SEMESTER IV

GBBT-401 ENZYME TECHNOLOGY

Course Objective:

1) The course is designed to enhance the understanding of students on enzyme characteristics, nomenclature, classification, enzyme hypothesis, enzyme kinetics and factors affecting rate of reaction.

2) The students will learn about two substrate reaction, enzyme inhibition and factors associated with catalytic efficiency.

3) The course will enhance the insight of students on mechanism of enzyme regulation, measurement & expression of enzyme activity, enzyme assay and techniques for studying mechanisms of action.

4) On completion of this course, the students will understand protein folding mechanism, protein sequencing, catalytic efficiency of enzymes, methods of analysis of structure of enzymes and structure-function relationship in enzymes.

5) This course will also give the knowledge on enzyme applications in industry.

Course Content:

UNIT I

ENZYMES: Definition, historical perspectives, systematic nomenclature & classification, significance of numbering system, coenzyme, cofactors.Types of specificity, hypothesis (lock-and-key, induced fit, strain or transition-state stabilization)activesite.Description of serine protease, lysozyme and chymotrypsin.

UNIT II

Factors affecting enzyme activity (Enzyme concentration, substrate concentration, pH, temperature.
Michaelis-Menten equation, Lineweaver- Burk plot,Eadie-Hofstee and Hanes–Woolf equation. Km and its significance.Competitive, non-competitive, uncompetitive inhibitions and mixed inhibition.

UNIT III

General mechanisms of enzyme regulation.Isoenzymes.Measurement and expression of enzyme activity: Extraction, enzyme assay, enzyme units, enzyme turn over number and specific activity.

UNIT IV

Enzyme applications: Immobilization of microbial enzymes-Methods *viz.* adsorption, entrapment & membrane confinement, covalent bonding and their analytical, therapeutic & industrial applications. Properties of immobilized enzymes.Enzyme engineering-Strategies, artificial enzymes, degradation of unnatural substrates and catalytic antibodies.Clinical and industrial applications of enzymes– Detergent, food, leather, dairy and medicine industries.

Suggested Reading:

1. Enzymes: Biochemistry, biotechnology, Clinical Chemistry (2007) by Trevor Palmer, Philip L Bonner, Horwood Publishing Limited.
2. Principles of enzymology for technological applications: BIOTOL series; (1993) Butter Worth Heinemann.
3. Fundamentals of enzymology: The cell and molecular biology of catalytic proteins (1999) by Nicholas C. Prime and Lewis Stevens; Oxford University press.
4. Biochemistry (1999) by Zubay, G., W.C.Brown Publishers, Oxford, England.
5. Biochemistry (2007) by Stryer, L., W.H. Freeman and Company, New York.
6. Principles of biochemistry, (2008) Albert Lehninger, Michael Cox, David L; 5th edition; Worth Publishers, New York-2008.
7. Biochemistry (2004) by Voet, D and Voet J.G., John Liley and Sons, Inc. New York.
8. Enzymology (2008) by DimiterKolev, World Scientific Pub Co Inc.
9. An Introduction to practical Biochemistry (2004) by Plummer D.T., Tata McGraw Hill Publishers Co. Ltd., New Delhi.
10. Practical enzymology (2005) By Hans Bisswanger, Wiley-VCH, Weinheim.
11. Introductory practical biochemistry) (2005) by S. K. Sawhney, Randhir Singh, Alpha Science International.

GBBT-402 Proteomics & Genomics

Course Objective

(i) After the competition of the course, the student will have a basic understanding on the type and management of biostatistical data.

(ii) The student will understand how to analyze 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 analyze computational 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

Model organisms and genome size.Unicellular and multicultural genome: Lessons learned sequencing of genomes, evolution of genome. Genome identification.Construction of genomic libraries, vector, mapping strategies (genetic maps,physical maps, cytological maps, comparative maps) and techniques (FISH,radiation hybrid mapping, finger printing).

UNIT II

cDNA library construction and screening: Methods development, justification for subtraction, normalization andfingerprinting; identification of cDNA's encoding rare messages, ESTprojects and their utility in research.Sequencing strategies for human genome.

UNIT III

Genome annotation and bioinformatics: How to identify genes, inferring gene function, database construction and searching.Protein evolution from exon shuffling, protein structural genomics, gene function by sequencing comparison.Whole genome analysis of mRNA and protein expression, types of microarray and applications.

UNIT IV

Comprehensive mutant libraries: High throughput gene knockout, gene targeting, gene trapping, genome widemutagenesis.OMICS: Toxicoginomics, Chemical genomics and Pharmacogenomics.

