SEMESTER II

GBBT-201 ENVIRONMENTAL BIOTECHNOLOGY

Course Objective

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
3. Microbiology of air – Sources of microorganisms in air
4. Ecosystems – Fresh water (ponds, Lakes, Streams, Marine, Esturies, Mangrooves, Deep sea).
5. After completion of this course students will learn about the application of biotechnology and microbiology in the environment and living system.

Course Content

UNIT I

Environmental studies: Multidisciplinary nature of Environmental studies; Scope; importance of environment; need for public awareness.

UNIT II

Natural resources: Renewable and non-renewable resources**:** Forest resources; Water resources; Mineral resources; Food resources; Energy resources; Land resources.

UNIT III

Environmental pollution: Air pollution;Water pollution; Noise pollution; Waste Water treatment; Thermal Pollution; Marine pollution; Soil pollution; Nuclear Hazards.

UNIT IV

Social issues and the environment: Rain Water harvesting; climate change; Global warming; Acid Rain; Ozone layer depletion; nuclear accidents.

Suggested Reading:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad -380013, India.
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
4. Clerk B.S., Marine Pollution, ClandersonPross Oxford (TB).
5. Cunningham, W.P.Cooper, T.H. Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R)

GBBT-202 GENETICS

Course Objective

On the completion of this course the students will be able to describe following subject matters:

• Cycle: Mitosis and Meiosis: Control points in cell-cycle, Law of segregation & Principle of independent assortment

• Unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, VNTRs & dinucleotide repeats

• characteristics of bacterial and eukaryotic chromosome, concept of cistron, exons, introns, genetic code, gene function.

• Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, Sex determination and sex linkage

• Linkage and Recombination of genes in a chromosome crossing over, Multiple crossing overs Genetic mapping, Extra chromosomal inheritance: Rules of extra nuclear inheritance
• Evolution and population genetics: In breeding and out breeding

Course Content

UNIT I

Introduction: Historical developments in the field of genetics. Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes.

UNIT II

Non allelic interactions: Interaction producing new phenotype, complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. Chromosome and genomic organization in prokaryotes and eukaryotes. satellite DNA. Centromere and telomere DNA sequences, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT III

Mutations: Definition and types of mutations, causes of mutations, AMES test, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), chromosomal aberrations in human beings, abonormalities - Aneuploidy and Euploidy. Sex determination and sex linkage, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV

Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Genetic mapping. Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal inheritance, cytoplasmic inheritance, Hardy Weinberg law (prediction, derivation) .

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics.VIII Edition JohnWiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition.John Wiley and SonsInc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.IX Edition.Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction toGenetic Analysis, W. H. Freeman & Co.

GBBT-203 MOLECULAR BIOLOGY

Course Objective:

On the completion of this course the students will be able to describe following subject matters:

• Cycle: Mitosis and Meiosis: Control points in cell-cycle, Law of segregation & Principle of independent assortment
• Unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, VNTRs & dinucleotide repeats
• characteristics of bacterial and eukaryotic chromosome, concept of cistron, exons, introns, genetic code, gene function.
• Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, Sex determination and sex linkage
• Linkage and Recombination of genes in a chromosome crossing over, Multiple crossing overs Genetic mapping, Extra chromosomal inheritance: Rules of extra nuclear inheritance
• Evolution and population genetics: In breeding and out breeding

Course Content

UNIT I

Nucleic Acids convey Genetic Information: DNA as the carrier of genetic information, Keyexperiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.

UNIT II

The Structures of DNA and RNA: DNA ;Miescher to Watson and Crick, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation. DNA topology-linking number, topoisomerases.Organization of DNA , Prokaryotes, Viruses, Eukaryotes. RNA Structure, DNA – mitochondria and chloroplast DNA.

UNIT III

Genome Structure, Chromatin and the Nucleosome: The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin. Organization of Chromosomes.

UNIT IV

The Replication of DNA (Prokaryotes and Eukaryotes): Chemistry of DNA synthesis, generalprinciples - bidirectional replication, Semi-conservative, Semi discontinuous, RNA priming, Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory protein.

Recommended Books:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition.John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.VIII Edition. Lippincott
3. Williams and Wilkins, Philadelphia.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition.
5. Pearson Benjamin Cummings Publishing, San Francisco.
6. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008)
7. Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Lab Course (GBBT 201, 202 & 203)

1. To determine total solid, total dissolved solid and total suspended solid in a given water sample.
2. To determine the total alkalinity of the given sample of water using standard acid solution
3. To determine the acidity of a waste water sample.
4. To study the life cycle of genetically important living organism.
5. To study the taxonomy and floral structure in pea.
6. To study the somatic and gamete chromosome number of common plans and animals.
7. To study mitosis and meiosis in plant cell.
8. To study Mendelian inheritance.
9. To isolate plant DNA by CTAB method.
10. Isolation of genomic DNA.
11. Plasmid isolation
12. To perform whole blood DNA extraction.
13. To perform Agarose gel electrophoresis.
14. Quantification of DNA by spectrophotometer.
15. Quantification of RNA by spectrophotometer.

