M. Phil / Ph. D– BIOCHEMISTRY
(Effective from the academic year 2020 - 2021 and onwards)

PREAMBLE

- The degree of Master of Philosophy [M. Phil] /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 specific major issues and will have an in-detail understanding of biochemistry, selected for research importance.

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

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

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

PEO 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 AND HUMANITIES
RESEARCH PROGRAM – M.Phil / PhD in Biochemistry
(2020–2021 and onwards)

Course code	Name of the course	Instruction hours / week	Credits	Maximum Marks (100)
20RBC101	Research Methodology and Pedagogy	4	4	100
20RBC201	Research and Publication Ethics	4	4	100
20RBC301	Enzyme and Enzyme Technology	4	4	100
20RBC302	Cancer Biology and Immunology			
20RBC303	Medicinal Plants and Plant therapeutics			
20RBC304	Clinical Biochemistry and Toxicology			
20RBC305	Plant Molecular Biotechnology			
20RBC306	Animal Tissue Culture			
20RBC307	Fish Nutrition and Tissue Culture			
Program Total		12	12	300

20RBC101 RESEARCH METHODOLOGY & PEDAGOGY 4H-4C

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 – Lacunae identification-Research process - Research design –Experimental and non experimental designs- Exploratory – Diagnostic.

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.

UNIT III: Data Processing

Data Collection Tools -Case studies - 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

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.

SUGGESTED READING

1. B. Somekh & C. Lewin, (2005), Research methods in the social sciences, Vistaar Publications, New Delhi

2. Crotty, M. (1998), The Foundation of Social Research: Meaning and Perspective in the Research Process, Sage Publications, London

3. Blaikie, N. (2000), Beginning Social Research, Polity Press, Cambridge

4. V. Desai & R. B. Potter, (2006), Doing Development Research, Sage Publications, New Delhi.

20RBC201 RESEARCH AND PUBLICATION ETHICS 4H-4C

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-shodhsindu-shodhganga- Database – e content development – Learning Management System (LMS) – e-PG - Pathshala- CEC (UG) SWAYAM- MOOCs- NPTEL-NMEICT.

IPR: Patent – Copyrights- Trademarks- Geographical Indications.

PRACTICE

Open access publishing

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

20RBC301 ENZYMES AND ENZYME TECHNOLOGY 4H-4C

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, 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.

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.

UNIT V: Enzymes in Biotechnology

Enzyme catalysis in organic solvents, Restriction endonucleases, DNA ligases, DNA polymerase and their uses in Biotechnology. Site directed mutagenesis, artificial enzymes, ribozymes and Abzymes and their uses.

SUGGESTED READING

1. Bommarius A.S., B.R. Riebel. 2004. Biocatalysis – Fundamentals and Applications, Wiley-VCH, Weinheim, Germany.
2. Buchholz K., V. Kasche, U.T. Bornscheuer. 2005. Biocatalysts and Enzyme Technology, Wiley-VCH, Weinheim, Germany.
3. Cook P. F., W.W. Cleland. 2007. Enzyme Kinetics and Mechanism, Garland Science Publishing, London, England and New York, USA.
4. Irwin Segel. 2004. Biochemical Calculations, John Wiley and Sons, California, USA.
5. Marangoni A.G. 2003, Enzyme Kinetics-A Modern Approach.

20RBC302 CANCER BIOLOGY AND IMMUNOLOGY 4H-4C

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 risk factors for cancer and methods to avoid such risks.
- Provide insight knowledge about the emerging themes and in-depth analysis of cancer and its therapeutic approaches.
- Understand the genetics of cancer
- Understand the immunology of cancer
- Understand and handle sophisticated techniques used in cancer research

Course Outcomes

On completion of the course, students will be able to

1. Understand the biological background of cancer
2. Analyze, decipher and identify the complexity of cancer biology.
3. Develop therapeutic approaches to circumvent cancer cell survival, multiplication and progression.
4. Understand the immunology of cancer
5. Understand the genetic basis of cancer
6. Handle the instruments involved in cancer research

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.

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.

