry and turbidometry.

Unit 5 Centrifugation

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors.RCF andsedimentation coefficient, differential centrifugation, density gradient centrifugation andultracentrifugation.

Practical

1. Use and care of microscope, pH meter and micropipettes.
2. Application procedure and precautions with PCR technique

3. Application procedure and precautions with Centrifuge and centrifugation
4. Application procedure and precautions with Gel electrophoresis
5. Application procedure and precautions with Laminar Airflow and Autoclaving
6. Spectrophotometry: Principle and application.
7. Software based analysis of protein sequences.
1. Software based analysis of DNA sequences.
2. Methods of eluting DNA from agarose gel.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and MolecularBiology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H.Freeman and Company.
3. Willey MJ, Sherwood LM &Woolverton C J. (2013). Prescott, Harley and Klein'sMicrobiology.9thEd., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition.JohnWiley &Sons.Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology.8th edition.Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition.ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology andBiotechnology.Tata McGraw Hill.

GBMB-505 FOOD MICROBIOLOGY, PRESERVATION & QUALITY CONTROL

Course Objectives:

"At the end of this course the students will be able to describe:1. Enzyme and polysaccharide synthesis and industrial applications. 2. Agricultural Biotechnology 3. Biotechnological applications in Environmental 4. Forensic science application of biotechnology 5. Application of Biotechnology in health. 6. cell immobilization, Metabolic engineering, Secondary metabolism 3. fermentation, batch and continuous culture, scale up production in the industry 7. bioprocess technology 8. student will learn about industrial process and it will be an industry-oriented course."

Course Contents:

Unit 1 Food as a substrate for microbial growth

Intrinsic and extrinsic parameters that affect microbial growth in foodMicrobial spoilage of food - milk, egg, bread and canned foods

Unit 2 Principles and methods of food preservation and food sanitation

Principles, physical methods of food preservation: temperature (low, high, canning, drying),irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging,chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethyleneoxide, antibiotics and bacteriocins, Food sanitation and control – HACCP

Unit 3 Dairy products, probiotics and Food-borne Diseases

Fermented dairy products - yogurt, acidophilus milk, kefir, dahi and cheese, Probiotics definition, examples and benefits, Food intoxication by *Clostridium botulinum*and*Staphylococcusaureus*
Food infection by *Salmonella* and *E.coli.*

Unit 4 Microbial spoilage of various foods

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Suggested readings:

1. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional,London.
2. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P)Limited Publishers, New Delhi, India.
3. Banwart JM. (1987). Basic Food Microbiology.1st edition.CBS Publishers and Distributors,Delhi, India.
4. Frazier WC and Westhoff DC. (1992). Food Microbiology.3rd edition. Tata McGraw-Hill
Publishing Company Ltd, New Delhi, India.
5. Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology.7th edition, CBSPublishers and Distributors, Delhi, India.

GBMB-506 BIOSTASTICS & BIOINFORMATICS

UNIT I

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphicalrepresentation of Statistical data.Measures of central tendency and Dispersion.Measures ofSkewness and Kurtosis.Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT II

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error,large sample test and small sample test. Problems on test of significance, t-test, chi-square testfor goodness of fit and analysis of variance (ANOVA), Correlation and Regression. Emphasis on examples from Biological Sciences

UNIT III

History of Bioinformatics.The notion of Homology. Sequence Information Sources, EMBL,GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on theweb.

UNIT IV

Protein Information Sources, PDB, SWISSPROT, TREMBL, Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT IV

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequenceAssembly, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Concept of Genome Annotation and Gene identification tools.

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.
5. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
6. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition.Wiley-Blackwell.
7. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.