

**DEPARTMENT OF BIOCHEMISTRY**  
**FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**  
**KARPAGAM ACADEMY OF HIGHER EDUCATION**  
(Deemed to be University, Established Under Section 3 of UGC Act 1956)  
(Accredited with A+ Grade by NAAC in the second cycle)  
Eachanari PO, Coimbatore – 641 023, India.

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**Ph. D – BIOCHEMISTRY**  
(Effective from the academic year 2023 - 2024 and onwards)

**PREAMBLE**

- The degree of Doctor of Philosophy (Ph.D) is awarded to a candidate who has submitted a thesis based on original and independent research in any biochemistry field of research.
- This contributes to the advancement of knowledge, which can be useful to the society.

**PROGRAMME EDUCATIONAL OUTCOME (PEO)**

**PEO 1:** Awareness about the discipline major issues and will have an in-detail understanding of biochemistry, selected for research importance.

**PSO 2:** Ethical issue awareness in research and career options to gain expertise in continuing laboratory procedures for experimental animal handling and disposal.

**PSO 3:** Capable of planning and executing experiments safely and infer experimental data.

**PSO 4:** Develop skills to present their work via written, oral and visual presentations of an original research proposal.

**PSO 5:** Persistent production of good research findings for quality publication

**PROGRAMME OUTCOME (PO)**

**PO1: Literature review:** Elaborate survey on the particulars of research advancements and its methodologies.

**PO2: Subject knowledge:** In-depth knowledge in the respective field to find the solutions for the uncovered areas.

**PO3: Innovative ideas:** Agenda is to adopt a constructive idea to accomplish a unique goal

**PO4: Project/Model design:** Developing/promoting ideas using tools of biochemistry

**PO5: Science and Society:** Finding remedies which can solve problems oriented to the society.

**PO6: Ethics:** Research and career options to gain more expertise in continuing laboratory procedures for experimental animal handling and disposal.

**PO7: Product development:** At the outset the ultimate aim is to develop a product which can be later commercialized and utilized for the beneficiaries.

**PO8: Data interpretation:** Analyzing the outcome using statistical tools which can exhibit a complete picture of problem.

**PO9: Continuous quest:** Investigation on a particular topic to be an expert on it.

### **PROGRAMME SPECIFIC OBJECTIVE (PSO)**

**PSO 1:** Exhibit in-depth mastery/scholarly of a wide range of knowledge biochemically that concern to the essentials of advanced biochemistry.

**PSO 2:** Be familiar in appropriate laboratory procedures and regulations in conduct and discarding of experimental animals with proper ethics.

**PSO 3:** Capable to associate biochemical model thorough theoretical view with laboratory skills to originate hypotheses, plan and execute experiments and then data collection, comparison and infer results to depict logical finale.

**PSO 4:** Data acquisition process using available software tools to analyze and further, can present their work through scientific publications and visual presentations.

**DEPARTMENT OF BIOCHEMISTRY**  
**FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**  
**RESEARCH PROGRAM – PhD in Biochemistry**  
**(2023–2024 and onwards)**

Course code	Name of the course	Instruction hours / week	Credits	Maximum Marks (100)
23RBC101	Research Methodology and Pedagogy	4	4	100
23RBC201	Research and Publication Ethics	4	4	100
23RBC301	Enzyme and Enzyme Technology	4	4	100
23RBC302	Cancer Biology and Immunology			
23RBC303	Medicinal Plants and Plant Therapeutics			
23RBC304	Clinical Biochemistry and Toxicology			
23RBC305	Plant Molecular Biotechnology			
23RBC306	Animal Tissue Culture			
23RBC307	Computer Aided Drug Designing			
<b>Program Total</b>		<b>12</b>	<b>12</b>	<b>300</b>

**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours**

### **Course Objectives**

**The course will help the scholars to**

- Learn to collect, analyze and interpret research data and to identify appropriate research topics
- Inculcate technical writing and communication skills
- Gain a practical understanding of the various statistical tools used for scientific research
- Learn the usage of appropriate tools for the types of research
- Learn pedagogical methods for small and large groups
- Gain basic understanding of the usage of computer for data preparation and presentation

### **Course Outcomes**

**On completion of the course, students will be able to**

1. Gain practical knowledge of handling the instruments
2. Understand some basic concepts of research and its methodologies
3. Design their research and present their data
4. Interpret the data in an effective way
5. Write and prepare research papers and research proposals
6. Handle classes effectively since they know the pedagogical techniques

### **UNIT I: Research Problem**

Definition - Identification - Review of Literature – Phases of Research - Lacunae  
identification-Research process - Research design –Experimental and non experimental designs-  
Exploratory Diagnostic.

