SYLLABUS
For the
MASTER OF SCIENCE

IN

HUMAN PHYSIOLOGY

VIDYASAGAR UNIVERSITY
MIDNAPORE – 721102
WEST BENGAL

Effective from 2013-14 sessions

Preamble

The subject of Human Physiology is one of the important interdisciplinary areas in teaching, training and learning which is considered to be important in terms of human resource development as well as community development. Human physiology is the life phenomenon studied at all level, from molecules to cell with special emphasis to human body. It is that branch of knowledge that applies the principles of physics, chemistry and the methods of mathematical analysis and computer modeling to understand natural phenomena of the human body. The major focus of human Physiology is on the analysis of different aspects of the functions of biological molecules, organisms and entities. The techniques and methodologies of Human Physiology have the wide applications in the biological, medical and related sciences. Human physiology works in Universities, R and D industry, Medical Centers/Colleges, Research Institutes, and Government Organization etc.

Eligibility Criteria:

A candidate shall be held eligible for admission to Two year course for the Master's Degree in Human physiology under faculty of Science, if candidate has passed the B.Sc. Examination with honours in Physiology. The graduate course should of three years duration.

General Instructions:

1. M.Sc. Human Physiology course is divided into four semesters each of 300 marks. There are 14 theory papers and 10 practical papers in four semesters.
2. Each Semester consists of Theory and Practical papers each of 50 marks consolidating to 300 marks. 3. Each paper is divided into two units each of 25 marks and each unit of theory papers is subdivided into 4 modules.
3. The students are required to complete 20 compulsory papers (12 theories and 8 practical) and 4 optional papers (2 theories and 2 practical). The optional papers will be announced at the beginning of each academic session
4. Every theory paper will have workload of 50 lectures each of 60 minutes duration distributed unit wise (45 lectures +5 tutorials). Every practical Paper will have workload of 75 periods each of 60 minutes duration
5. Each theory papers will be evaluated by internal assessment (10 marks) and semester examination (40 marks). For each paper there will be two internal assessments, which may be evaluated by written test or oral test or seminar presentation. The average marks of two assessments will be credited to the students.
6. Each student should participate in a field study for community health survey as a part of practical training in the second semester.
7. Students have to carry out an individual project of 50 marks in the final semester. The project will be evaluated by the project report submitted and seminar presented by the students.

SYLLABUS FOR M. Sc. HUMAN PHYSIOLOGY AT A GLANCE

Semester I: 300 marks		Semester II : 300 marks		Semester III: 300 marks		Semester IV: 300 marks		Total Marks : 1200	
Theo	Pract	Theo	Pract	Theo	Pract	Theo	Pract	Theo	Pract
200	100	150	150	200	100	150	150	700	500

First semester: 300 marks

Theory / Practical	Paper	Unit	Name	Marks
Theory	Paper PHY-101	01	Physiological chemistry and Metabolism	25
		02	Molecular biology	25
	Paper PHY-102	03	Biophysical principles in physiology	25
		04	Biomedical instrumentation	25
	Paper PHY-103	05	Biostatistics and research methodologies	25
		06	Computer application in biology and bioinformatics	25
	Paper PHY-104	07	Neural control systems and excitable cell	25
		08	Integrated physiology: Homeostasis	25
Practical	Paper PHY-105	09	Biochemical techniques	25
		10	Bio-analytical techniques and Microbiological studies	25
	Paper PHY-106	11	Statistical treatment of biological data	25
		12	Computer application in biological problems	25

Second Semester: 300 marks

Theory / Practical	Paper	Unit	Name	Marks
Theory	Paper PHY-201	13	Community health: General health and disease	25
		14	Community health: Nutrition and health	25
	Paper PHY-202	15	Community health: Exercise physiology and mass fitness	25
		16	Community health: Occupational health and ergonomics	25
	Paper PHY-203	17	Community health: Man and environment	25
		18	Community health: Environmental management and toxicology	25
Practical	Paper PHY-204	19	Anthropometry and community health survey	25
		20	Human experiments	25
	Paper PHY-205	21	Growth monitoring and nutritional assessment	25
		22	Assessment of environmental status.	25
	Paper PHY-206	23	Studies with cardiac muscle	25
		24	Studies with skeletal & smooth muscles and bioassay	25

Third semester: 300 marks

Theory / Practical	Paper	Unit	Name	Marks
Theory	Paper PHY-301	25	Electrophysiology	25
		26	Sensory Physiology	25
	Paper PHY-302	27	Microbes-human interaction	25
		28	Human immune system	25
	Paper PHY-303	29	System physiology	25
		30	Higher functions of brain	25
	Paper PHY-304	31	Special paper	25
		32	Special paper	25
Practical	Paper PHY-305	33	Histological and cytological techniques	25
		34	Histochemical and histometric techniques	25
	Paper PHY-306	35	Special paper practical	25
		36	Special paper practical	25

Fourth semester: 300 marks

Theory / Practical	Paper	Unit	Name	Marks
Theory	Paper PHY-401	37	Endocrinology	25
		38	Reproductive physiology	25
	Paper PHY-402	39	Cell and Inheritance Biology	25
		40	Biotechnology	25
	Paper PHY-403	41	Special paper	25
		42	Special paper	25
Practical	Paper PHY-404	43	Advanced physiological studies	25
		44	Advanced physiological studies	25
	Paper PHY-405	45	Special paper practical	25
		46	Special paper practical	25
	Paper PHY-406	47	Project	25
		48	Project	25

