DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
KARPAGAM ACADEMY OF HIGHER EDUCATION
(*Deemed to be University,Established Under Section 3 of UGC Act 1956*)
Eachanari PO, Coimbatore – 641 021, India.

M.Phil / Ph.D– BIOCHEMISTRY
(Effective from the academic year 2019 - 2020 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 on the basis of original and independent research in any biochemistry field of research.
- This makes a contribution to the advancement of knowledge, which can be useful to the society.

DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
RESEARCH PROGRAM – M.Phil / PhD in Biochemistry
(2019–2020 and onwards)

Course code	Name of the course	Instruction hours / week	credits	Maximum Marks (100)
19RBC101	Research Methodology and Pedagogy	4	4	100
19RBC201	Advanced paper in Biochemistry	4	4	100
19RBC301A	Enzyme and Enzyme technology	4	4	100
19RBC301B	Cancer Biology and immunology			
19RBC301C	Medicinal Plants and Plant therapeutics			
19RBC301D	Clinical Biochemistry and Toxicology			
19RBC301E	Plant Molecular Biotechnology			
19RBC301F	Animal Tissue Culture			
19RBC301G	Fish nutrition and tissue culture			
Program Total		12	12	300

19RBC101 RESEARCH METHODOLOGY&PEDAGOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjective:

Equip the students with:

- The availability of tools for literature search
- Usage of tools and documentation of available research
- Identification of lacunae in the literature
- Processing of data and evaluating statistical significance
- Nuances of scientific writing
- Dissemination of research data

CourseOutcome:

After successful completion, the students will understand

1. Scopus, Cochrane, Pubmed databases
2. Collation of available research and exportation to appropriate format
3. Methods involved in the identification of lacunae in the literature
4. How to Process data and evaluate statistical significance
5. Nuances of scientific writing
6. Dissemination of research data

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.

19RBC201 ADVANCED PAPER IN BIOCHEMISTRY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjective:

Equip the students with:

- Applications and limitations of antibody based assays
- Applications and limitations of fluorescence based assays
- Applications and limitations of microscopic assays
- Applications and limitations of nucleic acid analysis
- Analysis of protein using wet lab and computational methods
- Basic methodology of animal and plant tissue culture methods

Course outcomes:

After successful completion, the students will understand

1. Appropriate antibody based assays for a specific research question
2. Appropriate f fluorescence based assays for a specific research question
3. Specific microscopic assays for a research question
4. Appropriate nucleic acid analysis for a specific research question
5. Usage of wet lab and computational methods for a specific research question
6. General methodology of animal and plant tissue culture methods

UNIT I: Biochemical Techniques

Fluorescent Antibody assay – Histochemical localization, ELISA techniques – Principles & Applications. Immuno radiometric assay – Principles & Applications
Natural Products – Detection of bioactive molecules by gas chromatography, HPLC and HPTLC, Mass spectrometry, NMR. Emission Spectroscopy – Fluorescence, Phosphorescence and Chemiluminescence. X-Ray diffraction and Flow injection analysis.

UNIT II: Microscopy and PCRTechniques

Electron microscopy- transmission and scanning, Freeze fracture technique, specific staining of biological material. Flow Cytometry – Principles, Abnormal chromosome analysis, Karyotyping, Comet assay. DNA Fragmentation analysis – Microfabrication techniques and uses in biological applications. PCR methodology – Design of primers – RTPCR. PCR in genomic analysis and diagnostic applications. PFGE – Principles, techniques and applications.

UNIT III: Bioinformatics Tools

Biological database- DNA sequence database, protein sequence database SRS – Similarity searching, BLAST, FASTA Local and Global alignment, Multiple sequence alignment –

Phylogeny. Structure database – Secondary structure prediction. Predicting 3D folds (Threading) Visualisation tool.

UNIT IV: Genomics and Proteomics Human Genome project

History, techniques and applications: Anatomy of prokaryotic and human genome: genetic mapping and genetic markers-RFLP, Mini and micro satellite, STS and EST, SSCP, RAPD, AFLP, SNPs, Analysing gene expression- DNA micro array.Proteome analysis- 2D gel electrophoresis: protein-protein interactions- yeast two-hybrid system and protein micro arrays.

UNIT V: Culture Techniques

Plant Tissue Culture: Tissue culture media, composition and preparation, primary culture, callus and suspension cultures, somoclonal variation, micro propagation, organogenesis, Somatic embryogenesis, artificial seeds, Transfer and establishment of whole plants in soil, Haploidy: Protoplast fusion and somatic hybridization.

Animal Tissue Culture: Media - Natural media, balanced salt solution and simple media, serum and protein free chemically defined media. Primary cell culture,(chick, mouse and human biopsy)and methods of desegregations of tissues; continuous or established cell culture, tissue culture, organ culture; three dimensional culture, feeder layer, cell separation; cell synchronization; cryopreservation and revival.

SUGGESTED READING

1. Adrian Slater, Neigel Scott and Maark Fowler (2008), Plant Biotechnology – Genetic manipulation of plants, 2nd edition, Oxford University Press, New York.

2. Akay M. (2007) Genomics and Proteomics Engineering in Medicine and Biology Wiley-Interscience John Wiley & sons, Inc. Publication, USA.

3. Deepak Bhariog (2006), Fundamentals of Information Technology, 3rd Edition Excel Books India.

4. Hall, Christopher; Tews, Carey (Retrieved 7 November 2010). "Mac Office matches Windows — almost". InfoWorld. p. 117.

5. Freshney, R. I., &Freshney, M. G. (2010), Animal cell culture: a practical approach, 2nd ed. IRL Press at Oxford University Press.