Sample selection Acceptance and rejection criteria- Serum, plasma, whole blood, urine CSF.  
Ethical consideration. Study conduct in human sample, animal sample. Experimental design.  
Sample collection- Order of draw.

### **UNIT II: Sampling methods**

Sampling - Population –Census - Sample – Types – Probability – Non Probability sampling –  
Sampling size – Sampling process – Hypothesis and its formulation. Sampling distribution –  
Students t test. Experimental design – CRD, RBD. Analysis of experimental results – ANOVA  
and its interpretation. Duncan's Multiple Range Test. Interpretation.  
Clinical research study measurement- Site selection, sample size, test evaluation.

### **UNIT III: Data Processing**

Data Collection Tools -Case studies - Preparing for Interview – Questionnaire -Schedule - observation- Scaling techniques – Scale Construction – Rating scales. Hypothesis testing – Parametric and non parametric tests - Coding – Editing – Tabulation –Analysis – Correlation & regression.

### **UNIT IV: Scientific writing and presentation**

Definition of scientific documents - Research paper, review paper, books, thesis and project reports. Technical Writing: Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided. Microsoft Windows: Macintosh versions, Microsoft Word- Characteristics - Document statistics - Typical usage, Microsoft Excel - Basic operation – Charts - Using other Microsoft applications - Using external data, Microsoft Power Point –power point viewer – versions – uses, Microsoft Access –Uses – Features.

### **UNIT- V: Pedagogical methods in higher education**

Objectives and role of higher education- Important characteristics of an effective lecture- Quality teaching and learning- lecture preparation- characteristics of instructional design- Methods of teaching and learning: Large group- Technique – lecture, seminar, symposium, team teaching, project, small group technique- simulation, role playing demonstration, Brain storing, Case discussion, and assignment, methods of evaluation- self evaluation, student evaluation, diagnostic testing and remedial teaching- question banking- electronic media in education:- ‘e’ learning researches- web based learning. Risk management. Classification of medical devices. Risk- definition, identification, FMEA analysis.

### **SUGGESTED READING**

1. Nind, Melanie & Lewthwaite, Sarah (2018) Methods that teach: developing pedagogic research methods, developing pedagogy, International Journal of Research & Method in Education. DOI: <https://doi.org/10.1080/1743727X.2018.1427057>.
2. Voss, T., Kunter, M., & Baumert, J. (2011). Assessing teacher candidates’ general pedagogical/ psychological knowledge: Test construction and validation. Journal of Educational Psychology, 103(4), 952-969.
3. Dr. Shanti Bhushan Mishra, Dr. Shashi Alok (2017). Hand book of research methodology, Educreation publishing, New Delhi.
4. C R Kothari, Gaurav Garg. (2020). Research Methodology Methods and Techniques, new age international (p) limited, publishers, India.
5. Research Methodology - Course – NPTEL 2023, <https://onlinecourses.nptel.ac.in>

**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours****Course Objectives**

The main objectives of the course are

- To impart the knowledge on philosophy and ethics
- To apply the state of art knowledge for scientific conduct
- To become familiarize with publication ethics
- To understand the methods of publication misconduct
- To grasp knowledge on database and research metrics
- The students will learn overall open access publishing.

**Course Outcomes**

On completion of the course, students are able

1. To understand principles of philosophy and ethics
2. To explain research Intellectual honesty
3. To get insight into plagiarism
4. To develop the e-content
5. To access the Learning Management System
6. To understand publication misconduct

**Unit I Philosophy and Ethics**

Introduction to Philosophy: definition, nature, scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgment and reactions.

**Unit II Scientific Conduct:**

Ethics with respect to science and research - Intellectual honesty and research integrity, copyright Scientific misconduct: falsification, fabrication and Plagiarism (FFP) Redundant Publication: duplication and overlapping publication, salami slicing. Selective reporting and misrepresentation of data.

**Unit III Publication Ethics**

Publication Ethics: definition, introduction and importance, Best practice/standard setting initiative and guidelines: COPE, WAME, etc. Conflict and interest - Publication misconduct: definition, concept, problems that leads to unethical behaviour and vice versa, type. Violation of

publication ethics, authorship and contributorship Identification of publication misconduct, complaint and appeals Predatory publisher and journals.