M. Sc. Human Physiology

1st Semester: (Theory: 200 + Practical: 100)

Theory

(Total marks: 200)

Paper: PHY-101

Unit – 01
Physiological chemistry and metabolism

Module 1

Bioenergetics and biological oxidation:
First and second laws of thermodynamics, Entropy and Enthalpy, concept of free energy, Coupling of metabolic energy changes, Biological energy transfer, Group transfer Redox potentials, Aerobic oxidases, Mixed function oxidases, Anaerobic dehydrogenises including iron- suffer clusters and cytochromes, Mitrochondrial electron transport chain, its complex and their roles, Extra-mitochondrial electron transport chains; Oxydative phosphorylation – Chomiosmotic theory, Boyer's binding change model; Rodex – 100 ps; Q cycle, Mechanistic proton translocation, Substrate level phosphorylation in aerobic and anaerobic systems, ATP yield – energy converson and conservation, Ionophores in uncoupling oxidation and phosphorylation.

Module II

Enzyme Kinetics:
Kinetics versus thermodynamics; The Michaelis-Menten approach to enzyme kinetics, Lineweaver-Burk double reciprocal plots, Other linear transformations of enzyme kinetic data; Chemical mechanisms in enzyme catalysis; Competitive, noncompetitive and uncompetitive inhibition kinetics; Allosteric modulation, Sigmoid kinetics; Regulatory enzymes and their roles; Reversible covalent modification; Induction and repression; Isoenzymes and their roles in vivo; Experimental measures of enzyme activity, Separation methods in enzyme assays.

Module III

Three dimensional structures of proteins:
Primary, secondary, tertiary and quaternary structures of proteins, Bonds and interactions stabilizing the structure, Ramachandran plot, common fibrous and globular proteins, Protein aggregation and protein folding, role of molecular chaperones in protein folding ; misfolding of proteins, protein ligand binding

Protein targeting and degradation
Signal hypothesis; glycosylation of proteins at the level of endoplasmic reticulum and Golgi complex; Post-translational modification of proteins, Protein transport to lysosomes, mitochondria, peroxisomes and nucleus; eukaryotic protein transport across membranes; protein import by receptor-mediated endocytosis; protein degradation.

Module IV

Synthesis of Biomolecules:
Synthesis of amino acid from α-Ketoglutarate , phosphoglycerate , oxaloacetate and pyruvate;

cytoplasmic de novo synthesis of palmitate, microsomal desaturation and elongation of fatty acids; synthesis of arachidonate, prostaglandins, leukokotrienes, sphinglolipids, phosphoglycerides, cholesterol; synthesis of heme, informational molecules (acetyl-choline, catecholamines, GABA, serotonin, histamine)

Integrated metabolism:
Metabolism of biomolecules; Integration of carbohydrate, protein and fat metabolism, TCA cycle: Cataplerosis & Anaplerois; Vitamins as coenzymes in metabolic reactions.

Hormones in metabolic regulation:
Tissue specefic metaboliom: division of labor, hypophyseal, pancreatic, thyroidal, adrenal and parathyroidal hormones in carbohydrate, protein, lipid and mineral metabolisms, Leptin system: body mass regulation

Unit – 02
Molecular Biology

Module I

Chromosome structure and organization:
Structure and function of chromosome, story of DNA double helix, Geometry of DNA – double helical structure of DNA, B, A, and Z forms of DNA, hyperchromatism and hypochromatism, concept of euchromatin and heterochromatin, chromosomal rearrangement in health and diseases

Module II

DNA synthesis, processing and repair:
DNA polymerases, Unwinding proteins, Prokaryotic and eukaryotic replications, Reverse transcription, DNA repair excision, Reversal, recombination and SOS repairs Eukaryotic genomic organization – C value paradox, Repetitive sequences, Tandem-gene cluster, Gene amplification, coding and noncoding sequences, oncogenes

Classical Genetics:
Mendelian principles: Dominance,segregation, independent assortment; allele, multiple alleles, psudoallele, complementation tests; extension of Mendelian principles- codominance, incomplete dominance, pleiotropy, genomic imprinting, linkage, crossing over, recombination-homologous non-homologous, linkage maps, tetrad analysis, pedigree analysis, genetic disorders, structural and numerical alterations of chromosomes. Karyotyping

Module III

RNA synthesis and their processing:
RNA polymerases, eukaryotic and prokaryotic transcription, organization of transcriptional units, induction, repression and attenuation; exons, introns, post transcriptional modification (RNA processing) – cleavage and splicing, RNA editing, capping, polyanenylation, regulation of gene expression in prokaryotic and eukaryotic system

Module IV:

Genetic code, protein synthesis and their processing:
Genetic code, codon and anti codon interactions, translation in eukaryotic and prokaryotic organisms, glycosylation of protein, signal hypothesis and membrane trigger hypothesis, post translational modifications, amino acid sequencing in proteins

Mutations:
Chromosomal aberrations, Gene mutations, Inborn errors of metabolism. Types, mutant types-lethal, Conditional, biochemical, gain of function, loss of function,germinal versus somatic mutants.