GBBT-204 BOTANY II
(Fungi, Bryophytes, Pteridophytes)
Course Objective

"1. Students can learn about various classes of plants diversity. 2. Students will able to explain about diversity 3. student easily understand the diversity study procedures"

Course Content
UNIT I

1. General features of fungi, mycelia modifications, structure of a typical fungal cell and staining methods.2. Salient features and life cycle of *Aspergillus* (*Eurotium*), *Mucor*and*Alternaria*.3. Plant Quarantine system in India, Koch's Postulates.

UNIT II

1. Host-pathogen interaction, Disease cycle and general symptoms. 2. Chemical and biological control methods of the plant diseases. 3. The cycle of pathogens causing following significant diseases and its control measures: White rust of Crucifers, Late blight of potato, Black rust of wheat, Red rot of sugarcane

UNIT III

1. General Characters of Bryophytes.Comparative account of the morphology and mode of reproduction in *Riccia* and *Marchantia*, alternation of generation in bryophytes.2. A brief account of *Anthoceros* and *Funaria*.3. Economic importance of Bryophytes.

UNIT IV

1. General characters of Pteridophytes. 2. A comparative account of morphology and mode of reproduction in *Rhynia*and*Adiantum*.

UNIT V

1. A brief account of Stelar system and its evolution. 2. Heterospory and seed habit in Pteridophytes. 3. Apogamyandapospory in ferns.

List of Practical

1. Study of fungal cultures and staining methods.
2. Study and identification of fungal disease symptoms.
3. Study and demonstration of permanent fungal slides.
4. Analysis of bio-control methods of fungal plant pathogens.
5. Preparation of suitable sections & staining methods to study pathogenesis in White rust of Crucifers.
6. Preparation of suitable sections & staining methods to study pathogenesis in Late blight of potato.
7. Preparation of suitable sections & staining methods to study pathogenesis in Black rust of wheat.
8. Preparation of suitable sections & staining methods to study pathogenesis in Red rot of sugarcane.
9. Collection, identification and characterization of specimen Bryophytes.
10. Collection, identification and characterization of specimen Pteridophytes.

Books recommended:

1. Parihar, NS,The Biology and Morphology of Bryophytes. Central Book Depot, Allahabad.
2. Puri P. Bryophytes. Atma Ram and Sons, New Delhi.
3. Vashista BR. A Text Book of Fungi,S.Chand& Co. New Delhi.
4. Parihar NS. Pteridophytes, Central Book Depot, Allahabad.
5. Pandey SN. A Text book of Pteridophytes
6. Smith. Cryptogamic Botany Vol. II
7. Eams. Morphology of Vascular Plants- Pteridophytes.

GBBT-205 ZOOLOGY II
(Invertebrate Zoology)
Course objective

"At the end of this course the students will be able to: 1. Describe unique characters of animal kingdom. 2. Recognize life functions of different animal kingdom."

Course Content:

UNIT I

Introduction to Invertebrate: General Principles of Taxonomy and Animal classification. Salient features and classification up to classes in nonchordates.

UNIT II

Phylum-Protozoa, Porifera and Coelentrata: General characters of Protozoa: Type study of *Plasmodium vivax.* Protozoa and Human diseases.Origin of Metazoa, metamerism and symmetry.Type study of *Sycon,* with reference to reproduction and development.Polymorphism, Corals and Coral reef.

UNIT III

Phylum-Platyhelminthes and Nemathelmithes, Annelida: General characters, typestudy of *Taeniasolium.*Parasitic adaptations. Type study of *Ascarislumbriocodies.*Types and significance of Coelom, Study of Nephridial system in annelids.

UNIT IV

Phylum Arthropoda, Mollusca, Echinodermata and Minor Phyla: General characters of Arthropoda, Mollusca& Echinodermata. Social insects and their life cycle, Torsion and detorsion in gastropods, General Characteristics, life history and development of *Asterias* (star fish). General introduction of minor phyla with examples.

Practical

1. Study of different types of microscopes.
2. Phylum Protozoa: Study of *Amoeba*, *Paramecium*, *Euglena*, *Plasmodium* (signet ring).
3. Phylum Porifera: Study of *Sycon*, *Leucosolenia*, *Hyalonema*, *Euspongia*, *Poterion*.
4. Phylum Cnidaria: Study of *Metridium*, *Physalia*, *Aurelia*, *Pennatulam*, slides of *Hydra*, *Obelia* colony and medusa.
5. Phylum Platyhelminthes: Study of *Fasciola* Larva stages, miracidium, cercaria, redia and metacercaria.
6. Nematoda: Animal Parasitic nematode - *Ascaris*, Plant Parasitic nematode, Free-living nematode.
7. Phylum Annelida: Dissection of Earthworm (*Pheretimaposthuma*) nerve and ovary. Study of *Nereis*, Leech.
8. Phylum Arthropoda: Dissection of Cockroach (*Periplanetaposthuma*)mouth parts and digestive system.
9. Study of Prawn, Hermit, Julus, Honeybee, Limulus, Scorpion, peripatus.
10. Phylum Mollusca: Study of Chiton, Pila, Dentailum, Unio, Octopus, Sepia.
11. Phylum Echinodermata: Study of *Antendon*, *Echinus*, *Asterias*, *Ophiderma*.
12. Preparation of temporary mount of polytene chromosomes from *Chironomous* larva, *Drosophila* larva.