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: Immunology of cancer

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

UNIT V: Cancer Techniques

Techniques-FISH techniques, Real time PCR, Western blotting, ELISA assay, immunocytochemistry, immunohistochemistry, flow cytometry, fluorescent microscopy and confocal microscopy.

SUGGESTED READING

1. Alberts, B. et al. (2008). Molecular Biology of the Cell. 5th Ed. Garland Publishing House. USA.
2. Benjamin Lewin (2007) Genes VIII, Prentice Hall. USA.
3. Brown T.A. (2010), Gene Cloning & DNA Analysis, 6nd Edition, Wiley-Blackwell, New York.
4. Karp G. (2012), Cell and Molecular Biology: Concept and Experiments. John Willy, New York.
5. Klug, W.S., Cummings, M.R, Spencer C.A and Palladino, M.A. (2012), Concept of Genetics, 10th Edition, Pearson Education, Singapore.
6. Lodish H., Berk A., Kaiser CA., Kriger M .,Scott M.P.,Bretscher A., Ploegh H., Matsudaira P.2008. Molecular Cell Biology, 6th edition, W.H. Freeman and Company, New York.
7. Janeway et al., 2012.Immunobiology, 8th Edition, Current Biology publications, USA.
8. Watson J.D. 2009, A Passion for DNA: Genes, Genomes & Society, Cold Spring Harbor Laboratory press (CSHL).

20RBC303 MEDICINAL PLANTS AND PLANT THERAPEUTICS 4H-4C

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 knowledge on the role of secondary metabolites as antioxidants
- Provide understanding on the principle and mechanism of different classes of phytoconstituents.
- Provide understanding of basic principles and methods in Plant tissue culture and animal tissue culture.
- Provide basic handling of experimental animals.

Course Outcomes

On completion of the course, students will be able to

1. Bring basic knowledge on extraction, isolation and screening of bioactive compounds.
2. Perform different antioxidant assays of plant constituents'.
3. Produce secondary metabolites through PTC.
4. Perform different plant tissue cultures in the laboratory.
5. Handle small experiments animals for in vivo therapeutic studies.
6. Perform in vivo experiments to determine the therapeutic efficacy and safety.

UNIT I: Medicinal plants

Medicinal plants-bioactive principles in medicinal plants methods of extraction, isolation, 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, reactive oxygen species, antioxidant defence system, enzymic and nom-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.

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 medicinal plants using animal cell culture

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.

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

SUGGESTED READING

1. Dubey R.C. (2009). Text book of Biotechnology, S. Chand & Company Ltd. New Delhi.
2. Freshney, R. I., & Freshney, M. G. (2010). In Freshney, R. I. (ed.), Animal cell culture: a practical approach, 2nd ed. IRL Press at Oxford University Press.USA.
3. Jain V. K. (2010). Fundamentals of plant physiology, C. Chand and Company Ltd, New Delhi.
4. Purohit. S.S. (2005). Agricultural Biotechnology, Dr. Updesh Purohit Publishers, Jodhpur. India
5. Singh. M.P and Panda. H (2005). Medicinal Herbs with their formulations, Daya Publishing House, New Delhi.

20RBC304 CLINICAL BIOCHEMISTRY AND TOXICOLOGY 4H-4C

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, leukemia and anemia.
- 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.
- To provide an idea about the role of non-enzymatic antioxidant in biological system and major dietary sources of the non-enzymatic antioxidant.
- Definition of heavy metal toxicity and its prevention to humans**.**

Course Outcomes

On completion of the course, students will be able to

- Identify the hematological changes in different diseases
- Describe the theoretical background of clinical diagnostics for the most common disorders in different organ systems.
- Explain the principle of pharmaceutical effects and metabolism in the body.
- Describe pre-analytical factors that are important for the results, interpretation and quality of the analytical result.
- Identify the mechanism of toxicological parameters.
- Epidemiology of common genetic diseases

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 (cystic fibrosis, Hemachromatosis, thalassemias, sickle cell diseases).