Paper: PHY-102

Unit – 03
Biophysical principles in physiology:

Module I

Introduction to biophysics: Historical overview, Connections with physics, biology andmedicine.
Viscosity of liquids and gases: Use of viscometry, viscoelasticity, laminar and turbulent flow, the Reynolds' number, models for flows of liquids: Bernoulli and Poiseuille's equations and their applications
Dynamics of the cardiovascular system: Fluid mechanics - blood flow, blood pressure, hydraulic system and resistances to flow in different regions of the circulation; effects of gravity and external acceleration on circulation, haemodynamics in different phases of the cardiac cycle, heart sounds, mechanical power of heart

Module II

Mechanics in breathing: Elastic properties of lung and chest wall, static, dynamic and total lung compliance, Physical basis of lung compliance, physics of alveoli, surface tension, airway resistance, pulmonary vascular resistance, work of breathing, Dalton and Henry's laws of partial pressures in gas mixtures, gas exchange: Fick's law of diffusion, ventilation, perfusion.
Production of speech: Phonation (types, mechanism and physiology).
Physics of vision: Light and field of view, illumination of retina, eyes as an optical instrument, reduced eye, Critical fusion frequency (CFF)

Module III

Thermodynamics: Laws of thermodynamics and living organism, enthalpy, entropy, efficiency and free energy in thermodynamic system, concept of energy in biological system in the light of thermodynamics, living body as a thermodynamics system
Light and Associated Phenomena: Ultraviolet light on living system, photoreactivation, light and application in therapy, biological light (bioluminescence), light interaction with biological materials, light and pigmentary response
Effects of electromagnetic field, microwaves and gravitational fields on living systems:
Source and victims to exposures, penetration and propagation within the biological target
Organ.

Module IV

Fundamental physics of ultrasonic waves: Propagation equation, reflection and refraction at surfaces: diffraction, absorption and attenuation mechanisms, beam patterns of a transducer, piezoelectricity, ferroelectricity and magnetostriction, emission and reception of ultrasounds, ultrasound therapy, physiological effects of ultrasound therapy
Methods in biophysical analysis: Single neuron recording, brain activity recording, lesion and stimulation of brain, pharmacological testing, spectrophotometry, circular dichroism, optical rotary dispersion, fluorescence spectroscopy, Raman spectroscopy, X-ray diffraction,

Unit – 04
Biomedical Instrumentation

Module I

Bioelectric electrodes: ECG, EEG, EMG, microelectrodes.
Biomedical recorders: ECG, EEG, EMG, cardiac pacemaker, defibrillators.
Blood flow meters: Electromagnetic, ultrasonic, NMR, laser doppler

Module II

Pulmonary function analyzers: Spirometry, respiratory gas analyzers, blood pH, blood pCO2, blood pO2 analyzer.
Microscopy in biology and medicine: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy phase-Contrast microscopy; fluorescence, ultraviolet microscope

Module III

Ultrasonic imaging system: Echocardiogram, A, B, M scans and real-time B scanner. PET, MRI, fMRI, CAT
Biomedical telemetry: Wireless telemetry, single and multi-channel telemetry, transmission of physiological signal over telephone lines.
Detection of radiation: Detection and measurement of different types of radioisotopes normally used in biology; ionization chamber, G.M. counter, proportional counter, liquid scintillation counter, molecular imaging of radioactive material, safety guidelines

Module IV

Audiometers: Basic audiometer, Speech audiometers.
Haemodialysis Machine: Dialyzers, artificial kidney
Physiological transducers: Body temperature, Pulse sensors, Respiration sensors.
Basic idea about physiotherapy and electrotherapy instruments: Brief description of generation, circuit diagrams and testing. Demonstration of electrotherapy instruments, principles of their functioning, usage, and safety implications for human beings.

Paper: PHY-103

Unit – 05

Biostatistics and research methodologics

Module I

Aims and scope of statistics, classification of variables, population and samples

Frequency distribution and descriptive statistics: computation of a continuous frequency distribution and of the mean, median, percentiles, quartiles, quartile deviation, variance, coefficient of variation, absolute and relative measures of dispersion.

Sampling Statistics: standard errors, sampling distributions, degrees of freedom, probability distribution: normal, binomial, and Poisson distributions.

Module II

Testing of hypothesis: null hypothesis, levels of significance, errors of inference, one- tail and two-tail tests.
Correlation - product moment correlation, partial correlation, multiple correlations,
Regression-simple and multiple linear regressions
Correlations involving qualitative variables – biserial r, point biserial r, phi coefficient, tetrachoric r, contingency coefficient

Module III

Nonparametric statistics: Chi square tests, application of chi square in testing the normality of a distribution, G test
Kendal's rank correlation coefficient, Wilcoxon's signed rank test, Wilcoxons's composite rank test, Median test, Mann-Whitney U test

Module IV

Analysis of variance: types of anova, models of anova; multiple comparison test - t test, Scheffe's F test, Gabriel's SS-STP; Kruskal-Wallis non-parametric anova and multiple-comparison Mann-Whitney U test.
Multivariate analysis– growth and classification of multivariate technique, factor analysis; Experimental design, application of statistical method in research, formulation of research problems, art of dissertation writing

Unit – 06

Computer application in biology and bioinformatics

Module I

History and classification of computer: Importance of computer application in biological sciences, brief history of development of computer, computer generations, classification of computer – analogue, digital, hybrid, micro, mini, mainframe and super computers
Computer hardware: basic components of computer – CPU, peripheral devices, computer memory, and computer buses.
Software – Types of software- monitor program and operating system, utility program, application program, language processor, computer languages- machine language, assembly language, high-level languages

Module II

Number system and data representation – binary, octal, hexadecimal; simple binary arithmetic; representation of characters; ASCII code
Problem solving and flow charts – symbols, structure, methods of drawing of flowcharts, application in biological problems
Principle of programming in BASIC or C: simple programs for solving biological problems and statistical analysis of biological data.

