Common Pool of Generic Electives (GE) Courses
Offered by ACBR

Note: **Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

GENERIC ELECTIVES : CONCEPTS IN BIOTECHNOLOGY

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical / Practice		
CONCEPTS IN BIOTECHNOLOGY	4	3	-	1	The student should have studied science (Biological science/physical sciences)	NA

Learning Objectives

The Learning Objectives of this course are as follows:
The purpose of this course is to introduce students to importance of Biotechnology in allied fields. It will enable students from diverse backgrounds to understand basic concepts in Gene Cloning and DNA Analysis, and appreciate applications of Biotechnology in everyday life. The course will provide students with an insight into the various molecular biology techniques commonly used in Biotechnology, and some of the relevant bio-safety issues and ethical concerns.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Learn about basic biotechnology techniques and key concepts that are used in isolation and characterization of biomolecules (DNA and proteins).
- Develop basic understanding of the robust techniques with wide applications (such as PCR, DNA sequencing) and appreciate their contribution in development of biotechnology.
- Comprehend the importance of gene cloning in biotechnology and learn the intricacies of gene cloning using plasmids and bacteriophages as cloning vectors.

- Understand the importance of construction of genomic libraries and their specialized screening methods to identify gene of interest.
- Learn the concept and application of DNA fingerprinting, recombinant protein expression, biopharmaceutical protein production, and gene therapy.
- Gain an insight of safe handling of GMO's, their environmental release and ethical practices.

SYLLABUS

UNIT – I Techniques Used in Biotechnology (12 Hours)

Brief history of biotechnology and its importance. Isolation and purification of plasmid DNA. Agarose and Polyacrylamide gel electrophoresis (Native and SDS). Southern and Western hybridization. Polymerase Chain Reaction (PCR): Principle, DNA polymerases in PCR, Primer Designing, Types of PCR - Hot Start, Multiplex and Reverse Transcription and their Applications. Sequencing: Enzymatic (Sanger's dideoxy) method, Introduction to Automated Sequencing.

UNIT – II Process of Gene Cloning, Expression and Protein Purification (15 Hours)

Restriction endonucleases: Restriction and Modification Systems, Nomenclature and Types of Restriction Enzymes (Type I-IV), Recognition of Restriction Sites. Joining of DNA Molecules: Sticky End and Blunt End Ligations, Role of DNA Ligase, Adaptors, Linkers, Homopolymer Tailing. Vectors: Plasmids (pUC Vectors), Bacteriophage (Lambda Phage Derived Replacement And Insertion Vectors), Cosmids, In Vitro Packaging, Expression Vectors (One example each of prokaryotic and eukaryotic expression vectors). Bacterial Transformation, Antibiotic Selection and Blue/White Screening of Transformants. Challenges in Expression of Eukaryotic Proteins in Prokaryotic Hosts

UNIT – III Genomic and cDNA Libraries (18 Hours)

Construction of Genomic and cDNA Libraries, their Screening by Nucleic Acid Hybridization (Colony and Plaque Hybridization).

UNIT – IV Applications of Biotechnology (6 Hours)

DNA Fingerprinting. Using the Example of Human Insulin learn the Importance of Various Applications of Biotechnology: Recombinant Protein Expression, Biopharmaceutical Protein Production and Gene Therapy.

UNIT – V Biosafety and Ethical Issues (6 Hours)

Safe Handling and Disposal of GMOs and Relevant Ethical Issues. Impact of GMOs on the Environment (Bt. Toxin).

Practical component- (12 Sessions x 2 = 24 hrs)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. To prepare laboratory reagents.
2. To perform plasmid DNA isolation.
3. To perform agarose gel electrophoresis of isolated plasmid DNA.
4. To perform restriction digestion of plasmid DNA.
5. To perform agarose gel electrophoresis of digested DNA.
6. To study restriction mapping.
7. To amplify DNA using PCR.
8. To perform agarose gel electrophoresis of amplified DNA

Essential readings

- Cantor, C. R. and Smith, C. L. (2004). 1st Edition. Genomics: The science and technology behind the human genome project. New York, USA: John Wiley and Sons. ISBN-13: 978-0471461869.
- Old, R. W. and Primrose, S. B. (1994). 7th Edition. Principles of Gene Manipulation: an Introduction to Genetic Engineering. Boston: Wiley. ISBN-13: 978-0632037124.
- Joseph Sambrook, E.F. Fritsch, T. Maniatis. (1989). 2nd Edition. Molecular Cloning: A Laboratory Manual. New York, USA: Cold Spring Harbor Laboratory. Press ISBN- 978-0879693732.