#### **UNIT IV Publication Misconduct**

Group Discussions: Subject Specific Ethical Issues FFP, authorship, Conflict interest, Complaints and appeals: examples and fraud, from India and abroad. Software tools: Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

#### **UNIT V: Database and research metrics**

Database: Indexing database, Citation database: web of science, scopus, etc. Research metrics: Impact factor of Journal as per journal citation report, SNIP, SJR, IPP, Cite Score Metrics: h-index, g-index, i-10 index, altmetrics.

#### **UNIT VI: Development of e-content & IPR**

Integrated Library Management System (ILMS): e-journals, e-books, e-shodhsindushodhganga- Database – e content development – Learning Management System (LMS) – e-PG - Pathshala- CEC (UG) SWAYAM- MOOCs- NPTEL-NMEICT.

IPR: Patent – Copyrights- Trademarks- Geographical Indications.

#### **SUGGESTED READING**

1. Partha Pratim Ray (2023). A Guide to Research and Publication Ethics A Text Book As per UGC Guidelines for UG, PG, MPhil and PhD. ND Publishers, India.
2. Dr.S.B.Kishor, Dr.Ajay S.Kushwaha, Dr. J.Gitanjali (2021). Research & Publication ethics. Das Ganu Prakashan Publishers, Nagpur, India
3. Santosh Kumkar Yadav (2020). Research and Publications Ethics, Ane Books PVT, Ltd, India.
4. NSW Department of Primary Industries and Animal Research Review Panel. Available online: <https://www.animaethics.org.au/three-rs>
5. Webinar on Research and Publication Ethics – 2021  
<https://www.youtube.com/watch?v=kIgs6XSMdms>
6. Publication Ethics - Course – NPTEL 2021,  
<https://www.youtube.com/watch?v=CXVNIEpC83E>

#### **PRACTICE**

##### **Open access publishing**

1. Open access publication and initiatives - SHERPA/RoMEOonline resource to check publisher copyright and self-archiving policies Software tool to identify predatory publication developed by SPPU - Journal finder/journal suggestion tools viz. JANE, Elsevier Journal finder, Springer, Journal Suggester, etc.

**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours****Course Objectives**

The course will help the scholars to

- Understand the structure and organization of protein structure
- Learn and understand the catalytic mechanisms of enzymes.
- Develop expertise in the purification of enzymes and their analysis in various solvent systems.
- Learn the kinetics of enzyme catalyzed reactions.
- Learn the importance of enzyme immobilization and its wide applications in medicine and industries.
- Study the techniques for clinical analysis and also biochips and biocomputers.

**Course Outcomes**

On completion of the course, students will be able to

1. Understand the structure of proteins and mechanism of action of enzymes.
2. Understand the catalytic mechanisms of enzymes.
3. Apply the knowledge of enzyme immobilization to produce more products out of it.
4. Understanding of enzyme purification by downstream processes and the efficiency testing of enzymes in various solvent systems.
5. Apply the knowledge of enzymes gained in medicine and industry
6. Handle the sophisticated instruments and clinical analysis of enzymes.

**UNIT I: Protein and enzymes**

Protein structure, functions, compositions and conformation of proteins. Enzyme catalysis-Acid base catalysis, covalent catalysis, an example, serine proteases. Enzyme kinetics – Michaelis menton equation, Line weaver Burk plot, Hills equation, Hans plot.

**UNIT II: Isolation and purification of enzymes**

Sources of enzymes for industry, extraction of enzymes for scientific and industrial purposes. Downstream processing of enzymes, uses of soluble enzymes. Study of enzymes in aqueous biphasic systems. Factors affecting the enzyme activity -Substrate concentration, Purification of enzymes. Enzyme concentration, pH, temperature etc.,



### **UNIT III: Enzyme immobilization and their applications**

Techniques employed for immobilizing enzymes, kinetics of immobilized enzymes. Advantages and disadvantages in the utilization of soluble enzymes, Immobilized enzymes and immobilized cells. Different types of reactors of immobilized enzymes and their applications in various fields.

### **UNITIV: Clinical analysis of enzymes**

Application of ELISA and EMIT in clinical analysis. Different types of Biosensors- potentiometric, amperometric, piezo - electric and immuno biosensors. Electro analytical applications of enzymes, Methods of coenzyme regeneration. Biochips and Biocomputers. Enzyme assay.

### **UNIT V: Production of fermented products and downstream processing**

Production of alcohol and alcoholic beverages. Microbial production of Organic acids: Source, recovery and uses of Citric acid, Lactic acid, and Acetic acid. Production of antibiotics: Penicillin and Tetracycline. Bio-insecticides: Production of Bacterial and fungal polysaccharides, commercial production of Xanthan gum and pullulan. Production of edible mushroom and Single cell protein from azola. Yogurt and other cultured dairy products.