Module III

Simulation and modeling of different physiological parameters - cardiovascular functioning, neural circuitry, immunological system; biochemical pathways; drug design etc

Word processor- basic operation and its application in biological sciences; Ms excel – basic operation and it application in biological sciences; Ms. PowerPoint – steps of PowerPoint presentation, slide preparation for biological items

Basic concept of email, Internet- components of Internet, www, searching biological information from Internet, library-searching technique, LAN

Module IV

Concept of bioinformatics- field of application, common biological databases,

Database management: idea about database management in bioinformatics, structure of database- PDB, NDB, PubChem, Chem Bank, basic concept of derived databases, sources of primary data and basic principles of the method for deriving the secondary data, organization of data, contents and formats of database entries.

Major Bioinformatics Resources: NCBI, EBI, ExPASy, RCSB, knowledge of various databases and bioinformatics tools available at these resources, organization of databases: data contents and formats, purpose and utility in Life Sciences , open access bibliographic resources and literature databases**:** open access bibliographic resources related to life sciences viz., PubMed, BioMed Central, Public Library of Sciences (PloS)

Paper: PHY-104

Unit – 07
Neural control system and excitable cells

Module I

Basic components of Neural control system: Sensory and motor functions, association of information's: coding of signals, central computation of signals, sensory modalities, sensory perception

Nerve: Regeneration of nerves – growth cones, nerve growth factors, axoplasmic flow and molecular mechanism of transport in axon, excitation of nerve fiber

Module II

Skeletal and cardiac muscle: Muscle proteins, properties and locations, muscular contraction – interaction of filaments in vitro and in vivo, coupling of mechanical and chemicals events at the cross bridge, muscle energetic, muscle mechanics – mechanical transients, patho-physiology of muscle contraction – muscular dystrophy, Mc-Addis diseases

Smooth muscle: Molecular structure of contractile components, types, contraction mechanism, excitation – contraction coupling, mechanical properties and energetics, innervation and transmitter actions

Module III

Spinal cord as a control system: Segmental and intersegmental interactions: myotatic reflex, inverse myotatic reflex, flexor reflex, crossed extensor reflex, propiospinal reflex, feedback regulation of spinal motor functions, role of descending tracts in regulation of muscle tone, posture and spinal reflexes, γ – loop, autogenic inhibition.

Statokinetic control system: Vestibular apparatus, constant angular motion, sinusoidal movements, linear motion, gravitational receptors, transduction of vestibular hair cells, central processing of vestibular information, vestibule ocular and vestibule-spinal circuits, regulation of posture, nystagmus

Basal ganglia as a motor control system: Neural circuits and feedback loops of basal ganglia, regulation of muscle tone and movements, control of eye movements, dysfunctions of basal ganglia – Parkinson's diseases, Huntington's diseases, athetosis, Hemiballismus

Module IV

Neuronal communication: Synapse – electrically operated and chemically operated, different type of synapses, electronic microscopic and molecular structure of synapse – pre synaptic grid, intra membranous proteins, molecular basis of quantal release of neurotransmitters – interaction of vesicular membrane proteins, pre-synaptic membrane proteins and cytosolic proteins, postsynaptic events – IS spike and SD spike, neuromodulation at synapse, integrative functions of synapse, principal neurotransmitter systems – acetylcholine, epinephrine and norepinephrine, dopamine, serotonin, glutamate, glycine, GABA, opiod peptides, purinergic transmitters, nitrioxide, neurosteroids

Neuromuscular transmission: Structure, active zone, quantal release – exocytosis, endplate potential, conductance changes, nicotonic Ach receptor, MEPP, molecular basis of Mysthenia gravis and Lambert – Zaton syndrome, Drugs acting in neuromuscular junction

Unit – 08
Integrated physiology: Homeostasis

Module I

The internal environment and homeostasis: Different internal environments, general mechanism of homeostasis

The control system: physical and physiological control system, components of control system, regulatory mechanism of control system – negative feedback, positive feedback adaptive control system, loop gain and error reduction, stability, sensors – rate and integral. Multiple sensors, set point

The Autonomic control system: Anatomic organization of sympathetic and parasympathetic system, chemical transmission in ganglia and effector organ, metabotropic and ionotropic receptors in autonomic nervous system, the autonomic nervous system in the regulation of internal environment and homeostasis

Module II

Excretory system: Methods of study of tubular functions, tubular transport mechanism and trans tubular potential, Role of Kidney in the regulation of ionic, osmotic, acid and base balance of the body fluid, control of extracellular fluid volume

Gastrointestinal systems: Neural control gastrointestinal function – bile secretion and cholesterol homeostasis., immune function of GI tract, Physiology of gastrointestinal disorders, assessment of gastric, pancreatic and intestinal functions in different patho-physiological conditions

Module III

Regulation of body temperature: interaction of different systems in body temperature regulation. Role of receptors and hypothalamic thermostat, abnormalities of body temperature regulation

Blood and body fluids: regulation of blood volume in sudden loss of blood, hemostasis and coagulation of blood. Anticlotting mechanism and anticoagulants, abnormalities of homeostasis, lymph flow, lymphatic pump, interstitial fluid pressure –regulation, interstitial fluid dynamics, edema

Module IV

Homeostasis in extreme environments: Hypobaric and hyperbaric environment, extreme hot and cold environment, Altered G – force on human body, artificial gravity, zero gravity, space travel on human body.