Suggestive readings

- Glick, B. R. and Patten, C. L. (2022). 6thEdition. Molecular Biotechnology: Principles and Applications of Recombinant DNA. USA: ASM press, ISBN-13: 978-1683673668.
- Brown, T. A. (2020). 8thEdition. Gene cloning and DNA analysis: An introduction. New York, USA: John Wiley and Sons, ISBN-13: 978-1119640783.
- Karp, G. (2016). 8th Edition. Cell and Molecular Biology: Concepts and Experiments. United states: Wiley. ISBN-13: 9781538832462.
- Primrose, S. B. and Twyman, R. B. (2014). 7th Edition. Principles of Gene Manipulation and Genomics. New York, USA: John Wiley and Sons. ISBN-13: 978-1118653883.
- Green, M. R. and Sambrook, J. (2012). 4th Edition. Molecular Cloning: A Laboratory Manual (three-volume set). New York, USA: Cold Spring Harbor Laboratory Press ISBN-13: 978- 1936113422

GENERIC ELECTIVE COURSE PATHOLOGICAL BASIS OF DISEASE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Pathological Basis of Disease	4	3	-	1	XII Passed.	Have basic knowledge of biology

Learning Objective:

- Learn how diseases develop and progress by studying changes in cells, tissues, and organs. Understand basic terms like inflammation, infection, and degeneration.
- Identify common symptoms and causes of diseases, including infections, genetic disorders, environmental factors, and lifestyle influences.
- Gain insight into the processes underlying widespread diseases such as cardiovascular disorders, and autoimmune conditions.
- Learn about common diagnostic tools like blood tests, imaging studies, and histopathology/ biopsies, and their role in understanding diseases.

Learning Outcomes

Having successfully completed this course, students will have a comprehensive understanding of

- Human pathology, including the underlying mechanisms of disease.
- Identify and accurately use common terms in pathology such as etiology, pathogenesis, and prognosis.

- Understanding of diagnostic methods, and the clinical relevance of pathological findings.
- They will be equipped to understand laboratory results, histopathological slides, and clinical data in relation to human diseases.

SYLLABUS **45 hrs**

Unit I: **Introduction:** **(2 hrs)**

History of Pathology, Basic definitions and common terms used in pathology, Basic Concepts in Cell and Tissue Organization.

Unit II: Tools and Techniques used in Pathology **(7 hr)**

Basic overview of tools and techniques: Biochemical assays for urine and blood testing, Immunological assays for disease detection, Histopathological examination (Tumors), PCR-based assays for identifying diseases (dengue), Imaging techniques for diagnostic purposes.

Unit III: Cell Injury and responses of cells to injury **(12 hrs)**

An overview of cellular adaptation: Hyperplasia, Hypertrophy, Atrophy, Metaplasia; Causes and mechanisms of cell injury, reversible and irreversible injury, Necrosis, Apoptosis, Types of apoptosis.
Neoplasia: Definitions, Nomenclature, characteristics of benign and malignant neoplasms.

Unit IV: **Inflammation, Tissue Regeneration and Repair**
(12 hrs)

Basic concepts of acute and chronic inflammation: Vascular Changes, cellular events, important chemical mediators of inflammation. Study of morphological patterns of inflammation taking tuberculosis as an example.
Mechanism of tissue regeneration, role of ECM, repair by healing, scar formation, cutaneous wound healing, tissue remodeling - cirrhosis and fibrosis in liver.

Unit V: Hemodynamic Derangements **(12 hrs)**

An overview of Edema, hyperemia, congestion, hemorrhage, hemostasis and thrombosis, Embolism, Infarction (Myocardial infarction) and shock

Practical: **(30 Hours)**

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Qualitative detection of protein, ketones and glucose in artificially prepared urine samples using biochemical assays.
2. Study of histological slides showing hypertrophy, hyperplasia, dysplasia.