Reference Books:

1. Gibson G., Muse S. V. (2009). A primer of genome science (SinauerAssociates, Inc. Sunderland, MA).
2. Igor Jurisica, Dennis Wigle. (2005). Knowledge discovery in proteomics (Edition Illustrated, Publisher CRC Press).
3. Pennington S.R. (Ed), Dunn M. J. (Ed) (2001). Proteomics: From protein sequence to function (Edition Illustrated, Publisher Taylor & Francis).
4. SrivastavaSudhir (Ed). (2005). Informatics in proteomics (Edition Illustrated Publisher CRC Press).
5. Akay M. (Ed). (2007). Genomics and proteomics engineering in medicine and biology (Wiley-Interscience John Wiley & Sons, Inc. Publication, USA).
6. Sensen C. W. (2002). Essentials of genomics and bioinformatics (Wiley- VCH, Weinheim).
7. Baxevanis, A.D., Davison, D.B., Page, R.D.M., Petsko, G.A. (2004). Current protocols in bioinformatics (John Wiley & Sons, Inc. Publications, New York).

GBBT-403 TOXICOLOGY

Course Objective:

(i) The students will have a general idea about toxicology, its branches, and how the chemicals can cause the toxicity.

(ii) The student will be able to understand how the amount of chemicals can lead to toxicity.

(iii) The student will have an idea about the severity of toxicity that results when a xenobiotic enters the body.

(iv) The students will be able to able to learn about inorganic toxicants, pesticides, and their mechanism of action.

(v) The students will have an idea about the management of toxicated patients in the clinics.

Course Content:

UNIT 1 Introduction to Toxicology

Definition, scope and different branches of toxicology, Classification of toxic agents, Characteristicof exposure, Spectrum of undesired effects, Interaction of chemicals and their toxic effect, Tolerance.

UNIT 2 Dose-Response relationship&Measuring toxicities

Graded and Quantal response, Hormesis, Assumption and evaluation of dose response relationship, Variation in toxic responses.Toxicity testing methods, The LD50Experiment, Acute, Short-Term and Chronic toxicities and its manifestations: Mode of application, administration, exposure and in vitro tests.

UNIT 3 Disposition of toxicants

Absorption, Distribution, Metabolism and Excretion (ADME) of toxicants and chemicals, Xenobiotic Biotransformation by Phase I (Hydrolysis, Oxidation, and Reduction) and Phase II (Glucuronidation, Sulfation, Acetylation, Methylation and Conjugation reactions).

UNIT 4 Toxic agents

Toxic effects of metals: Mercury, Lead, Arsenic, Fluoride; Source, exposure, absorption, target site interaction and health hazards. Toxic effects of pesticides: Brief classification with examples; Residual and non-residual pesticides; Mode of entry and mode of action of pesticides in target and non-target organisms. Toxic effects of solvents and vapours: Solvent-induced chronic encephalopathy, solvent abuse, Chlorinated hydrocarbons, fuel and fuel additives.

Text Books:

1. Cassarett and Doull's Toxicology: The Basic Science of Poison by Curtis D. Klassen 7thEdition, McGraw Hill Publishers, 2007.
2. Cassarett and Doull's Essentials of Toxicology by Klassen and Whatkins, 1stEdition, McGraw Hill Publishers, 2003.
3. Environmental Biology and Toxicology by P.D. Sharma, Rastogi& Co Meerut, 1993.
4. Principles of Toxicology by Karen E. Stine and Thomas M. Brown 2ndEdition, Taylor and Francis Publishers, 2006.
5. Lu's Basic Toxicology by Frank C. Lu and Sam Kacew 4thEdition. Taylor and Francis Publishers, 2002.
6. Introduction to Toxicology by John Timbrell 3rdEdition, Taylor and Francis, 2002.

Lab Course (GBBT 401, 402 & 403)

Practicals:

1. Estimation of Alkaline phosphatase in given sample.
2. Estimation of Amylase in given sample.
3. Estimation of Lactate dehydrogenase in given sample.
4. Effect of substrate concentration on enzyme activity.
5. Effect of temperature on enzyme activity.
6. Effect of inhibitors on enzyme activity.
7. To perform PCR amplification of specific target sequence from genomic DNA.
8. To study the elution of Plant DNA fragment from Agarose gel.
9. Demonstration of the working mechanism of PCR.
10. To study polymerase chain reaction cloning.

GBBT-404 BOTANY IV

(Ecology, Morphogenesis& Economic Botany)

Course Objective:

"On the completion of this course the students will be able to describe, the students understand in advanced level of the diversity in plant life can be understood from the following topics of diversity: Diversity on The Basis of Habitat, plants classified into following groups students understand the geographical understanding respectfully: Hydrophytes: These plants may be: Hygrophytes: Halophytes: Mesophytes: Xerophytes: Geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms. Life histories of Cycas &Pinus"

Course Content:

Unit-1

1. Various disciplines of Ecology, A general concept of biotic and abiotic factors.
2. Ecological concepts: Ecads, Ecotypes, Ecotone, Ecological niche and ecological equivalents.
3. Population Ecology: Characters of Population, survivorship curve, r and k selected populations.