### **SUGGESTED READING**

1. Dr. Aditya Arya (2018). Understanding Enzymes: An Introductory, S.G. Press.
2. Anil Kumar, Sarika Garg (2017). Enzymes and Enzyme Technology, M.V. Publishers.
3. Khan, M. Y., Khan, Farha (2023). Principles of Enzyme Technology, PHI Learning Private Limited, Delhi.
4. Enzyme Technology Challenges (2023) - <https://www.youtube.com/watch?v=5g61pEe0C1U>.
5. Enzyme Technology – <https://www.youtube.com/watch?v=BJBAC1Ddqeg>

**Instruction hours/week: L: 4 T: 0 P: 0****Marks: 100****End Semester Exam: 3 Hours****Course Objectives**

The course will help the scholars to

- Understand the initiation and promotion pathways of cancer as a complex biological system.
- Educate on the etiological risks factors for cancer and methods to avoid such risks.
- Gain insight knowledge about the emerging themes and in depth analysis of cancer and its therapeutic approaches.
- Understand the mechanisms of humoral immunity and cell mediated immunity
- Gain Knowledge on hyper activation of immune cell and associated pathogenesis
- Utilize immune based principles in diagnostic field

**Course Outcomes**

On completion of the course, students will be able to

1. Analyze, decipher and identify the complexity of cancer biology.
2. Educate on etiological risks factors for cancer and methods to avoid such risks.
3. Develop therapeutic approaches to circumvent cancer cell survival, multiplication and progression.
4. Interpret structure and functions of specialized immune cells in clinical practices
5. Differentiate humoral immunity and cell mediated immunity
6. Utilize immune based principles in diagnostic field

**UNIT I: Biology of cancer**

Biology of Cancer - Phenotype of a cancer cell causes of cancer-DNA tumor viruses, RNA tumor viruses, cell cycle and its control-role of protein kinases, checkpoints, kinase inhibitor and cellular response. Mutations that cause changes in signal molecules.

**UNIT II: Apoptosis**

Programmed cell death (Apoptosis)-Intracellular proteolytic cascade, cascade of caspase proteins, adapter proteins, Bcl-2, IAP family proteins, extra cellular control of cell division, tumor necrosis factor and related death signals. Cytokines.

### UNIT III: Genetic basis of cancer

Genetic basis of cancer-oncogenes, tumor suppressor genes, aberrations in signaling pathways. oncogenic mutations in growth promoting proteins, Mutations causing loss of growth –inhibiting and cell cycle control, Role of carcinogens and DNA repair in cancer.

### UNIT IV: Cancer Immunology

Immunity- Active, passive, humoral and cell-mediated immunity. Therapeutic uses of cytokines and cytokine receptors. Test for lymphocyte function. B cell and T cell immuno deficiency disorder. Clinical laboratory methods for the detection of antigens and antibodies test for histocompatibility antigens, neoplasm of the immune system. Regulation of immune response.

### UNIT V: Cancer Techniques

Techniques-FISH techniques, Real time PCR, Western blotting, ELISA assay, immunocytochemistry, immunohistochemistry, flow cytometry, fluorescent microscopy and Cytometry, cDNA, EPP (Protein Electrophoresis).

Detection of cancer markers- CA-125, PSA, CEA and CA 15.3

### SUGGESTED READING

1. Vincent T. DeVita (2021). Cancer: Principles and Practice of Oncology Primer of Molecular Biology in Cancer, 3rd Edition.
2. Oxford Textbook of Cancer Biology (2020), Oxford University Press Publisher,
3. Xu Zhang, Xin Li, Yanhui Yu, Xichen Zhang, Xiaocen Wang, Nan Zhang, Mengge Chen, Pengtao Gong, Jianhua Li. (2023). *Giardia lamblia* regulates the production of proinflammatory cytokines through activating the NOD2-Rip2-ROS signaling pathway in mouse macrophages. Immunology and Cell Biology, 100 (4), 1021-1035.
4. Immunology - Course – NPTEL 2021, <https://nptel.ac.in/courses/102105083>
5. Tumour Immunology and Immunotherapy  
<https://www.youtube.com/watch?v=K09xzIQ8zsg>