6. Karp G. (2012), Cell and Molecular Biology: Concept and Experiments. John Willy, New York, USA.

7. Lodish et.al. (2013) Molecular Cell Biology, 7th edition, W.H.Freeman and Company, New York.USA.

8. Watson, J. D., Baker, T. A. & Bell, S. P. (2007). Molecular Biology of the Gene. 6th Ed. BenjaminCummings.USA.

M.Phil/Ph.DBiochemistry		2019-2020
19RBC301A	**ENZYMES AND ENZYME TECHNOLOGY**	**4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 **Marks:100**

End Semester Exam: 3 Hours

CourseObjective:

Equip the students with:

- Techniques involved in the analysis of protein structure and function
- The applications and limitations of methods involved in isolation of enzymes
- The applications and limitations of methods involved in purification of enzymes
- Physical, Chemical and Biological methods of enzyme immobilization
- Clinical significance of enzyme analysis
- Biotechnological applications of enzymes

CourseOutcomes:

After successful completion, the students will understand

1. X-Ray crystallographic, Spectrophotometric analysis of enzymes
2. How to estimate the fold purity during isolation of an enzyme
3. Enzyme purification techniques
4. Physical, Chemical and Biological methods of enzyme immobilization
5. The clinical significance of enzyme analysis in analyzing the vital organ functions
6. Applications of enzymes in the area of medical and industrial biotechnology

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.

19RBC302B CANCER BIOLOGY AND IMMUNOLOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- Etiology of cancer
- Steps involved in the progression of cancer
- Changes in the cell division during oncogenesis
- Programmed cells death
- Immune surveillance strategy
- Techniques involved in the assessment of cancer development and progression

CourseOutcomes:

After successful completion, the students will understand:

1. The reasons for the development of cancer
2. Factors involved in the advancement of cancer
3. Targeting the cell division for the treatment of cancer
4. Targeting apoptosis for the treatment of cancer
5. Methods of enhancing immune surveillance for cancer treatment
6. Usage of appropriate techniques for assessment of cancer stages

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., KrigerM .,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).

19RBC303C MEDICINAL PLANTS AND PLANT THERAPEUTICS 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives

Equip the students with:

- Methods to identify plants/herbs with a specific biological activity
- Evaluating the presence/absence of flavonoids, terpenoids, glycosides and steroids
- Analysis of the crude extract in vitro to evaluate its free radical scavenging activity
- Fractionation methods to isolate a specific compound and its evaluation
- Enhancing the production of secondary metabolite using plant tissue culture
- Assessment of the efficacy of a specific plant metabolite using animal cell culture

CourseOutcomes:

After successful completion, the students will understand:

1. The availability of traditional knowledge search resources
2. Identify flavonoids, terpenoids, glycosides and steroids
3. Analyze the crude extract in vitro for its free radical scavenging activity
4. Column chromatography, TLC
5. How to enhance the production of secondary metabolite using plant tissue culture
6. Animal cell culture

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, micropropogation 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.

19RBC304D CLINICAL BIOCHEMISTRY AND TOXICOLOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- The collection of blood, serum and plasma
- Analyzing the inflammatory markers
- Clinical significance of enzyme assays
- Role of oxidative stress in physiological and pathological state
- Enzymatic and non enzymatic antioxidants
- Toxicological studies

CourseOutcome:

After successful completion, the students will understand:

1. The different anti-coagulants used for the isolation of plasma and its significance
2. Assessment of inflammation
3. Role of enzymes to predict vital organ functioning
4. Regulation of oxidative stress
5. Significance of endogenous antioxidant system
6. Principles and applications of histo-chemical analysis

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. RamnikSood (2009). Medical Laboratory Technology,; Jaypee Brothers Medical Publishers, New Delhi
6. Tietz. Fundamentals of Clinical Chemistry (2008). 6th Edition, Elsevier, USA.
7. VoetD.andVoet J (2008) .Biochemistry, 3rd Edition, J. Wiley & Sons, USA.

19RBC305E PLANT MOLECULAR BIOTECHNOLOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with

- The organization of plant genome
- Molecular markers of plant tissues
- Growth regulators of plant
- Cloning strategies
- Transformation methods
- Manipulation of plant nucleic acids

CourseOutcomes:

After successful completion, the students will understand:

1. Organization of plant genome
2. Molecular markers of plant tissues
3. Growth regulators of plant
4. Cloning strategies
5. Transformation methods
6. Manipulation of plant nucleic acids

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.

19RBC306F ANIMAL TISSUE CULTURE 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 Marks:100

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- Applications and limitations of cell based studies
- Aseptic methods to perform animal cell culture
- Types of cell culture techniques
- Assessment of cell proliferation
- Assessment of cell differentiation
- Scale up technologies

CourseOutcomes:

After successful completion, the students will understand:

1. The need and circumstances for the cell based studies
2. Sterile working culture
3. Suspension and adherent cell culture
4. Thymidine incorporation, WST-1 Assays
5. Galactosidase staining, von-kossa, and alizarin red staining
6. Organ culture

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 - 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.

19RBC301G FISH NUTRITION AND TISSUE CULTURE 4H-4C

Instruction hours/week: L: 4 T: 0 P: 0 **Marks:100**

End Semester Exam: 3 Hours

CourseObjectives:

Equip the students with:

- Fish nutritional value
- Larval nutritional requirements
- Formulation of fish feeds
- Handling of fish
- Breeding methods for fish
- Fish as a model system for the assessment of diseases

CourseOutcomes:

After successful completion, the students will understand:

1. The nutritional value of fish
2. Nutritional requirements for fish larval culture
3. Composition and role of fish feeds components
4. How to handle the fish
5. Methods for the breeding of fish
6. Usage of fish model to determine the efficacy of therapeutic drugs

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 brooderfishes.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.