## SEMESTER III

**GBBT-301 Immunology**

**Course Objective:**

"At the end of this course the students will be able to describe: 1. What is active and passive immunity: Structure, Functions and Properties of Immune Cells and Immune Organs. 2. Haptens, Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants. 3. What is Auto immunity and hypersensitivity, Hybridoma technology: Introduction, production of monoclonal antibodies; vaccines. 4. Immuno-techniques - Blood grouping, Antigen-Antibody reactions.

**Course Content:**

**UNIT I**

Concept of Innate and Adaptive immunity;

Active and passive immunity: Structure, Functions and Properties of Immune Cells and Immune Organs Characteristics of an antigen; Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

**UNIT II**

Immunoglobulins: Types, Structure, Functions and Properties of antibodies. Structure and Functions of MHC I & II molecules; Antigen processing and presentation.Cytokines, Compliment System.Primary and Secondary Immune Response; Generation of Humoral and Cell Mediated ImmuneResponse.

**UNITIII**

Types of Auto immunity and Hypersensitive: Tissue transplantation and graft rejection. Diseases of immune system and ImmunodeficienciesHybridoma technology: Introduction, production of monoclonal antibodies; Applications.Vaccines: Introduction to conventional and modern vaccines (DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines); Advantages, mechanism of action.

**UNITIV**

Immuno-techniques - Blood grouping, Antigen-Antibody reactions: agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA.Immunodiffusion, Western blotting, Immunofluoresence, Flow cytometry.

**Recommended Books:**

1. *Immunology: An Introduction*by I.R. Tizard, Saunders College Publishing, Philadelphia.
2. *Kuby Immunology* (2012)by J. Owen, J. Punt and S. Stranford, W.H. Freeman and Co., USA.
3. *Roitt's Essential Immunology*(2007)by P.J. Delves, S.J. Martin, D.R. Burton and I.M. Roitt, Wiley-Blackwell, USA.

**GBBT-302 RECOMBINANT DNA TECHNOLOGY**

**Course Objective**

"At the end of this course, genetic engineering the students will be able to describe: • Vectors and Enzymes, Plasmids, Cosmids, Phasemids, Transposons, Artificial Vectors • Sticky and Blunt Ended ligation methods, Homopolymer tailing method, Gene transfer in Prokaryotes and Eukaryotes, Strategies of gene transfer, blotting techniques, DNA sequencing methods • Applications of Molecular markers; RAPD and RFLP • Golden Rice, Bt Cotton, Antisense RNA technology, Production of transgenic mice • Gene therapy, Merits and demerits of GMOs "

Course Content:

**UNIT I**

Tools and techniques used in Genetic Engineering, Vectors and Enzymes, Plasmids, Cosmids, Phasemids, Transposons, Artificial Vectors, Transformation and Transduction.Competent cell making, Selectable markers.

**UNIT II**

Methods of making of recombinant DNAs: Sticky and Blunt Ended ligation methods, Homopolymer tailing method.

Gene transfer in Prokaryotes and Eukaryotes, Strategies of gene transfer: Liposome mediated; Electroporation, Shot Gun Cloning, Agrobacterium mediated gene transfer, Expression vectors, Concept of Gene/Germplasm bank.

**UNIT III**
Polymerase chain reaction, blotting techniques, DNA sequencing methods
Applications of Molecular markers; RAPD and RFLP.
**UNIT IV**
Transgenic plants and animals, Golden Rice, Bt Cotton, Antisense RNA technology, Production of transgenic mice.
**UNIT V**
Products of genetic engineering: proteins, hormones, immune modulators and vaccines. Gene therapy, Merits and demerits of GMOs.

**Recommended Books:**


1. Alcamo IE. (2001). DNA Technology: The Awesome Skill. 2nd edition. Elsevier Academic Press, USA.
2. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
3. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
4. Glick BR and Pasternak JJ. (2003). Molecular Biotechnology. 3rd edition. ASM Press Washington D.C.
5. Nigam A and Ayyagari A. (2007). Lab Manual in Biochemistry, Immunology and
6. Biotechnology. Tata McGraw Hill, India.
7. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
8. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2008) Prescott, Harley and Klein's Microbiology.7th edition.McGraw Hill Higher Education.


**GBBT-303 MOLECULAR BIOLOGY OF VIRUSES**
**Course Objective:**
At the end of this course the students will be able to describe:
• virus structure, classification, viral replication cycle, Detection of viruses, Serological diagnosis of virus
• Bacteriophages, Plant & Animal Viruses
• Molecular Virology

**Course Content:**
**UNIT I**
Introduction to Viruses; Discovery, virus structure, classification, viral replication cycle, detection and enumeration of viruses, virus cultivation in lab, viriods, prions.
**UNIT II**
Bacteriophages; Morphology, life cycle of viruses, reproduction of ds DNA phages, ss DNA phages and RNA phages, Lysogeny.
**UNIT III**
Plant & Animal Viruses; Nomenclature and classification, viruses of fungi, algae and protozoa, viruses infecting fruits and vegetables.
Viruses containing ss(+) RNA, ss(-) RNA, ds RNA and DNA and ssDNA, RNA tumor viruses requiring DNA intermediate for synthesis, Miscellaneous viruses.
**UNIT IV**
Molecular Virology; Retroviruses and Influenza viruses, Interferons.