**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours****Course Objectives**

The course will help the scholars to

- Understand the basic knowledge of medicinal plants.
- Provide knowledge on the pharmacological studies using medicinal plants.
- Provide understanding on the principle and mechanism of different classes of phyto constituents.
- Provide understanding of basic principles and methods in Plant tissue culture.
- To learn metabolic engineering to increase the production of plant secondary metabolites
- To become familiar with the transformation process and its applications

**Course Outcomes**

On completion of the course, students will be able to

1. Bring basic knowledge of using medicinal plants in therapeutics.
2. Bring new knowledge of using medicinal plants in alternative medicine.
3. Develop advanced practical knowledge in plant
4. Follow the fundamentals of tissue culture techniques
5. Understand the role of secondary metabolites production and their importance
6. Equip with gene transfer techniques

**UNIT I: Medicinal plants**

Medicinal plants-bioactive principles in medicinal plants methods of extraction, isolation, characterization, separation and screening, pharmacologically active plants-CNS, CVD, Hypoglycemic, Hepatoprotective, anti-allergic, anticancer, immunoactive plants, plants protecting against oxidative stress, chemotherapeutic products.

**UNIT II: Free radicals**

Free radicals –types, sources, importance, production, free radicals induced damages, lipid peroxidation, measurement of free radicals, disease caused by radicals, types of antioxidants, reactive oxygen species, antioxidant defence system, enzymic and non-enzymic antioxidants, role of antioxidants in prevention of diseases, phytochemicals as antioxidants.

### **UNIT III: Metabolites of Plant**

Alkaloids, flavonoids, terpenoids, phenols-Occurrence, distribution & functions, Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques, elicitation, biotransformation- production of pharmaceutical compounds. Isolation of active metabolites from plants and its characterization.

### **UNIT IV: Plant cell culture**

Principles-callus, meristem and organ culture, culture methods, culture media & preparations, plant regeneration, protoplast technology, micropropagation in plants, somatic embryogenesis, somoclonal selection.

### **UNIT V: Therapeutic studies of animal cell culture techniques**

Animal cell culture: Culture media, Serum and protein free defined media and their application. Functions of different constituents of culture medium. Role of carbon dioxide, growth factors, glutamine in cell culture. Cell lines, primary culture and culture maintenance.

Experimental animals and Animal handling - Sacrification, collection of sample. Ethical issues for animal handling. Use of approved ethical materials.

*In vivo* and *in vitro* assays for specific therapeutic studies.

### **SUGGESTED READING**

- 1.Monika Sharma (2020). Gallery of Medicinal Plants (Dravyaguna Vigyan) 1st Edition, Thieme Publishers, India.
- 2.K. V. Krishnamurthy (2023). Bioactives from Botanicals: An Overview, CRC Press, Taylor & Francis, India.
3. Mallappa Kumara Swamy, Jayanta Kumar Patra, Gudepalya Renukaiah Rudramurthy (2019). Medicinal Plants: Chemistry, Pharmacology, and Therapeutic Applications, CRC Press, India.
4. Introduction to plant tissue culture - Course – NPTEL 2021 - <https://nptel.ac.in/courses/102103016>.
5. Herbal Medicines - <https://www.youtube.com/watch?v=GHartHwwH2o>

**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours****Course Objectives**

The course will help the scholars to

- Provide knowledge about the clinical enzymology, diagnosis and toxicological effects, which affects the daily activities in healthcare.
- Learn the clinical diagnostics for hematology, leukaemia and anaemia.
- Assessment of inflammatory markers
- Estimation of clinically relevant enzymes
- Study the principles of pharmaceutical effects, metabolism in the body and the factors that influence these.
- Describe the principles of drug analyses, toxicological analyses and addiction analyses.

**Course Outcomes**

On completion of the course, students will be able to

1. Identify the hematological changes in different diseases
2. Describe the theoretical background of clinical diagnostics for the most common disorders in different organ systems.
3. Explain the principle of pharmaceutical effects and metabolism in the body.
4. Knowledge to describe and identify the main characteristics of diagnosis, screening, and prognosis of disease.
5. Describe pre-analytical factors that are important for the results, interpretation and quality of the analytical result.
6. Provides an in-depth analysis of specific drug classes, its metabolism and therapeutic approaches.

**UNIT I: Serology**

Blood collection, processing and transfusion process. Normal blood profile. C- reactive protein test, immunological test for pregnancy. Rheumatoid arthritis (RA) test, ESR. Coagulation test, prothrombin test. Haemoglobin Normal and abnormal Hb, separation of haemoglobin, Thalassemia, Hemoglobinopathies. Disorder of erythrocyte metabolic pathways, erythrocyte enzyme disorders. Porphyrins and disorder: porphyrias.