Homeostasis in stress: Neuroendocrine system in stress, oxygen as toxic molecule, free radicals, reactive oxygen species (ROS). Reactive nitrogen species (RNS), reactive sulfur species (RSS), Effect of free radicals on different biomolecules, cellular homeostasis against oxidative stress, antioxidant defense mechanism

1st semester

Practical

(Total marks: 100)

Paper: PHY-105

Unit – 09

Biochemical techniques

1. Preparations of buffers, physiological solutions, molecular solutions, determination of $P^{H,}$ preparation of tissue homogenate
2. Blood analysis: estimation of blood glucose: Nelson-Somogyi method, Hagedorn-Jenson method
3. Protein estimation by Lowry method UV spectroscopy.
4. Blood calcium and blood lactate estimation
5. Estimation of total cholesterol content of blood.
6. Estimation of triglyceride content of blood.
7. Total non-protein nitrogen estimation.
8. Estimation of urea, uric acid, creatine and creatinine.
9. Enzyme activity: effect of P^{H} and temperature on enzyme activity
10. Determination of Km.
11. Acid and alkaline phosphatase, bilirubin, free fatty acids, S.G.O.T and S. G. P. T (transaminases) for liver function test

Unit – 10

Bio-analytical techniques and Microbiological studies

a) Bio-analytical techniques

1. Separation and identification of amino acids by paper chromatography
2. Separation and identification of amino acids by thin-layer chromatography
3. Identification of sugars by thin-layer chromatography.
4. Electrophoresis of serum proteins.
5. Separation of protein by polyacrylamide gel electrophoresis (PAGE).
6. Separation of DNA by gel electrophoresis.

b) Microbiological studies

1.Preparation of media and cultivation of bacteria, molds, yeasts and their isolation from natural sources.

2.Microbial morphology – gram staining, acid fast staining, spore staining, staining of molds, yeast, determination of microbial dimensions.

3.Isolation of pure culture from mixes bacterial culture by streaking, spread plate, pour plate.

Paper: PHY-106

Unit – 11

Statistical treatment of biological data

1. Computation and significance of product- moment r between two continuous measurement variables.
2. Computation and significance of Kendall's rank correlation coefficient between two ordinal variables .
3. Computation and significance of partial correlation coefficient between two variables
4. Computation and significance of multiple correlation coefficient between a continuous measurement variable and two others continuous measurement variables.
5. Computation and significance of point biserial r between a continuous measurement variables and a genuinely dichotomous qualitative variable.
6. Computation and significance of biserial r between a continuous measurement variable and an artificially dichotomized variables.
7. Computation and significance of phi coefficient between two genuinely dichotomous variables
8. Computation and significance of tetrachoric r by cosine pie formula between two artificially dichotomized variables.
9. Computation and significance of contingency coefficient between two qualitative variables having more two classes.
10. Computation of percentile values from grouped data

11 Testing the goodness of fit of a continuous frequency distribution with best –fitting normal distribution by Chi square test and G test.

12. Computation and significance of one- way model I analysis of variance and multiple comparison t- test and Scheffe's F test .
13. Computation of Kruskals-Wallis test for one- way anova and multiple comparisons by Mann-Whitney U test
14. Computation of models I linear regression equation of one variable on another

Unit – 12

Computer application in biological problems

1. Basic operation of computer – different operations of WINDOWS; data entry, printing of programs and results.
2. Programming with BASIC or C for solving biological problems:
   a. Simple programs - computation of sum and mean values of some biological data.
   b. Arrangement of biological data – ascending order, descending order, highest value, lowest value
   c. Tabulation of biological data
   d. Evaluation of nutritional status- computation of calorie, BMI, BSA ; Study of growth rate
   e. Computation of frequency and percentage distribution of different Physiological parameters in different age groups, in different communities, percentage distribution of blood groups
   f. Statistical analysis of biological data – Mean, SD, SE, t-test, correlation coefficient, percentile values etc.
4. Operation of Ms Excel – tabulation of biological data, computation of different groups of data, making charts with Ms Excel - bar diagram, line diagram, pie diagram for representing biological data
5. Operation of word processor – text presentation, editing, formatting and printing. Making table

with MsWord

6. Operation of Ms Power point – making slide for any biological topic, editing, slide show
7. Bioinformatics - study of structure of biomolecules – primary and secondary structure, tools for sequence analysis

2nd semester

300 marks (Theory: 150+ Practical: 150)

Theory

Paper: PHY-201

Unit – 13

Community health: General Health and disease

Module I

Concept of Community, Health and Diseases

Community structure, definition and concept of health and diseases, dimension of health, health system, health situation in India; diseases: causation and prevention of diseases, mode of intervention, epidemic and endemic forms of diseases, physiologists as health counsellors

Population Genetics:

Basic concept of population genetics- allele and genotype frequencies, gene pool, Hardy-Weinberg law in trait inheritance, eugenics. Genetic counselling: prospective and reproductive study.