**Books recommended:**


1 Microbiology by Pelczar.
2 Microbiology by Atlas.
3 Field's Virology.
4 Virology by Biswas and Biswas.
5 Microbiology by Prescott.


**Lab Course I (based on papers GBBT301, 302, 303)**

1. Estimation of hemoglobin by canomethemoglobin
2. Quantification of serum proteins
3. Determination of A/G ratio in serum
4. DNA isolation from given biological material.
5. Demonstration of Transformation
6. RNA isolation from baker's yeast.
7. DNA estimation
8. RNA estimation
9. Mitosis
10. Meiosis
11. Counting of cells.
12. Extraction and estimation of DNA from plant samples.
13. Extraction and estimation of DNA from microbial cultures.
14. Extraction and estimation of plasmids.
15. Agarose Gel Electrophoresis.
16. Competent Cell formation.
17. Transformation of given microbial cells.
18. Phylogenetic analysis of given DNA Finger Print Data & calculation of similarity and dissimilarity Index, using NTSYS PC based software.

**GBBT-304 BOTANY III**
**(Gymnosperms, Angiosperms and Embryology)**
**Course Objective:**

After the completion of this course, 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. Salient features of Gymnosperms. 2. Comparative study of the structure and life history of *Cycas* and *Pinus*. 3. Fossils: Process of fossilization and types of fossils, Living fossils.4. Economic importance of the Gymnosperms

**Unit-2**

1. Elementary knowledge of centres of origin, classification as proposed by Linnaeus, Bentham and Hooker. 2. Nomenclature: International Code of Botanical Nomenclature (ICBN), history, scientific naming of plants, priority, types and validity. 3. Collection and preservation techniques of specimens for herbarium and museum, Botanical gardens, Herbaria and Botanical Survey of India (BSI).

**Unit-3**

1. General taxonomy and economic importance of the following families:
(a) Malvaceae, Fabaceae,
(b) Solanaceae.
(c) Cruciferae
(d). Monocotyledonae: Poaceae.

**Unit-4**

1. Structure of anther, micro-sporogenesis and development of male gametophytes in angiosperms.
2. Structure of ovule, mega sporogenesis and development of the female gametophytes.
3. Pollination, fertilization and life history of a typical angiosperm.

**Unit - 5**

1. Endosperm and embryo development.
2. Polyembryony and apomixis.
3. Seed germination and dormancy, elementary plant movements.

**Practical**

1. Demonstration of permanent slides of Gymnosperms.
2. Demonstration of permanent slides of angiosperms.
3. Preparation of a standard herbarium using suitable tools and techniques.
4. Study of the floral description of the family-
5. Study of the floral description of the family-Malvaceae
6. Study of the floral description of the plant- *Daturastramonium-Family;*
7. Study of the floral description of the family- Cucurbitaceae
8. Study of the floral description of the family- Rubiaceae
9. Study of the floral description of the family-Lamiaceae
10. Study of the floral description of the family-Euphorbiaceae
11. Study of the floral description of the family-Poaceae
12. Preparation of Transverse section of anther to observe the structure of microsporangium.
13. Slide preparation to study the structure of ovule and mechanism of megasporogenesis.
14. T.S. of monocot root and description (Maize)
15. T.S. of dicot root and description (*A. hypogea*)
16. T.S. of monocot stem and description (Maize)
17. T.S. of dicot stem and description (*A. hypogea*)

**Books recommended:**

1. Sharma OP, An Introduction to Gymnosperm PragatiPrakashan, Meerut.
2. Bhojwani SS and SP Bhatnagar. Embryology of Angiosperms
3. Maheshwari P. An Introduction to Embryology of Angiosperms
4. Gupta RK Text book of Systematic Botany, Atma Ram and Sons, New Delhi
5. Pandey BP A Textook of Angiosperms. S Chand & Co. New Delhi
6. Singh V and Jain DK. Taxonomy of Angiosperm.

**GBBT-305 ZOOLOGY III**
**(Vertebrate Zoology)**
**Course Objective:**

"At the end of this course the students will be able to: 1. Describe unique feature of diverse appearance of animals, this course will enhance the students to get the knowledge about the anatomy of different systems of higher chordates. 2. 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: Origin &General Characteristics of Chordates**

Chordate characters, origin and evolution of chordate groups, scheme of Chordate classification.General characteristics of primitive chordates, structure and affinities of *Balanoglossus,* and *Herdmania.*

**Unit II: Cyclostomes and Pisces**

General characteristics of Cyclostome and of Pisces, migration.Accessory respiratory organs in fishes.Common edible fishes of India.Pisciculture – Status and scope of Fisheries in India.Species of fishes suitable for culture in India. Different types of breeding, hypophysation.

**Unit III: Amphibia and Reptiles**

Origin, general characteristics & classification up to orders, Parental care General characteristics & classification up to order, Identification of poisonous and non-poisonous snakes, Biting mechanism, Venom and antivenom, Extinct reptiles.