AIDS- (Clinical diagnosis). Diagnosis of genetic diseases by molecular biology techniques: RT PCR – SARS CoV2, Dengue IgG, IgM, Anti HIV, HBS Ag and HCV, (cystic fibrosis, Hemachromatosis, thalassemias, sickle cell diseases). H1N1 (Swine flu).

## **UNIT II: Clinical Enzymology and cancer markers**

Clinical significance of Phosphatases, transaminases, 5'nucleotidase, Gamma –glutamyl transferase, Lactate Dehydrogenase, Creatine Phospho kinase.

Diagnostic enzymes in hepatobiliary disease, Atherosclerosis, Myocardial infarction, renal dysfunction. Cancer markers for oral, prostate, colorectal breast and GI tract cancer, oncofetal cancer markers.

## **UNIT III: Free radicals**

Formation of free radicals, autoxidation initiated by oxygen radicals, Influence of free radicals in metal toxicity. Free radicals and cancer. Oxidative process in tissue injury. Detection of free radicals and radical ions. Role of free radicals in diseases.

## **UNIT IV: Antioxidants**

**Enzymic antioxidants**- Chemistry, mechanism, antioxidant effect of SOD, catalase, Glutathione Peroxidase.

**Non Enzymic antioxidants**- source, chemistry, toxicity, biochemical functions, bioavailability, bioassays, Antioxidant effects of Vit A, Vit C, Vit E, glutathione and selenium.

**Trace elements** - Introduction, sources, biochemical functions of zinc, copper and magnesium and iron.

## **UNIT V: Toxicity**

Effects of physiochemical and biological factors on heavy metal toxicity, toxic mechanism- Carcinogenesis, teratogenesis and immunotoxicity. Bioassays for heavy metal toxicity, pathological, histopathological examinations for heavy metal toxicity.

## **SUGGESTED READING**

1. Chatterjea, M.N., (2012). Text book of medical biochemistry, 8<sup>th</sup> edition, Jaypee Brothers, Medical Publishers, New Delhi.
2. Harper's Illustrated Biochemistry (2009) 28<sup>th</sup> Edition McGraw Hill, Mumbai.
3. Devlin (2006). Biochemistry with Clinical Correlation, 6<sup>th</sup> Edition, John Wiley & Sons, USA.
4. Ramnik Sood (2009). Medical Laboratory Technology; Jaypee Brothers Medical Publishers, New Delhi
5. Tietz. Fundamentals of Clinical Chemistry (2008). 6<sup>th</sup> Edition, Elsevier, USA.
6. Voet D. and Voet J (2008). Biochemistry, 3<sup>rd</sup> Edition, J. Wiley & Sons, USA.

7. Clinical and Medical Biochemistry – NPTEL – 2023  
[https://onlinecourses.swayam2.ac.in/cec20\\_ag01/preview](https://onlinecourses.swayam2.ac.in/cec20_ag01/preview)
8. Clinical Biochemistry – Basic Concepts and Notes:  
[https://www.youtube.com/watch?v=c2GVY1WWH\\_4](https://www.youtube.com/watch?v=c2GVY1WWH_4)



**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours****Course Objectives**

The course will help the scholars to

- Provide an advanced understanding of the core principles and topics in plant biotechnology
- Enable students to acquire a specialized knowledge and understanding of advanced techniques in plant biotechnology.
- Understand recent science areas such as plant genomics and transformation techniques.
- Acquire knowledge on gene expression and regulation, transgenic plants and production of secondary metabolites.
- To learn metabolic engineering to increase the production of plant secondary metabolites
- To become familiar with the transformation process and its applications

**Course Outcomes**

On completion of the course, students will

1. Have strong understanding of plant genome, advanced techniques in genomic studies.
2. Acquire knowledge on micro propagation techniques and using such techniques for the enhanced production of secondary metabolites.
3. Acquire skills required to execute modern plant biotechnology experiments.
4. Recall the role of plant growth substances in various stages of plant growth
5. Follow the fundamentals of tissue culture techniques
6. Understand the role of secondary metabolites production and their importance

**UNIT I: Plant genome**

Plant genome organization, structural features of a representative plant gene. Organization of chloroplast genome and mitochondrial genome. Molecular markers (AFLP, ISSR and RAPD). Plant tissue culture media, plant hormones and growth regulators in tissue culture, preparation of suitable explants. Micro propagation of plants - somatic embryogenesis, protoplast culture, somatic hybridization and synthetic seeds. Organization of nuclear genome.

