

BHARATHIAR UNIVERSITY : COIMBATORE- 641 046

M.Phil. / Ph.D. in Life Sciences (DIPAS)
(w.e.f. 2008-2009 and onwards)

PART-I SYLLABUS

PAPER I : Research Methodology in Life Sciences

PAPER II : Research Trends in Life Sciences

PAPER III : Special Papers

1. Molecular Biology
2. Phytochemistry and Toxicology
3. Neurobiology
4. Biochemistry, Metabolism and Nutrition

Paper-I : Research Methodology in Life Sciences

UNIT 1

- a). Basic electronics (electrical unit e.g. E.M.F, Charge, Current flow, Resistance, Impedance, Frequency, Conductance etc. ECG, EMG, EEG, GSR (Galvanic Skin Response), EP (Evoked Potential) their principles of measurements, BP measurement.
- b) pH measurement, buffers, estimation of macro molecules (protein, carbohydrate and nucleic acids), enzyme kinetics, Colorimetry- ultraviolet-visible spectrophotometry-principles, instrumentation and application, fluorescence spectrophotometry.

UNIT 2

- a. Chromatography techniques and principles and different types (Affinity chromatography, ion exchange chromatography, Gel exclusion chromatography, Gas chromatography, HPLC, TLC, paper chromatography). Isolation of natural products (extraction, purification and separation.
- b. Different types of microscopic techniques (light microscope, compound microscope, dark field microscope, phase contrast microscope, Normaski microscope, confocal microscopy, transmission electron microscopy (TEM) and scanning electron microscopy (SEM), Cell sorting-flow cytometry,

UNIT 3

- a) Ergometry - its principles and different type of ergometers and their applications. Pulmonary function tests, Spirometry. Respiratory gas analysis (expired air), Blood gas analysis. Physical performance assessment.
- b) Routes of immunization, types of adjuvant and their importance, antigen antibody interaction, monoclonal and polyclonal antibodies. ELISA techniques-principle and applications, Immunoradiometric assay- Principles and applications, Hybridoma.

UNIT 4

- a) Environmental/Bio-meteorological analysis: Heat indices using Dry bulb &Wet bulb thermometer, Kata thermometer. Anaemometer, measurement of Basal Metabolic Rate, energy expenditure Direct and indirect calorimetry).
- b) Isolation of genomic DNA and plasmid DNA, DNA sequencing techniques (PCR, RTPCR, restriction analysis, DNA fragmentation analysis, Hybridization techniques) etc. COMET assay, cell viability assay, karyotyping.

UNIT 5

- a) Statistics in biomedical research- Experimental design, Various sampling methods, Probability, frequency distribution average (arithmetic, geometric, means, mode and median) Standard Deviation, Standard Error of Mean, Degree of Freedom, Significance, t-test, Correlation, null hypothesis, distribution.
- b) Bioinformatics: use of computers in data analysis, Biological databases- DNA sequence databases and protein sequence databases. BLAST, FASTA, Multiple sequence alignment.

Paper-II : Research Trends in Life Sciences

UNIT 1

- a) Environment factors effective human health and performance (Heat, Cold, High Altitude, Under water and Space).
- b) Occupational environment and Pollution (type, effect on human health).

UNIT 2

- a. Thermoregulatory mechanisms in human beings and adaptive/acclimatization responses.
- b. Glycolysis, gluconeogenesis, citric acid cycle, pentose phosphate pathway, β -oxidation of fatty acids, ketone bodies; integration of metabolic pathways, electron transport chain, oxidative phosphorylation. k_m , competitive, non-competitive and mixed inhibition, effect of pH; principles of toxicology.

UNIT 3

- a) Physical work capacity (Changes in different environmental conditions, High Altitude, Heat and Cold). Anthropometric and body composition changes in different age and sex.
- a) Oxidative stress and types of free radicals, their role in cell metabolism and diseases; antioxidant defense system, detoxification mechanism; neurotransmitter and neuromodulator

UNIT 4

- a) Biorhythms- Different types mechanisms. Effect of circadian rhythms on human health and efficiency.
- b) Development of immune system, regulation of immune response, humoral and cell mediated immunity

UNIT 5

- a) Different heat stress indices (Effective Temperature, WBGT) its measurement principles and applications. Wind Chill Index, Measurement, Applications. Clo value, its definition and application.
- b) Gene structure and function, DNA replication and repair, cloning and expression of genes. Transcription and translation in prokaryotes and eukaryotes.

Life Sciences

Special Paper – 1 : Molecular Biology

Unit 1

- a) Molecular nature of gene- gene structure, function and regulation, physical and chemical structures of nucleic acids and proteins, forms of DNA helix, Denaturation-renaturation.
- b) DNA replication, repair, Mutations and Mutagenesis

Unit 2

- a) Recombinant DNA technology- cloning and expression vector-prokaryotic and eukaryotic viz; Plasmid, cosmids, Phages, bacterial artificial chromosome (BACs) and yeast artificial chromosomes (YACs), yeast promoter systems and terminators, yeast signal sequences.
- b) PCR and its types, primer designing, Restriction digestion, ligation, cDNA, transformation and transfection. DNA sequencing, RFLP, RAPD, AFLP.

Unit 3

- a) Transcription and translation in prokaryotes and eukaryotes: transcription apparatus, Operons, RNA polymerases, promoters.
- b) Transcription factors, DNA protein interactions, post transcriptional events: splicing, capping, polyadenylation.