UNIT II: Clinical Enzymology

Clinical significance of Phosphatases, transmainases, 5'nulceotidase, 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, Glulathione 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. Chatterjee M.N. and Rana Sinde, (2006) Text Book of Medical Biochemistry, 6th Edition, Jaypee Brothers, Medical Publishers, New Delhi.
2. Harper's Illustrated Biochemistry (2009) 28th Edition McGraw Hill, Mumbai.
3. Nelson and Cox (2005). Principles of Biochemistry by, 4th Edition, Mumbai.
4. Devlin (2006). Biochemistry with Clinical Correlation, 6th Edition, John Wiley & Sons, USA.
5. Ramnik Sood (2009). Medical Laboratory Technology; Jaypee Brothers Medical Publishers, New Delhi
6. Tietz. Fundamentals of Clinical Chemistry (2008). 6th Edition, Elsevier, USA.
7. Voet D.and Voet J (2008). Biochemistry, 3rd Edition, J. Wiley & Sons, USA.

20RBC305 PLANT MOLECULAR BIOTECHNOLOGY 4H-4C

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 of in plant biotechnology
- Enable students to acquire a specialized knowledge and understanding of advanced techniques in plant biotechnology.
- Develop students about better understanding of 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 have a better understanding of major techniques involved in production of secondary metabolites by plant tissue culture.
- Provide a better understanding of the major techniques involved in plant tissue culture.

Course Outcomes

On completion of the course, students will be able to

1. Acquire knowledge about setting a plant tissue culture laboratory and necessity of concept asepsis.
2. Students would get strong understanding of plant genome, advanced techniques in genomic studies.
3. Students acquire knowledge on micropropagation techniques and using such techniques for the enhanced production of secondary metabolites.
4. Acquire skills required to execute modern plant biotechnology and animal biotechnology experiments.
5. Students get knowledge about the steps involved in plant acclimatization and hardening.
6. Acquire better knowledge on therapeutic and pharmacological value in plant molecular biology.

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. Micropropagation of plants - somatic embryogenesis, protoplast culture, somatic hybridization and synthetic seeds.

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.

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 production. 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. Altman A, Hasegawa P M. 2012 “Plant Biotechnology and agriculture. Prospect for the 21st century” Academic Press, USA.
2. Brown T. A. 2010. Gene Cloning and DNA Analysis: an introduction, 6th edition, Wiley-Blackwell Publisher, UK.
3. Chawla H.C. 2009 Introduction to Plant Biotechnology 3rd Edition, Oxford & IBH publication Pvt .Ltd, New Delhi.
4. Davies K. 2004. Plant Pigments and their Manipulation – Annual plant reviews, vol 14 Blackwell Publication, UK.

5. Glick and Paster mark, 2002. Molecular Biotechnology - Principles and Applications in Recombinant DNA. Panima Publishing Co-operation, Banglore.
6. Primrose S.B and R.M. Twyman. 2003. Principles of Genome Analysis.Blackwell Publishing, Oxford.
7. Slater A, Scott NW, Fowler MR. 2008 Plant Biotechnology: the genetic manipulation of plants, Oxford Press, UK.
8. Winnacker E. 2003. From Gene to Clones; Introduction to gene technology, 4th edition, Panima Publisher, India.

20RBC306 **ANIMAL TISSUE CULTURE** **4H-4C**

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 scholars on the preparation of sterile culture media, aseptic methods to be used for the subculturing and passaging of cells.
- To avoid the risks during cell culture
- To explain the basis of primary cell cultures and cell lines, types of cell culture and methods to ascertain the structure and function of cells.
- To acquire the necessary practical skills for the isolation of animals cells for *in vitro* studies.
- Maintenance of animal cells in vitro and manipulation of animal cells in vitro.
- Application of molecular techniques to in vitro situations.

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. To teach students basic aseptic technique, routine maintenance of established cell lines, and primary culture
3. Better understanding of different types of culture media and its composition.
4. Learn the techniques behind cell-based assays, which is required for pharmaceutical/research and development institutions.
5. Acquire knowledge about different types of cell culture and techniques.
6. To generate trained individuals who can function in academic as well as corporate settings.

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 - biohazards.