Module II

Genetic Predisposition of Diseases:

Role of genetic predisposition to common disorders: cancer, coronary heart diseases, diabetes, mental disorders, mutations in chromosome – variation caused to chromosome number and arrangement, monosomy, trisomy , polyploidy, chromosome deletion, duplication , inversion and translocations, fragile sites, genetics and evolution.

Mental Health:

Definition of mental health, characteristics of mentally healthy person, parent-child relationship and mental health, types of mental illness / causes, remedial measures for mental illness, problems of mental health in India, mental problems of old age

Module III

Vulnerable Sections in the Society and their Health Care:

Health and diseases in infant /children/girl child/old persons, women in the reproductive age, rural/tribal population, Health problems of old ages

Module IV

Control and Prevention of Communicable and Non-Communicable Diseases:

Epidemiological triad, web of causation, high - risk group, prevention of communicable diseases, prevention of non -communicable diseases, drug abuse and addiction, drug metabolism and detoxication

National Health Policy/Programme, Role of Non-Govt. and International Organisations:

National health policy, Role of WHO, UNICEF, UNDP, FAO, UNESCO, ILO, WORLD BANK, Red Cross, CARE, National health programmes, control of malaria, kala-azar, diarrhoeal disorders and endemic iodine deficiency disorders, alternate health care planning

Unit – 14

Community health: Nutrition and health

Module I

Different food groups and nutrients, dietary fibres, food additives, artificial sweeteners, food processing, food toxicity and safety

Nutraceuticals and antioxidants-Classes of nutraceuticals, Nutraceuticals to age, sex, physiological status (pregnancy), dietary supplements, probiotics and prebiotics, functional foods and its prospects.

Nutrients, Gene and Health-Transgenic foods and its importance; drug –nutrient interaction,

nutritional epigenomics, nutrient sensing - role of sensing transcription factors and dietary signaling routes, genomics and transcriptomics

Module II

Nutrition in adult: Nutritional requirement in adults.

Nutrition in infancy: Nutritional requirements of nutrients during infancy, breast feeding – nutritional and others factors, advantages, breast feeding and human immunodeficiency virus transmission, infant milk substitute (IMS) act 1992, formula feeding, vitamin and mineral supplementation – vit –D, Iron, Fluoride, supplementary foods of milk, cow's milk, goat's milk, vegetarian beverages, fruit juice, nursing caves; solid supplements wearing, nutritional requirement of pre- term babies; feeding problems – food allergies, cow's milk protein allergy, lactose intolerance, diarrhea, constipations vegetarianism

Nutrition in childhood and adolescence: Nutritional requirement of pre-school and school children, monitoring growth and development, nutrition related problems of children- childhood obesity, dental caries, allergies, deficiency of Vit-A- aetiology, symptoms, prevention. Nutritional requirement and problem of adolescents- anorexia nervosa, bubnia nervosa, binge eating disorder, premenstrual syndrome

Nutrition in pregnancy:

Physiological changes during pregnancy, maternal factors effecting pregnancy outcome: maternal age, pre-pregnant weight, weight gain during pregnancy, life style factors. Birth weight standards, Nutritional requirements during pregnancy, problems in pregnancy- morning sickness, nausea and vomiting, constipation, oedema and leg cramps, Heart burn, excessive weight gain. Complication- anemia, toxemia, Diabetes mellitus

Nutrition in lactating women:

Physiology of lactation, Nutritional requirements, Factors affecting the volume and concentration of breast milk

Module III

Nutrition related disorders:

Overweight and obesity:- prevalence, factors – environmental and life style factor, food intake, genetic factors- Prader Willi's syndrome, adipocyte factors –leptin, adiponectin, adipose drug targets for obesity treatment, obesity management- drugs, VLCDs, bariatric surgery; underweight – aetiology and management.

Protein energy malnutrition:- PEM- symptoms, nutritional requirement in dietary management

Nutritional anemia:-Prevalence, Iron metabolism, Iron absorption enhancers and inhibitors, clinical features and management of Iron deficiency anemia, megaloblastic anemia

Cardiovascular disorders-Coronary heart disease (CHD): food and nutrients in CHD, cardiovascular risk factors and nutritional management of CHD, hypertension: diet and blood pressure

Diabetes mellitus- Dietary management of diabetes mellitus – nutritional requirements, glycaemic index, complication of diabetes – hypoglycaemia and insulin shock, ketoacidosis.

Module IV

Nutrition promotion in community: causes and consequences of malnutrition in India, community based intervention programmes – Mid-day meal for school children, special nutrition programme (SNP), integrated child development services (ICDS), National Nutritional Anaemia control programmes, Vit – A prophylaxis programme, national iodine deficiency disorder control programme, public distribution system, targeted public distribution

Nutrition and aging:

Process of aging, changes in organ function with aging, nutritional requirement, nutrition related problems in old age- osteoporosis, anemia, obesity, constipation, malnutrition; antioxidants in the health of old age

Assessment of nutritional status: Diet survey, biochemical methods, anthropometric methods

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Paper: PHY-202

Unit – 15

Community health: Exercise physiology and mass fitness

Module I

Concept of fitness: role of exercise in fitness and health: prescription of exercise- frequency, duration and intensity, dose – response, general guidelines for improving fitness, maintenance of fitness- sequence of physical activities: walking, jogging, and common games and sports

Static and dynamic exercise: energy production and transfer during exercise, energy metabolism during exercise

Physical training – general principle, strength and endurance training, different methods of physical training

Module II

Nutrition and weight control: body weight and health, physiology of weight gain and loss, obesity and exercise, methods of weight control, long-term concept of weight control.

