SEMESTER V

GBBT-501 PLANT & ANIMAL BIOTECHNOLOGY

Course Objective:

At the end of course students will be able to describe following:-

- Organogenic differentiation, Types of culture, Protoplast culture
- In vitro haploid production
- Protoplast Isolation and fusion, Somaclonal variation
- Plant Growth Promoting bacteria.
- Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation,
- Biocontrol of pathogens

Course Content:

UNIT I

Introduction, Cryo and organogenic differentiation, Types of culture: Seed , Embryo, Callus, Organs, Cell and Protoplast culture.Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II

In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesisSgnificance and use of haploids, Artificial seeds, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT - III

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridizationlimitations.Somaclonalvariation Plant Growth Promoting bacteria.
Biocontrol of pathogens, Growth promotion by free-living bacteria.

UNIT IV

Animal tissue culture media, primary and secondary cultures, cell lines, Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer,Retrovirus& Gene transfer, Introduction to Stem Cell Technology and its applications.

UNIT V

Introduction to transgenesis.Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect.
Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

SUGGESTED READING

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB.,Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture.Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.
7. Sambrook&Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation ofPlants, Oxford University Press.
9. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
10. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition.ASM press, Washington, USA.
11. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
12. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

GBBT-502 BASICS OF FORENSIC SCIENCES

Course Objective

1. This course will help to gain the in-depth knowledge about the Forensic science, criminal investigation and death types with reference to injuries.
2. After completion of this course, the students will be aware about different types of fire explosives with their chemical evidences.
3. With the help of this course, the students will come to know about the handwriting characteristics, comparison between hand-writings and ink analysis.
4. This course is designed to enhance the students' knowledge about the toxics, fingerprinting techniques and unique personal fingerprint identification.
5. The purpose of this course is to give in-depth knowledge of purpose of DNA finger printing, Cyber security and preserving of evidence.

Course Content:

Unit I

Introduction and principles of forensic science, forensic science laboratory and its organizationand service, tools and techniques in forensic science, branches of forensic science, causes ofcrime, role of modus operandi in criminal investigation. Classification of injuries and theirmedico-legal aspects, method of assessing various types of deaths.

Unit II

Classification of fire arms and explosives, introduction to internal, external and terminalballistics.Chemical evidence for explosives. General and individual characteristics ofhandwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit III

Role of the toxicologist, significance of toxicological findings, Fundamental principles offingerprinting, classification of fingerprints, development of finger print as science for personalidentification.

Unit IV

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine,Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers,Introduction to Cyber security.

SUGGESTED READING

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime SceneInvestigation, CRC Press, Boca Raton (2013).

GBBT-503 ENTREPRENEURSHIP & IPR

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 bioeconomics 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 Content:

UNIT-I

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT II

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

UNIT III

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

UNIT IV

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

SUGGESTED READING

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

GBBT-504 INDUSTRIAL FERMENTATION AND BIOPROCESS ENGINEERING

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 Content:

UNIT I

Production of industrial chemicals, biochemicals and chemotherapeutic products. Biofuels: Biogas, Ethanol, butanol,hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbialpolysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics,anti-cancer agents, amino acids.

UNIT II

Secondary metabolism – its significance and products.Metabolic engineering of secondary metabolism for highest productivity.Enzyme and cell immobilization techniques in industrial processing, enzymes in organicsynthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in foodtechnology/organic synthesis.

UNIT III

Upstream and downstream processing, solids andliquid handling.Distribution of microbial cells, centrifugation, filtration of fermentation broth,ultra centrifugation, liquid extraction, ion-exchange recovery of biological products.Experimental model for design of fermentation systems, Anaerobic fermentations.

UNIT IV

Rate equations for enzyme kinetics, simple and complex reactions.Inhibition kinetics; effect ofpH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics,mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka)determination, factors depending on scale up principle and different methods of scaling up.Metabolic engineering of antibiotic biosynthetic pathways.

UNIT V

Introduction to bioprocess technology.Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types ofculture/production vessels- Airlift; Cyclone Column; Packed Tower and their application inproduction processes. Bioprocess measurement and control system with special reference to computer aidedprocess control.

SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology.1st edition.Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.2nd edition.Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology.1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation TechnologyCasida LE.(1991). Industrial Microbiology.1st edition.Wiley Eastern Limited.
6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.2nd edition.Panima Publishing Co. New Delhi.
7. Patel AH. (1996). Industrial Microbiology.1st edition, Macmillan India Limited.
8. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.2nd edition, Elsevier Science Ltd.

GBBT-505 BIOANALYTICAL TOOLS AND TECHNIQUES

Course Objective:

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 I

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy.

UNIT II

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles andparticles.

UNIT III

Introduction to the principle of chromatography. Paper chromatography, thin layerchromatography, column chromatography: silica and gel filtration, affinity and ion exchangechromatography, gas chromatography, HPLC.

UNIT IV

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE),agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectricfocusing, Western blotting. Introduction to Biosensors and Nanotechnology and theirapplications**.**

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.
8. Software based analysis of DNA sequences.
9. Methods of eluting DNA from agarose gel.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley&Sons.Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006.Cell and Molecular Biology.8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

GBBT-506 BIOSTATISTICS & BIOINFORMATICS
BIOSTATISTICS
Course Objective:

"(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 Content:

UNIT I

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.Probability classical & axiomatic definition of probability, Theorems on total and compoundprobability), 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 test for 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 the web.

UNIT IV

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

UNIT IV

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Introduction to BLAST, usingit 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.