**Units IV: Ayes and Mammals**

General characteristics, Flight adaptation and migration in birds, Origin and of bird, General characteristics of Prototheria, Metatheria&Eutheria Evolution of horse and Man. Tissue types and histology of liver, kidney, pancreas, stomach, intestine, thyroid gland, testes and ovary.

**Practical**

1. Chordates: Study of *Balanoglossus*, *Herdmania*, *Salpa*, *Amphioxus*.
2. Cyclostomes: *Petromyzon*, *Myxine*.
3. Chondrichthyes: *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*.
4. Osteichthyes: *Acipenser*, *Exocoetus*, *Wallago*, *Protopeterus*, *Anguilla*, *Labeorohita*, *Channa*.
5. Amphibians: *Urotyphlus*, *Bufo*, *Hyla*, *Necturus*, *Siren*, *Axolotl* larva.
6. Study of local amphibian fauna.
7. Reptilians: Turtle, Crocodile, Krait, Viper, *Hydrophis*, *Chamelion*, *Calotesversicolor*.
8. Study of local reptilian fauna.
9. Aves: Study of *Psittacula* (parrot), *Eudynamys* (koel), *Tytoalba*(owl), *Passer* (sparrow), *Columba* (pigeon).
10. Study of local avian fauna.
11. Mammals: Study of Mole, Mangoose, Bat, Squirrel, Loris.
12. Study of local mammalian fauna.
13. Preparation of temporary mounts of placoid scales.
14. Dissection of *Heteropneustesfossilis* to study secondary accessory organs.
15. Dissection of *Scoliodon* to study cranial nerves and digestive system.
16. Dissection of Rohu to study Weberianossicles.

**Recommended Books**


1. Green N.P.O. et al., 1995, Biological Scienes, Second Edition, Cambridge University Press.
2. Kotpal R.L., 2001, Modern Text Book of Zoology, Vertabrates, Rastogi Publication, Meerut, India.
3. Parker T.J. and Haswell W.A., 1990, A Text Book of Zoology, Vol. II Revised by A.J. Marshall.
4. Sinha, A.K., Adhikari, S., and Ganguli, B.B., 2001, Biology of Animals (Vol.-II & III), New Central Book Agency, Calcutta.
5. Subramoniam, T., 2002, Developmental Biology, Narosa Publishing House Pvt. Ltd., New Delhi.
6. Parker, T.J. and Haswell, 1995, A Text Book of Zoology (Vol. I & II), 7$^{th}$Edition, Low Price Publication, Delhi.
7. Leeson&Leeson, 1984, Histology, WB Saunders –IgakuShoin Publication Philadelphia & Tokyo.
8. R.C. Kotpal. Modem text book of Zoology-Vertebrates.


**GBBT-306 CHEMISTRY III**

**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 student will learn the general concepts regulating organic chemistry reaction mechanism and their examples with real world applications. (iii) The students will learn different types of organic reaction mechanisms and their examples. (iv) The students will learn the physical chemistry concepts in gaseous states and its applications."

**Course Content**

***1.Acids and Bases* :** Arrhenius, Brönsted-Lowry, Solvent System and Lewis concepts of acids and bases. Factors affecting strengths of Lewis acids and bases.

***2.Non-aqueous Solvents* :** Physical properties of a solvent for functioning as an effective reaction medium. Types of solvents and their general characteristics.Reactions in liquid ammonia and liquid sulfur dioxide.

**3.Solution and Colligative properties**: Types of solution, ideal solution, non-ideal solution, partial and immiscible liquids, lowering of vapour pressure, elevation of boiling points, depression of freezing point, osmosis and osmotic pressure, relationship between different colligative properties, abnormal colligative properties of solution.

***4. Stereochemistry*:**Fischer, saw-horse and Newman projection formulae. Chirality-optical activity, enantiomerism and diastereoisomerism involving one and two chiral centers, configuration, geometrical isomerism, D/L, R/S and E/Z nomenclatures.

***5. Aromaticity:*** Structure, stability and reaction of benzene, Huckel rule, Electrophilic aromatic substitution reactions, mechanism of nitration, mechanism of sulphonation, mechanism of halogenation, mechanism of protonation, Alkyl benzene, mechanism of friedel craft alkylation, reaction of alkyl benzene, electrophilic aromatic substitution in alkyl benzene, halogenation of alkyl benzene, side chain halogenation of alkyl benzene, alkenylbenzene, alkynylbenzene.

***6. Phenols, Aromatic Aldehydes and Ketones*:** Preparation, reaction and acidity of phenols. Rearrangement of hydroperoxides, Fries rearrangement, Ring substitution, Kolbe reaction, Reimer-Tiemann reaction.Preparation and important reactions of benzaldehyde and acetophenone.

7. ***Transition Metals*:**Characteristic properties of 3d elements – ionic radii, oxidation states, complexation tendency, magnetic behaviour and electronic spectral properties. Spectrophotometric estimation of metal ions.

**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 Distributors, 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.