Unit-II

1. Community Ecology: Qualitative and quantitative characters of the Community.
2. Concept of Ecosystem, Ecological Pyramids.
3. Concept of Bio-indicators and Succession.

Unit- III

1. Function of plant growth regulators:Auxins, Gibberellins, Cytokinins and Abscissic acid.
2. Physiology of flowering – Photoperiodism and vernalization.

Unit- IV

1.Origin of cultivated plants, centre of origin of some important crop plants.
2. A general account of cereals, fibres, oils, legumes, medicinal and timber yielding plants.

Practical

1. Estimation of Diversity indices (Simpson's Diversity Index) in various population samples.
2. Calculate the index of similarity and dissimilarity of sample community.
3. Estimation and analysis of frequency, density, abundance & Dominance in studied community.
4. Analysis of IVI (Importance Value Index) in various Community samples.
5. Analysis of Raunkiaer's law of frequency.
6. Analysis of Raunkiaer's life forms & biological spectrum.
7. Field survey to identify and list out different Biological Indicators.
8. Analysis of the effect of Plant Growth Regulators (PGRs) *in vitro*.
9. Collection, Identification and characterization of various economic crops and medicinal plants.
10. Analysis of soil samples for carbonates, chlorides, sulphates/Phosphates and nitrogen contents.

Books Recommended:

1. Bendre A and Kumar A. Economic Botany. Rastogi Publ. Meerut
2. Hill. R. Economic Botany (Indian Print).
3. Ecology by E.P. Odum.
4. Ecology and Environment, By P.D. Sharma, Rastogi Publications.
5. Plant Physiology by S.K. Verma, S. Chand Publishers.
6. Plant Physiology by Taiz and Zeiger.

GBBT-405 ZOOLOGY IV

(Developmental Biology and Evolution)

Course Objective

"On the completion of this course, this course will enhance the students to get the knowledge about the anatomy of different systems of higher chordates. On completion of this course, the students will gain in-depth knowledge related to excretory system, nervous system and structures of Brain, Eye and Ear."

Course Content

Unit I: Principles and basic concepts: Potency, commitment,specification, induction, competence, determination and differentiation;morphogenetic gradients; cell fate and cell lineages; stem cells; genomicequivalence and the cytoplasmic determinants; imprinting; roles ofmutants and transgenics in study of development.

Model Systems in Biotechnological studies: Definition of 'Model System',Introduction to some important model systems including *Saccharomycescerevisiae*, *Arabidopsis thaliana* (Plant); *D. melanogaster, C. elegans*(invertebrates); *Xenopuslaevis,* Chicken, Mouse, Zebrafish(vertebrates).

Unit II: Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognitionin animals; zygote formation, cleavage, blastula formation, embryonicfields, gastrulation and formation of germ layers and their fates inanimals; embryogenesis.

Unit III: Morphogenesis and organogenesis in animals: Kinds ofcleavages, stages of embryo, proximal and distal pattern and axes formation in *Drosophila*,amphibia and chick; organogenesis; vulva formation in *Caenorhabditiselegans*;post-embryonic larval development andmetamorphosis; brief introduction to environmental factors that regulatenormal development; sex determination. Development of *Drosophila*.

Unit IV: Origin and evolution of life: Concept, process and sequence of evolution; chemical and organic evolution. Theories of evolution of life.Darwinism and modern synthetic theory.Naturalselection.Industrialmelanism.Origin of diversity and variation, mutation, migration, isolation and speciation.

Practical

1. Study of various developmental stages of *Amphioxus* through models.
2. Study of different types of eggs.
3. Development stages of housefly/honey bee.
4. Development stages of frog.
5. Study of various stages of chick embryo by permanent slide.
6. Effect of temperature and light on animal (Insect).
7. Study of population of any animal in a given time and space.
8. Study of the diversity of ecosystem in and around university campus.
9. Study of the environmental ecology with reference to air and water.
10. Application of ecological knowledge for the human and environmental welfare (a model exercise).
11. Study wild animals close to you and study their natural significance and suggest conservation methods (Lizards).
12. Preparation of temporary mount of chick epithelial tissue.
13. Study of Epithelial tissue by permanent slides.
14. Comments on types of epithelia by temporary mount of cheek cells.
15. Study of connective tissue from permanent slides.
16. Temporary mounts of Adipose and Areolar connective tissue from mammals.
17. Study of different kinds of muscle fibers by permanent slides.
18. Temporary mount of skeletal muscle cells of frog.
19. Study of nervous tissue by slides.