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. Butler. M. 2004. Animal Cell Culture and Technology, BIOS Scientific Publishers, Taylor and Francis Group. U. K.
2. Freshney, R. I., & Freshney, M. G. 2010. In Freshney, R. I. (ed.), Animal cell culture: a practical approach, 2nd ed. IRL Press at Oxford University Press.
3. Gupta P.K. (2010), Biotechnology & Genomics, 5th Reprint, Rastogi Publications Meerut.
4. Ranga M.M., Animal Biotechnology, (2007) Agrobios, India.
5. Satyanarayana, U., 2006. Biotechnology Books and Allied (P) Ltd. India.

20RBC307 **FISH NUTRITION AND TISSUE CULTURE** **4H-4C**

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

- To gain in depth knowledge and field exposure on sustainable aquaculture practices.
- Understand the principles and nutrition required for fish life.
- Learn the methods of standard feed formulations for fish with adequate nutritional requirements.
- Understand the fish breeding and tissue culture techniques.
- Understand about the fish feed formulations and feeding stragey.
- Helps in economic evaluation of aquaculture practices.

Course Outcomes

On completion of the course, students will be able to

1. Develop nutritional feed for fish life
2. Develop quality food for larval growth and development
3. Perform the quality test for confirmation of the standard of feed for fish
4. Perform fish breeding and tissue culture techniques
5. Create basic understanding on the nutritional requirements of shellfish and feed manufacture
6. To learn seed production and hatchery management of commercially important cultivable fishes.

UNIT – I: Fish Nutrition

Fish nutrition: Principles of fish nutrition and terminologies, Role of nutrients: amino acids, fatty acids, proteins, lipids, carbohydrates, vitamins and minerals. Essential aminoacids, vitamins and minerals and their role in fish and shellfish nutrition.

Unit – II: Energy nutrition

Energy nutrition: Definition, energetics, expression of energy value of feed (gross energy, digestible energy, metabolizable energy, net energy), partitioning of energy and energy budget, protein energy ratio.

UNIT- IV: Larval nutrition

Larval nutrition: Nutritional requirements of fish and shellfish larvae, quality requirements of larval feeds (particle size, digestibility), natural food and its importance in aquaculture,

nutritional quality of commonly used fish food organisms (bacterioplankton, phytoplankton and zooplankton) and their roles in larval nutrition.

Unit -IV: Feed Formulations

Feed Formulations and Feed Technology: Classification of feed ingredients. Antinutrients in fish feed ingredients. General principle of feed formulation, Methods of feed formulation: Pearson's method, quadratic equation linear programming, limitations. Types of feed.Hydro-stability of feed and their storage and prevention of spoilage from rancidity. Feed additives: - Classification, function, and specific use for economic and quality fish and shellfish production. Feed evaluation through the study of growth performance, FCR and PER analysis.

Unit V: Fish breeding and Tissue culture

Fish breeding and TissueCulture: Collection, selection and Nutritional management of brooder fishes.Methods of natural and artificial fertilization of fish reproduction. Induced breeding by synthetic hormones and its analogues. Genetic improvement of inheritance, inbreeding and cross breeding.General principles of cell and tissue culture.Culture of primary cell and secondary cell (sub-culture), Cryopreservation of cells, Cell viability and Karyotyping. Fish cell culture and development of fish cell lines and their application.

SUGGESTED READING

1. Cyrino. J. E. P., Bureau, D. and Kapoor B. G. (2008) Feeding and Digestive Functions in Fishes. Edited by. xiii 575 pp. Published by Science Publishers, Enfield, New Hampshire. ISBN 978-1-57808-575-6.

2. Guillame J, Kaushik S, Bergot P &Metallier R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publication.

3. Heil, N. (2009). Nutritional Wild Fish Health Survey – Laboratory Procedures Manual 5th Edition. U.S. Fish and wildlife services, Warm Springs, GA, Washington, DC.

4. Goswami, M. and Lakra, W.S. (2012). Fish Cell and Tissue Culture: A Text Book. Published by Narendra Publishing House, Delhi. ISBN 10: 9380428642 / ISBN 13: 9789380428642.

5. Westerfield, M. Leonard Zon, H. and Detrich,W. (2009) Essential Zebrafish Methods: Cell and Developmental Biology. 1st Edition, Academic Press.