3. To perform Platelet count and its pathological significance
4. Hematological assessment: Study and analysis of a blood report: CBC and LFT.
5. Immunological kit based detection of CRP and hCG.
6. Study of four distinct stages of alcoholic liver disease through permanent slide.
7. Study of fractures using x-ray films.
8. Virtual demonstration of detection of any one disease using PCR.
9. Visit to Pathological Laboratory

Essential Readings:

- Kumar, V., Abbas, A.K., Aster, J.C. and Fausto, N. (2020). 10th Edition. Robbins and Cotran Pathologic basis of disease. Philadelphia, USA: Saunders Publishers. ISBN 13: 9780323531139.
- Cross, S.S. (2024). 8th Edition. Underwood's Pathology: a Clinical Approach. ISBN: 9780443116995
- Sood, R. (2024). 7th Edition Volume 1 and 2. Medical laboratory technology methods and interpretations. India: Jaypee Brothers Medical Publishers. ISBN-9789354652493

Suggested Readings:

- Goswami, P; Kalla, A.R; Khatri, K. Dubey, A and Goswami, K. (2022) 1st Edition, Comprehensive Pathology Practical and Technical book , Scientific Publishers. ISBN: 9789392590313.
- Copstead-Kirkhorn, L. C. (2021). 7th Edition. Pathophysiology. Philadelphia, USA: d1Saunders. ISBN: 9780323761550.

GENERIC ELECTIVE COURSE PHARMACOLOGICAL SCIENCE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Pharmacological Science	**4**	**3**	**-**	**1**	**XII Passed**	**Basic knowledge of human physiology**

Learning Objectives:

- This course focuses on the study of drugs and their application in treating various diseases. Students will gain knowledge about different drug formulations and their methods of administration within the body.
- The course covers the fundamental mechanisms through which drugs influence or modify physiological processes to achieve therapeutic effects.
- Additionally, students will develop an understanding of selecting and utilizing drugs to manage microbial infections and address diseases resulting from hormonal imbalances.

Learning Outcomes:

- Students will be introduced to the naming and formulation of drugs, the routes of drug administration, and the factors influencing the choice of one route over another in specific patient conditions.
- The course will cover fundamental concepts of drug absorption, transport, excretion, and the effects of metabolism on drug activity. Topics will include the quantification of drug half-life, bioavailability, and elimination, along with the factors that influence these processes. Students will also explore the primary macromolecular targets of drugs in the body, such as receptors and enzymes and gain insight into measuring drug response, efficacy, potency, and the variables affecting drug action.
- Additionally, students will learn about the mechanisms of action, side-effects and contraindications of various drug classes.
- The course will also address the selection and use of antimicrobial drugs, the challenges associated with their indiscriminate or inadequate use, and the therapeutic applications of hormones and hormone antagonists.

SYLLABUS

Unit I: Introduction to pharmacology (10 hours)

Nomenclature of drugs (Generic, IUPAC and Proprietary name); Drug formulations- Powders, Liquids, Emulsions, Semisolid, Solid dosage forms and Aerosols; Routes of drug administration, their advantages and disadvantages, drug adverse effects.

Unit II: Pharmacokinetics and pharmacodynamics (12 hours)

Pharmacokinetics: Drug absorption, distribution, metabolism, and excretion, bio-availability, Therapeutic window, Kinetics of elimination, biological half-life of drug.

Pharmacodynamics: Various macromolecular targets of drugs (membrane receptor, transporters, enzymes, channels etc.). Dose response curve, Therapeutic Index, Affinity, Efficacy, Potency, Agonist and Antagonist.

Unit III: Mechanism of action of different classes of drugs (15 hours)

Mechanism of action, main side-effects and contraindications of the following drugs-

1. Antipyretics and Analgesics (Paracetamol and Ibuprofen)
2. Anti-inflammatory drugs (Aspirin, Celecoxib)
3. Sedatives (Diazepam)
4. Cholinergics (Bethanechol)
5. Adrenergics (Isoprenaline)
6. Oral hypoglycemic agent (Tolbutamide)

Unit IV : Pharmacotherapy: Antimicrobials and Hormonal Agents (8 Hours)

(a): Anti-microbial therapy

General aspects of anti-microbial therapy, Antibacterial drugs (Ciprofloxacin), Antifungal drugs (Amphotericin B).

(b): Hormones as drugs

Brief introduction; Insulin and Insulin Analogues, Hormone Replacement Therapy (HRT), Estrogen and Progestins.