**UNIT II: Cloning strategies**

Tools for cutting and joining of DNA; gene transfer techniques; Methods of selection and screening of recombinant DNA. Construction of genomic libraries and cDNA libraries - probe construction and labelling (radio and non-radio). Molecular mechanism of anti-sense technology - inhibition of splicing, disruption of RNA structure & capping - application of anti-sensing technology.

### **UNIT III: Gene regulation**

Inducible enzymes, regulatory mutations, repressor, operon, promotor, catabolic repression, repressible enzyme systems, control by attenuation, positive control, gene regulation in eukaryotes, transcriptional regulation, post transcriptional regulation, hormones & gene expression; viruses & gene expression, genetic control of pattern formation in plant development. Transcriptional gene silencing.

### **UNIT IV: Plant transformation technology**

Symbiotic nitrogen fixation in legumes by rhizobia - biochemistry and molecular biology. Binary vectors, Use of 35s & other promoters genetic markers methods of nuclear transformation viral vectors & their applications, Use of reporter gene, Particle bombardment, Electroporation, Microinjection, Chloroplast transformation, Transformation of monocots, Transgene stability & gene silencing in Plant transformation.

### **UNIT V: Plant manipulation and its applications**

Transgenic plants - for– biotic (weeds, insects, viruses, fungi and bacteria) and abiotic (drought, salt, temperature, poor soil quality and oxidative) stress tolerance. Production of secondary metabolites. Molecular farming (improvement in protein, lipids, carbohydrates. Plant antibodies, vaccines, therapeutic proteins and active principles. Biofortication of important crops (rice and banana).

### **SUGGESTED READING**

1. Caroline Bowsher, Alyson Tobin (2021). Plant Biochemistry 2<sup>nd</sup> edition
2. Goodwin, T.W., and Mercer, E.I., (2017). Introduction to Plant Biochemistry, 1<sup>st</sup> edition, Robert Maxwell. M.C Publisher, New York.
3. Bahadur B., Rajam M V., Sahijram L (2015). Plant Biology and Biotechnology: Volume II: Plant Genomics and Biotechnology
4. Altman A, Hasegawa P M. (2012) “Plant Biotechnology and agriculture. Prospect for the 23<sup>st</sup> century” Academic Press, USA.
5. Brown T. A. (2010). Gene Cloning and DNA Analysis: an introduction, 6<sup>th</sup> edition, Wiley-Blackwell Publisher, UK.
6. [https://kau.in/sites/default/files/documents/a\\_plant\\_biotechnology\\_laboratory\\_manual.pdf](https://kau.in/sites/default/files/documents/a_plant_biotechnology_laboratory_manual.pdf)
7. <https://jru.edu.in/studentcorner/lab-manual/agriculture/Lab%20Manual%20PPB.pdf>

**Instruction hours/week: L: 4 T: 0 P: 0****Marks:100****End Semester Exam: 3 Hours****Course Objectives****The course will help the scholars to**

- Equip on the preparation of sterile culture media, aseptic methods to be used for the sub culturing and passaging of cells
- Avoid the risks during cell culture
- Explain the basis of primary cell cultures and cell lines, types of cell culture and methods to ascertain the structure and function of cells.
- Study about tissue culture laboratory and safety measures– biohazards issues
- Extrapolate the different types of culture media and types of culture
- Gain knowledge on the importance of Tissue Engineering in clinical sector

**Course Outcomes****On completion of the course, students will be able to**

1. Learn the basis of cell culture techniques as an alternative method to use animal model to test the drugs.
2. Learn the techniques behind cell based assays, which is required for pharmaceutical/research and development institutions.
3. Extrapolate the different types of culture media
4. Understand the various types of cultures
5. Learn synchronization of cell cultures and cell division
6. Know the importance of Tissue Engineering.

**UNIT I: Introduction to animal cell culture**

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture, advantages and limitations medical/pharmaceutical products of animal cell culture-genetic engineering of animal cells and their applications. Risks in a tissue culture laboratory and safety measures - biohazards issues.

**UNIT II: Types of cell culture**

Different types of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification.

### **UNIT III: Types of Techniques**

Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell line selection - types of cell lines - maintenance of cell lines - immobilization of cells and its application - synchronization of cell cultures and cell division - production of secondary metabolites - biotransformation - Induction of cell line mutants and mutations - cryopreservation – germplasm conservation and establishment of gene banks.