Exercise and aging: aging and muscular strength, aging and joint flexibility, aging and physical work capacity, aging and exercise training, free radical in exercise and training

Module III

Clinical aspects of exercise physiology:

Exercise physiology in prevention and rehabilitation of cardiovascular diseases: physiological bases for using exercise in CHD prevention, exercise tests for assessment of cardiovascular dysfunctions, exercise induced indicators of coronary heart diseases, principle of exercise testing in cardiac rehabilitation, exercise prescription of cardiac patients, weight training for cardiac rehabilitation

exercise prescription for pulmonary diseases, neuromuscular diseases, and renal disorders.

exercise for diabetic patients, exercise prescription for pregnancy, effect of exercise on cancer

Module IV

Environment and exercise: exercise in cold - physiological responses to exercise in cold, health risks during exercise in cold, effect of cold on human performance, exercise in hot environment- physiological responses to exercise in heat, health risks during exercise in heat,

Exercise in high altitude- aerobic performance at high altitude, training for competition at high altitude.

Exercise for the disabled- physically and mentally challenged

yogic exercise and fitness: physiology of yogic exercise, therapeutic use of yoga

Unit – 16
Community health: Ergonomics and Occupational health

Module I

Ergonomics - definition, early history, aim and application in different fields. Social significance of ergonomics
System ergonomics, system classification, man –machine-environment interface, goal of safety, goal of productivity , factors of system design
Human information processing and performance - Human information processing model, coding and cognition, role of short term and long term memory, cognitive system, cognitive model of human operator.

Module II

Anthropometry – Static and dynamic anthropometry, instrument for anthropometry, method of anthropometric data collection, data analysis; uses of anthropometry – assessment of nutritional status, application for ergonomic design
Body composition- different methods of assessing body composition, body composition and performance
Manual material handling – health problems, risk factors, guidelines of material handling

Module III

Occupational Health – definition, factors affecting occupational health, occupational health hazards in work place – mechanical , chemical, biological, fire, toxic substances, and explosive materials , environmental hazards – heat stress, cold stress, noise, vibration, ultra-violet radiation.
Occupational safety and health – concept of health and safety; accidents – theories of accident, effect on industry; method of assessment of accidents, promotion of safety, health and safety training , personal protective devices .

Module IV

Occupational diseases – Pneumoconiosis, silicosis, asbestosis, bagasosis, byssinosis, anthrocosis, occupational cancer – skin, lungs, urinary bladder, blood, occupational health problem of agricultural workers
Prevention and health measures of occupational hazards – nutrition, disease control, environmental sanitation, medical measures, ergonomic measures, legislation
Occupational stress – causes, evaluation of stress, management of stress

Paper: PHY-203

Unit – 17
Community health: Man and environment

Module I

Concept and types of environment- physical environment; biotic environment; biotic and abiotic interactions, urban, rural and industrial environment
Ecosystem – structure and function, different types of ecosystem, food chains, food webs and energy flow and mineral cycling in ecosystems; primary production and decomposition, biogeochemical cycle

Pollutants, Environmental Change and health
Major pollutants and their effect, changing environment, global climate change – ozone layer depletion, the green house effect, global warming and its consequences, the changing disease pattern, different environmental diseases-cancer, birth defects, reproductive damage, respiratory diseases, heavy metal induced diseases etc

Module II

Air Pollution
Major atmospheric regions and their characteristics, air pollutants - sulfur oxides, nitrogen oxides, carbonmonoxide, particulate matter, volatile carbon compounds (PAH etc.) - their effects, control and prevention, air quality criteria, standards.
Water pollution
Water resources and major water compartments, different sources of water pollution including municipal, agricultural, industrial, radioactive effluents, ground water pollution, marine oil pollution, thermal pollution, metallic pollutants - mercury, lead, cadmium, arsenic and fluoride toxicity; chelating agents and their characteristics, use of chelator to control metal pollution, eutrophication, waste water or sewage treatment, water quality criteria, standards, safe drinking water; wetland and its importance

Module III

Radionuclide and ultrasonic pollution
Types of ionizing radiation, radionuclide; radiation dosimetry; biological effects of ionizing radiation radionuclide metabolism; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, radiation safety, ultrasonic pollution and its effects
Soil pollution
Soil pollution by biological agents, mycotoxins, xenobiotic mechanisms of pesticides and fertilizers in soil, heavy metal stress on soil organisms

Module IV

Pesticide pollution
Hazards produced by organochlorine, organophosphate, carbamate, nicotinoid, pyrethroid pesticides and other biocides, pesticide residues in food and drinking water and their biological monitoring
Waste disposal
Human excreta disposal; solid waste disposal- hazards and protection; hospital and biomedical wastes – hazards and protection, recycling of waste, radioactive waste, electronic waste and techno trash hazards and protection

