

BHARATHIAR UNIVERSITY : COIMBATORE- 641 046

Defence Institute of Physiology and Allied Sciences (DIPAS)-New Delhi
Govt. of India, Ministry of Defence, Defence Research & Development Organization

M.Phil. / Ph.D. - Life Science/Physiology (DIPAS)
(W.e.f. 2008-2009 and onwards)

PART-I SYLLABUS

PAPER I : Research Methodology in Life Sciences / Physiology

PAPER II : Research Trends in Life Sciences / Physiology

PAPER III : Special Papers

1. Life Sciences

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

2. Physiology

1. Cold Physiology
2. Ergonomics and Work Physiology
3. Neurophysiology

Life Sciences and Physiology

Paper-I : Research Methodology in Life Sciences / Physiology

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.

Life Sciences and Physiology

Paper-II : Research Trends in Life Sciences / Physiology

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

Paper III- 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

Life Sciences

Paper III- 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 phytomedicine

- (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

Paper III - 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

Paper III - 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

Physiology

PAPER III- Cold Physiology

UNIT 1

- a. Temperature regulation-Principle and Heat Balance
- b. Regulation of body temperature-Neuropsychological & biochemical basis of temperature regulation

UNIT 2

- a. Types of Cold exposure, Newton Law of cooling, Insulation
- b. Measurement of body temperature and blood flow (Thermography etc)

UNIT 3

- a. Responses to acute cold exposure, shivering, non shivering thermogenesis, cold induced vasodilatation
- b. Responses to cold adaptation, Eskimos, Australian Aborigine

UNIT 4

- a. Hypothermia, Experimental hypothermia
- b. Frostbite mechanism and treatment modality

UNIT 5

- a. Oxidative stress, reactive oxygen species, Antioxidant systems, Lipid peroxidation
- b. Role of antioxidants, Natural and Synthetic antioxidants

Physiology

PAPER III- Ergonomics & Work Physiology

UNIT 1

- a. Concept of ergonomics, focus of ergonomics, application of ergonomics, understanding man-machine environment system components, macro and micro ergonomics
- b. Types of muscles, EM Structure of skeletal muscle, mechanism of muscular contraction, chemical basis of muscular contraction, neuromuscular junction and transmission

UNIT 2

- a. Anthropometric principles in work place and equipment design, application of anthropometry | design, designing for a population and for everyone, effectiveness and cost effectiveness
- b. Designing for standing and seated work

UNIT 3

- a. Types of work, O₂ and CO₂ consumption, aerobic and anaerobic work, O₂ debt, maximum aerobic capacity (limit factors affecting standard methods of measurement), lactate threshold
- b. Classification of workload, work rest cycle, physical fitness (measurement factors affecting, environmental impact)

UNIT 4

- a. Effect of environment on human performance (effect of noise, vibration, heat, cold and illumination), personal protection and protective equipment.
- b. Body composition (measurement and analysis), physical activity and obesity, theories of weight control

UNIT 5

- a. Ergonomic methods and tools for work analysis (posture analysis-OWAS, RULA, Comfort/discomfort analysis, CG analysis)
- b. Occupational ergonomics (ergonomics in military and industrial work environment), musculo-skeletal disorders (development, analysis and prevention).

Physiology

Paper –II : Neurophysiology

UNIT 1

- a. Conduction and transmission of nerve impulse, action potential, processing of information
- b. Synapses, synaptic transmission, CNS neurotransmitters

UNIT 2

- a. Sleep wakefulness, types of sleep, physiology, mechanism, EEG and neurotransmitters involved in sleep wakefulness
- b. Meditation, Physiological effects, applications

UNIT 3

- a. Intellectual functions of cerebral cortex, thoughts and consciousness, memory, consolidation
- b. Limbic system, hypothalamus, hippocampus, amygdala and limbic cortices, sleep deprivation and cognitive function

UNIT 5

- b. EEG, Polysomnography, sleep staging
- c. Evoked potentials, event related potentials, fMRI, PET

UNIT 6

- a. Effect of low oxygen on the body
- b. Sleep at high altitude, cerebral edema, acute mountain sickness.