### **UNIT IV: Animal cell culture scale up**

Animal cell culture scale up: Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture; Scale up in monolayer - Roller bottle culture, multi surface culture, multi array disks, spirals and tubes - monitoring of cell growth. Organ culture - whole embryo culture - specialized culture techniques - measurement of cell death.

### **UNIT V: Tissue engineering**

Tissue engineering: Design and engineering of tissues - tissue modeling. Embryonic stem cell engineering - ES cell culture to produce differential cells - Human embryonic stem cell research. Transgenic animals-transgenic animals in xenotransplantation.

### **SUGGESTED READING**

1. Aschner, M., & Costa, L. (Eds.). (2019). Cell Culture Techniques. Neuromethods.
2. Darling, D.C., and Morgan, S.J., (2018). Animal Cells Culture and Media, BIOS Scientific Publishers Limited.
3. Satyanarayana, U., (2006). Biotechnology, Books and Allied (P) Ltd. India.
4. Bhojwani S S (2013). Plant tissues culture – an introductory text
5. Swayam Course – Cell Culture Technologies -<https://nptel.ac.in/courses/102104059>.

### Course Objectives

#### The course will help the scholars to

To impart the knowledge on basic theory on phylogenetics and molecular evolution.

To understand the principles and concepts of molecular modeling and computer aided drug designing.

To understand the protein structure prediction and conformational changes throughout the simulation.

To provide brief idea of receptor and receptor-ligand complex, inhibition and inactivation of enzyme, receptor theories.

To study the role on different types of bonds in interaction, structural and chemical features of the receptor and ligand compounds.

### Course Outcomes

#### At the end of the course the scholars will be able to

1. Understand the basic methods of phylogenetic analysis and their application in fields such as systematics, comparative biology, and molecular evolution.
2. Predict protein structure and understand its molecular mechanisms.
3. Steps involved in the designing of new drugs and its validation.
4. Theory and practical knowledge on combinatorial chemistry and library design, virtual screening and compound filtering towards drug repurposing.
5. Decipher the mode/mechanism of inhibition and inactivation of enzymes, drug deactivation.

**Unit I:** Phylogenetics: Basic concepts in Systematics, Taxonomy and Phylogeny: Species concept, kingdom to species, the five kingdoms, classical, phenetic and cladistic approaches. Taxonomic information on viruses, microbes, plants & animals. Concepts in Molecular Evolution. Phylogenetic representations, Definition and description, various types of trees; Steps in constructing a tree, Consensus (strict, semi-strict, Adams, majority rule).

**Unit-II** Molecular Modelling in Drug Discovery: Drug discovery process, Role of Bioinformatics in drug design, Methods of computer aided drug design, ligand design methods, drug design approaches, Target identification and validation, lead optimization and validation, Structure and ligand based drug design, modelling of target-small molecule interactions, Molecular simulations. Protein Modelling

**Unit-III** Molecular Dynamics simulation methods – Molecular Dynamics using 16 Days simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time – dependent properties; Solvent effects in Molecular Dynamics; Conformational changes from Molecular Dynamics simulation and application.

**Unit-IV** Molecular Docking and lead optimization – Molecular Docking; Types of Molecular Docking, docking

algorithms and programs, Structure-based methods to identify lead compounds; de novo ligand design; Applications of 3D Databases Searching and virtual Screening; Strategy for target identification and Validation, lead identification, optimization and validation. Combinatorial chemistry and library design, virtual screening, drug likeness and compound filtering, Absorption, distribution, metabolism, excretion and toxicity (ADMET) property prediction, computer based tools for drug design.

**Unit-V** Pharmacophore and QSAR – Pharmacophore derivation, 3D pharmacophore prediction and application in drug discovery; QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors. Use of Genetic Algorithms, Neural Networks and Principle Components Analysis in the QSAR equations

### **SUGGESTED READING**

1. Rigden, D. J. (2017). From Protein Structure to Function with Bioinformatics (2<sup>nd</sup>Ed.), United States, Springer.
2. Singh, V. and Kumar, A. (2021). Advances in Bioinformatics (1<sup>st</sup> Ed.), India, SpringerNature.
3. Singh, D. B. and Pathak, R. K (2021). Bioinformatics: Methods and Applications (1<sup>st</sup>Ed.), India, Elsevier.
4. Tiwary, B. K. (2021). Bioinformatics and Computational Biology: A Primer for Biologists (1<sup>st</sup> Ed.), India, Springer Nature.
5. <https://www.youtube.com/watch?v=UzBnu8GxYqs>