Recommended Books

1. Barnes, R. S . K., 2001. The invertebrates: a synthesis. Blackwell Science.
2. Brusca, R. C. ,Brusca, G. J., 2003. Invertebrates. Sinauer Associates; Palgrave.
3. Dawkins, R., Wong, Y., 2005. The ancestor's tale: a pilgrimage to the dawn of life.Phoenix, London.
4. Gullan, P. J., The insects: an outline of entomology. Wiley-Blackwell, Oxford.
5. Hickman, C. P., 2008. Animal diversity. McGraw-Hill.
6. McGavin, G. ,Lewington, R., 2001. Essential entomology: an order-by-orderintroduction. Oxford University Press.
7. Moore, J., Overhill, R., 2006. An introduction to the invertebrates. Cambridge University Press.
8. Naylor, P., 2005. Great British marine animals. Sound Diving Publications.
9. Pough, F. H., Janis, C. M., Heiser, C. B., 2005. Vertebrate life. Prentice Hall.
10. Ruppert, E. E., Fox, R. S., Barnes, R. D., 2003. Invertebrate zoology. Brooks/Cole.
11. Tudge, C., 2002. The variety of life: a survey and a celebration of all thecreatures that have ever lived. Oxford University Press.
12. R.L. Kotpal-Modern Textbook of Zoology-Invertebrates.

GBBT-206 CHEMISTRY II

Course Objective

"(i) After the completion of this course, 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."

Course Content:

1. ***Chemical Bonding*****:** (i) ***Ionic Bond*** – Types of ionic solids, radius ratio effect and coordination number, limitations of radius ratio, lattice defects, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules.

(ii) ***Covalent Bond*****:** Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions such as NH3, H3O+, SF4, ClF3 $ICl2^{-}$, and H2O by valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals. Applications of MO theory to explain the stability of homo and hetero dinuclear diatomic molecules, multi-centre bonding in electron-deficient molecules.

(iii) ***Bond Energy*****:** Dissociation and average bond energies – determination, periodic trends and applications. Metallic Bond : Free electron, valence bond and band theories. Weak Interactions: Hydrogen Bond – experimental evidence, van der Waal's forces.

2. ***s-Block Elements*** **:** Hydride (classification, general methods of preparation and salient features), hydration energies, solvation and complexation tendencies of alkali and alkaline-earth metals, principle of metallurgical extraction, Chemistry of Li and Be, their anomalous behaviour and diagonal relationships, alkyls and aryls; role in biology.
3. ***p-Block Elements*** **:**Comparative study (group-wise) of group 13 & 14 elements with respect to periodic properties. Compounds such as hydrides, halides, oxides and oxyacids; diagonal relationship; preparation, properties, bonding and structure of diborane, borazine and alkalimetalborohydrides. Preparation, properties and technical applications of carbides and fluorocarbons.Silicones and structural principles of silicates.
4. ***Chemical Kinetics*** **:** Order and molecularity of a chemical reaction, basic kinetic laws of first and second order reactions, analysis of kinetic data for the determination of the rate constant and order, effect of temperature on reaction rates (Arrheninus equation), collision theory of rates of bimolecular reactions.
5. ***Thermodynamics*** **:** Introduction of different terms and processes in thermodynamics : [systems (isolated, closed, open) and surrounding, macroscopic properties (extensive and intensive), kinds of processes], First Law of thermodynamics and internal energy, state and state functions (exact differential), sign convention for heat and work, nature of work, path dependence of work and heat. Enthalpy, heat changes at constant volume and constant pressure, heat capacities (Cv , Cp) and relation between them for ideal gases. Reversible and irreversible processes, maximum work, thermodynamic quantities (w, q, DU, DH) for isothermal and adiabatic reversible expansion of ideal gases.Ideal gas law for adiabatic reversible expansion, comparison of adiabatic and isothermal reversible expasion. Change in internal energy (DU) and enthalpy (DH) of chemical reactions, relation between DU and DH, variation of heat of reaction with temperature (Kirchhoff's equation).
6. Solid State Chemistry: Crystal lattice and unit cell, crystal system, lattice plane, x-rays, diffraction of x-rays by crystals, miller indices, Bragg equation, packing, type of crystals, Defects in crystals.
Recommended Books:

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.