Unit 4

- a) Cell as basic structural unit: structure of prokaryotic and eukaryotic cells, structure and functions of various cell organelles,
- b) cell membrane system, cell division, cell signaling (Signal transduction)

Unit 5

- a) Gene Silencing: RNA interference (SiRNA, micro-RNA), antisense RNA, pharmacological inhibitors
- b) Transgenic animals and plants, knockout mice, Gene therapy, chromosomal diseases.

References:

- Glick B.R. and J.J. Pasternak. 1994.** Molecular Biotechnology, ASM Press, Washington.
Freifelder D. 1987. Molecular Biology, Narosa publishing house, New Delhi.
Weaver, R.F. 1999. Molecular Biology. WCB Mv Gray-Hill.
T.A. Brown. Essential Molecular Biology Vol. I and Vol. II

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Special Paper – 2 : Phytochemistry and Toxicology

Unit 1

Chemistry of Medicinal Natural Products

- (a) Chemistry of aromatic medicinal plants
- (b) General methods of extraction procedures; conventional and modern methods of extraction.

Unit 2

Isolation, characterization and analysis of phyto medicine

- (a) Isolation, characterization and analysis of phytopharmaceuticals belonging to the group of alkaloids, glycosides, terpenoids, steroids, bioflavonoids, purines, lipids, tannins and other phenolics, volatile oils and terpenoids, fixed oils and carbohydrates;
- (b) Identification of active components and their estimation by various analytical techniques.

Unit 3

Standardization of raw materials and herbal products

- (a) Physicochemical characterization of plant material.
- (b) WHO guidelines for Quality control, Good laboratory practices.

Unit 4

Basics of Toxicology

- (a) Classification Of Toxic Agents, Types of Toxicity: LD50 and ED50
- (b) Acute and Chronic Exposure, Route of Exposure, Site of Exposure, Duration and Frequency of Exposure, Factors Influencing Toxicity.

Unit 5

Animal Toxicology

- a) Toxicokinetics: Absorption, Distribution, Metabolism and Excretion
- b) Dose- Response Relationship: Animal Toxicity Tests: Acute, Sub acute and Chronic tests, Mutagenicity, teratogenicity and Carcinogenicity tests.

Life Sciences

Special Paper – 3 : Neurobiology

UNIT 1

THE CELL BIOLOGY OF NEURONS AND GLIA

- a) Structure of Neurons – Types of Neurons – GLIA and their functions, Blood Brain Barrier
- b) G Protein coupled receptors, Synaptic transmission and Ligand gated channels, Structure and function of Voltage gated channels, Action potentials, Receptor Potentials, Fast synaptic excitation-Fast synaptic inhibition.

UNIT 2

NEUROTRANSMITTERS AND NEURO MODULATORS

- a. Synapse, Types of synapse, Synthesis and release of Acetyl choline, Glutamate, GABA.
- b. Synthesis of Serotonin, Dopamine, Epinephrine, Norepinephrine etc, Neuromodulators and their functions in brain.

UNIT 3

TECHNIQUES USED IN NEUROPHYSIOLOGICAL RESEARCH

- a. Microelectrode techniques, Voltage clamp techniques, Evoked potentials, Stereotaxis, EEG
- b. Microionophoresis, Microdialysis, Brain Imaging techniques

UNIT 4

BEHAVIOURAL NEUROSCIENCE

- a. Tools and methods in behavioural neuroscience, Structure of Hippocampus, Types of memories their mechanism of storage, Synaptic Plasticity, Retrograde and Anterograde Amnesia.
- b. Neural control of mood and emotions, Brain mechanisms of emotions, Expression and learning, anxiety, fear & aggression

UNIT 5

OXIDATIVE STRESS AND ANTIOXIDANTS

- a. Mechanism of Oxidative stress generation in brain, Neurodegenerative disorders, Apoptosis and Necrosis in Neurons,
- b. Synthesis, Protective action of transport and protective action of Glutathione, Vit C, E and Metallothionins, Antioxidant Enzymes in quenching free radicals.

REFERENCE

1. Launder Sherwood. Human Physiology, from cells to systems 4th edition 2001, Broad Scale publishers
2. Richard F. Thompson. The Brain: A Neuroscience Primer. 2nd edition 2000. Worth Publishers, New York
3. Smith CUM. Elements of Molecular Neurobiology, 1989, A Wiley Medical Publication
4. RW Davis & BJ Morris. Molecular Biology of the Neurons. 1999. Bios Scientific Publishers, New Delhi
5. Duane E Haines. Fundamental Neurosciences. 2nd Edition 2002 Churchill, Livingston's Pennsylvania

Life Sciences

Special Paper - 4 : Biochemistry, Metabolism and Nutrition

Unit 1

Basics of Biochemistry

- a) Structure, function and metabolism of carbohydrates, lipids and proteins
- b) Hormones and metabolic regulation

Unit 2

Amino Acids

- a) General characteristics and classification of amino acids, acid-base properties
- b) Amino acid Deamination, Urea cycle, Protein synthesis

Unit 3

Nucleic Acid

- a) Structure of nucleic acid
- b) DNA replication, repair and recombination

Unit 4

Oxidative Stress and Xenobiotic Metabolism

- a) Generation, role of free radicals in stress, disease conditions
- b) Antioxidant defense system, Drug metabolizing enzymes, CYP 450, Phase I & II reactions

Unit 5

Nutrition

- a) Human energy requirements, Recommended dietary allowances (RDA)
- b) Macronutrients (Carbohydrates, fats and proteins), Micronutrients, Vitamins, Minerals, Dietary fibre, Nutraceuticals