Recommended Books

1. Gilbert SF, 9th Edition. 2010. Developmental Biology. Sinauer Associates Free material online:http://9e.devbio.com/pdfs/Developmental_Biology_8e_Ch20.pdf
2. Fujimoto K, Ishihara S, Kaneko K (2008). Hogeweg, Paulien. ed. "Network Evolution of Body Plans". PLoS ONE 3 (7): e2772.
3. Christ B, Schmidt C, Huang R, Wilting J, Brand-Saberi B (January 1998). "Segmentation of the vertebrate body". Anat. Embryol. 197 (1): 1-8.
4. Wolpert L, Beddington R, Jessell T, Lawrence P, Meyerovvitz E, Smith J (2002). Principles of development (2nd ed.). Oxford university press.

GBBT-406 CHEMISTRY IV

Course Objective:

"At the end of this course the students will be able to describe, the student will understand the modern view of atomic structure, and learn to fill configuration of elements (ii) The students will learn the physical chemistry concepts in gaseous states and its applications. (iii) The student will be able to understand the homogenous non-crystalline substance, generate application of colloids and nano-materials and their real-world applications. (iv) The students will learn different types of organic reaction mechanisms and their examples."

Course Content:

1. ***Coordination Compounds*** **:**Werner's theory, nomenclature, chelates, stereo-chemistry of coordination numbers 4, 5 and 6. Various types of isomerism in coordination complexes.Important applications of coordination compounds. Theories of metal-ligand bonding in transition metal complexes- Sidgwick effective atomic number concept, valence bond theory of coordination compounds.

2.Phase rule: Derivation of phase rule, stability of phases, phase diagrams, one component system, two component system, three component system, Nernst distribution law, Limitation and applications of distribution law.

***3. Electrochemistry* :**Arrhenius theory of electrolytic dissociation, classification of electrolytes; Hydrolysis of salts, hydrolysis constant, buffer solutions, indicators and theory of acid-base indicators. Migration of ions : transference number and its determination (Hittorf and Moving Boundary methods). Conductance of solutions, variation of molar conductance with concentration (Kohlrausch square root law), Kohlrausch law of independent migration of ions, ionic mobility, hydration of ions, application of conductance measurements (degree of dissociation of weak electrolytes, dissociation constant of weak acids, determination of solubility of sparingly soluble salts, degree of dissociation of water, conductometric titrations).

***4. Nuclear Chemistry* :**Isotopes : their separation and applications. Nuclear forces, nuclear binding energy, stability of nucleus, energy changes in nuclear reactions, Bethe notation, nuclear fission and fusion. Uses of nuclear radiations (radiation, sterilization, radiation energy for chemical synthesis).Radio isotopes as a source of electricity.

5.*Polymers and Polymerization* :Elementary treatment - Alkene polymerization and condensation polymers – polyethylenes, nylons and terylene.

6.*Active methylene compounds* :Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate, Tautomerism.

7. Heterocyclic compounds: Five membered rings, Structure of pyrrole, Structure of furan, Structure of thiophene, electrophilic substitution in five membered rings, six membered ring, structure and reaction of pyridine, electrophilic and nucleophilic substitution in pyridine, basicity of pyridine.

Books Recommended

1. *"A New Concise Inorganic Chemistry",* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. *"Modern Inorganic Chemistry",* **R. C. Aggarwal**, 1st Edition (1987), KitabMahal, Allahabad.
3. *"Basic Inorganic Chemistry",* **F. A. Cotton, G. Wilkinson, and Paul L. Gaus,** 3rd Edition (1995), John Wiley & Sons, New York.
4. *"Organic Chemistry",* **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
5. *"Organic Chemistry",* **S. M. Mukherjee, S. P. Singh, and R. P. Kapoor**, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.
6. *"Organic Chemistry – Structure and Reactivity",* **Seyhan N. Ege**, 3rd Edition (1998), AITBS Publishers and Distributtors, Delhi.
7. *"Organic Chemistry",* **Paula Y. Bruice**, 2nd Edition , Prentice-Hall InternattionalInc, New Jersey, International Edition (1998).
8. *"Physical Chemistry",* **P. C. Rakshit,** 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
9. *"Principles of Physical Chemistry",* **B. R. Puri, L. R. Sharma, and M. S. Pathania,** 37th Edition (1998), ShobanLalNagin Chand & Co., Jalandhar.
10.*"Physical Chemistry",* **K. J. Laidler and J. M. Meiser**, 3rd Edition, Houghton Mifflin Comp., New York, International Edition(1999).
11. "Principle of Nanoscience and Nanotechnology", (2010), **M. A. Shah and Tokeer Ahmad,** Narosa Publishing House, New Delhi.