Practical: **(30 Hours)**

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Handling and housing of laboratory animals.
2. Demonstration of different routes of drug administration using rat/mice.
3. Fixing of organ bath and kymograph
4. To record CRC of acetylcholine using guinea pig ileum/ rat intestine (virtually)
5. Study of competitive antagonism using acetylcholine and atropine.
6. Determination of dose ratio.
7. Study the effect of an analgesic by Tail-flick test.
8. Study of effect of an anti-anxiety drug using Plus Maze test.

Essential Readings:

- Tripathi, K.D. (2018). 8th Edition. *Essentials of Medical Pharmacology*. Jaypee Brothers, India, ISBN-13: 9352704996-978.
- Kulkarni, S.K. (2014). 4th Edition, Reprint. *Handbook of Experimental Pharmacology*, Vallabh Prakashan, India, ISBN-13: 978-8185731766.

Suggestive Readings:

- Katzung, B. G., (2021) Basic and Clinical Pharmacology, 15th Edition, McGraw-Hill Education, ISBN: 978-1260452310.
- Ritter, J.M., Flower, R., Henderson, G., *et al*. (2019). 9th Edition (International). *Rang and Dale's Pharmacology.* Relx India Pvt. Ltd, ISBN-13: 978-0702074479.

Essential readings

- Alberts, B et al. (2014). 6th edition. Molecular Biology of the Cell. W. W. Norton & Company. ISBN-13 : 978-0815345244
- Bryson, B. (2003) A short history of nearly everything. Transworld Publishers. London W5 5SA. A Random House Group Company. ISBN: 9780552997041.
- Lodish H et al. (2003). 5th Revised edition. Molecular Cell Biology. W.H.Freeman& Co Ltd; ISBN-13 : 978-0716743668
- Green, M. R. and Sambrook, J. (2012). 4th Edition. Molecular Cloning: A Laboratory Manual, New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13:978-1936113422.
- Kornberg, A. (2005). 2nd Edition. DNA Replication. California, United States: University Science Books, ISBN-13: 978-1891389443.

Suggestive readings -

- Watson, J. D. (2011) The Double Helix – A personal account of the discovery of the structure of DNA. Scribner. ISBN 9780743219174.
- Cooper, G. M. and Hausman, R. E. (2013). 6th Edition. The cell: A molecular approach. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551
- Karp, G. (2013). 7th Edition. Cell and molecular biology: Concepts and experiments. New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.
- Cox, M. M. Doudna J. A. and Donnell, M. O. (2012). 1st Edition. Molecular Biology: Principles and Practice. London, United Kingdom: W H Freeman & Co Publishers, ISBN-13: 978-0-716-7998-8.
- Watson, J. D. Baker T. A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2013). 7th
- Edition. Molecular Biology of the Gene. New York, United States: Cold Spring
- Harbor Laboratory Press, ISBN-13: 978-0-321-76243-6.

GENERIC ELECTIVES : TOXIC SUBSTANCES AND HUMAN HEALTH

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of t he course
		Lecture	Tutorial	Practical/ Practice		
TOXIC S UBSTANCES AND H UMAN HEALTH	4	3	-	1	Open to Students from all subjects	NA

Learning Objectives

The Learning Objectives of this course are as follows:

In daily life, humans are exposed to several toxic substances. Many household products, medicines, cosmetic products, paints, and even food and water may contain toxic substances.; Frequent or improper use of many consumer products or exposure to higher amounts than prescribed, may cause serious health problems. This paper introduces the common toxic substances to which humans are routinely exposed; and health related issues in case of toxicity.

Learning outcomes

The Learning Outcomes of this course are as follows:
After studying, students will be able to:

- Introduction to the various toxic substances and how humans come in contact with toxic hazards. Definitions of various terminologies used in toxicology, and methods of assessment of toxicity of a substance are also covered.
- Upon contact with humans, toxic compounds may be absorbed in the body, and distributed to various organs to show toxic effects. Toxic compounds, once inside the body, are also metabolized or chemically altered. In most cases, after metabolism, the physicochemical properties of toxicants are altered, which helps in their speedy removal from the body.
- Many household products contain substances/ingredients which, if properly not used or applied on the body in excess, can cause serious health effects. These substances include cleaners, household pesticides, cosmetics, disposable utensils, paints, polish, etc. Students will be introduced to few such ingredients and their harmful effects.
- In addition to nutrients, our food also contains several substances which are unavoidable or added unintentionally. These substances and food adulterants, if taken for long time can cause adverse effects.
- Drugs are used to treat diseases. However, if taken at high dose (such as overdosing), drugs act as potential toxic substances. Moreover, several drugs have side effects even at prescribed dose or if used for prolonged duration.
- Anthropogenic activity and natural causes in some cases leads to contamination of soil, water and air with several potential toxicants. These toxicants enter human body via air that we breathe, drinking water and food. With examples of a few toxic substances, students will be introduced how toxicants enter the body from the environment and the adverse health effects caused by them.

SYLLABUS

UNIT – I Introduction to toxic substances and assessment of toxicity (9 Hours)

Types of toxic substances, human contact/exposure with toxic substances (occupational, intentional, accidental etc.); various definitions (toxin, toxicants, xenobiotics, exposure, acute toxicity, chronic toxicity etc); Dose Response Relationship, efficacy, potency, LD50, TD50, NOAEL, ADI; selective toxicity.

UNIT – II Movement of toxic substances inside the body (6 Hours)

Brief introduction to absorption of toxicants via various routes, concept of bioavailability, first pass metabolism, distribution and excretion.

UNIT – III Household toxicants (9 Hours)

Route of exposure, mechanism of toxicity and health effects of common household toxicants:

i). Cleaners, disinfectants, air fresheners (sodium hypochlorite, ammonia, phenol, naphthalene, 1, 4-Dichlorobenzene, methanol).
ii). Garden products, and home mosquito repellents and rat kills (pesticides: organophosphates, pyrethroids, aluminium and zinc phosphide).
iii). Cosmetic products (metals: lead, cadmium; solvents: toluene, acetone).
iv). Other products: disposable utensils (styrene), antifreezing agents (ethylene glycol), Volatile Organic Compounds (VOCs).

UNIT – IV Toxicants and toxins in food (6 Hours)

Mechanism of toxicity and health effects of:

i. Pesticide residues (DDT, lindane)

ii. Toxins (amatoxin, muscarine, bacterial toxins)

Brief discuss on food preservatives, colouring agents and flavouring agents etc, and food adulterants.

UNIT – V Drugs as toxicants (6 Hours)

Brief introduction of drugs as toxicants with examples; adverse effects of drugs at therapeutic doses, and overdosing.

UNIT – VI Environmental toxicants (9 Hours)

Route of exposure, mechanism of toxicity and health effects of:

i. Industrial chemicals (mercury, Polycyclic Aromatic Hydrocarbons, dioxins).

ii. Gaseous air pollutants (nitrogen oxides, sulfur dioxide, carbon monoxide).

iii. Particulate matter (PM).

Practical component - (30 Hours)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Calculation of LD50 value of an insecticide from the data provided.
2. To estimate formaldehyde content in the given sample.
3. To detect presence of paracetamol in the given sample.
4. Analysis of sodium hypochlorite content in various household products.
5. To detect primary alcohol in sample/ household products.
6. To detect aromatic amines in the sample/ household products.
7. To study various toxic substances in terms of exposure, health effects, from various online resources (such as https://www.atsdr.cdc.gov/ , TOXNET or other sources)
8. To separate a mixture of naphthol and naphthalene by solvent extraction method.

Essential readings

- Klaassen, C.D. (2018). 9th Edition. Casarett and Doull's Toxicology, The Basic
- Science of the Poisons. McGraw Hill. ISBN-13: 978-1259863745.
- Stine, K.E. and Brown T.M (2015). 3rd Edition. Principles of Toxicology.
- Florida, USA: CRC Press. ISBN-13: 9781466503434.
- Timbrell. J. (2001). 3rd Edition. Introduction to Toxicology. CRC Press. ISBN13: 978-0415247634.

Suggestive readings

- https://www.atsdr.cdc.gov/
- https://www.cdc.gov/
- Klaassen, C.D and Watkins, J.B. (2015). 3rd Edition. Casarett and Doull's
- Essentials of Toxicology. McGraw Hill Education. ISBN-13:978-0071847087.
- Klaassen, C.D and Watkins, J.B. (2021). 4th Edition. Casarett and Doull's
- Essentials of Toxicology. McGraw Hill, ISBN-13: 978-1260452297.