Unit – 18
Community health: Environmental management and toxicology

Module I

Environment management Concepts and Environmental issues
The concept of sustainable development, environmental protection programs, Stockholm conference, UNEP, Rio de Janeiro earth Summit, UN follow-up etc, environmental Governance in India, WTO, GATS, environmental concerns and WTO
Endangered species management and conservation of biodiversity
Biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches, principles of conservation; major approaches towards conservation; Indian case studies on conservation

Module II

Conventional and sustainable (non-convention) energy

Conventional energy sources; sustainable energy sources: solar energy, biomass, hydropower, wind energy, geothermal energy, tidal and wave energy, ocean thermal electric conversion (OTEC)

Biotechnology and Environment

Role of biotechnology in pollution control; biotechnology in forestry and waste land development

Module III

Environmental toxicology-I

Toxicokinetics and toxicodynamics – toxic kinetic factors as basic mechanisms of toxicity, toxic dynamic factors as basic mechanism of toxicity; design of toxicity study; biotransformation and bioactivation / bioinactivation of xenobiotics; factor affecting xenobiotic action

Module IV

Environmental toxicology-II

Effects of toxicants on mammalian organisms; xenobiotic-induced oxidative stress, hepatotoxicity, reproductive toxicity, nephrotoxicity, neurotoxicity, genotoxiciy, immunotoxicity, endocrine disruption;
environmental risk assessment and assessment of risk to humans, risk management, biomonitoring- use of biomarkers, biosensors

2nd semester

Practical

Paper: PHY-204

Unit – 19
Anthropometry and Community health survey

Anthropometric measurements:

1. Body weight
2. **Measurement of height** – stature, eye height, sub-nasal height , gnathion height, suprasternal height, porion height , acromion height , naval height, iliac crest height, knee height, ankle height ,infrascapular height, elbow height
3. **Measurement of diameter** – biacromion diameter, bicristal diameter, transverse diameter of the chest, antero-poterior diameter of the chest, hip breadth
4. **Measurement of girth**- neck, upper arm , forearm, chest, waist, hip, thigh, calf, upper body, lower body
5. **Measurement of sitting height**- vertex height , eye height, shoulder height, stomion height, elbow rest height, popliteal height, knee height, thigh clearance height
6. **Measurement of head** – head length, head breadth, head circumference,
7. **Measurement of hand**- hand length, hand breadth, maximum hand breadth, fist girth
8. **Measurement of foot**- foot length, foot breadth, ankle diameter

Community health survey

Students shall have to participate in the field studies to evaluate different parameters related to health status of the community and have to submit a field survey report during practical examination properly endorsed by a teacher. The students shall be divided in to some small groups (3 to 4) and a field work of each group will be supervised by a separate teacher. The field survey may be done in the following fields.

1. Cardio-vascular status of the community.

2. Nutritional status of the community.
3. Anthropometrics survey.
4. Prevalence of different disease.
5. Health awareness levels of the community and immunization.
6. Evaluation of awareness and implication of family planning programs.
7. Evaluation of problems and awareness of environmental pollutants.
8. Survey work reproductive health at rural areas.
9. Survey work on mother- child – health care at rural areas.
10. Occupational health.

Unit 20:
Human experiments

1. Determination of diurnal variations of pulse rate, blood pressure, respiratory rate.
2. Study of pulse rate and breathing rate with the change of postures.
3. Study of blood pressure with the change of postures.
4. Study of pulse rate as an effect of breath-holding.
5. Study of pulse rate with the variation of static work load.
6. Study of blood pressure with the variation of static work load.
7. Study of pulse rate as an effect of dynamic exercise.
8. Study of blood pressure as an effect of dynamic exercise.
9. Determination of Galvanic skin response (GSR)
10. Determination of visual acuity.
11. Determination of visual field by the perimeter.
12. Brightness discrimination test

Paper: PHY-205

Unit – 21

Growth monitoring and nutritional assessment

1. Assessment of nutritional status of infant (birth to 36 month) from the standard growth curve and determination of stage of malnutrition.
2. Growth monitoring and nutritional assessment: assessment of nutritional status of boys and girls of different ages of a community (2 to 20 years) from standard stature for age, and weight for age curves.
3. Assessment of nutritional status from MUAC, head circumference, skin fold (triceps and sub scapular) in infancy, pre–school and school children.
4. Determination of outset of puberty from the velocity growth curve of stature of school children.
5. Assessment of nutritional status of boys and girls from the standard body mass index-for age curves.
6. Determination of grades of malnutrition of children by Gomez classification and waterloos classification.
7. Determination of grades of malnutrition by percentile value and Z – score of height, weight of children using standard data.
8. Assessment of nutritional status from height–vs–weight of adult male and female.
9. Assessment of nutritional status of adult male and female from triceps and sub scapular skin folds.
10. Assessment of nutritional status from measurement of food intake by 24 – hour recall method and food frequency questionnaire method.
11. Assessment of nutritional status from anthropometric measures and anthropometric indices such as BMI, Body surface area, ponderal index, Dugdel nutritional index, Waist- Hip ratio, obesity index

Unit – 22

Assessment Environmental status

1) **Environmental Study**

(a) Measurement of illumination level, sound level in different environmental conditions.
(b) Measurement of relative humidity, moisture content of the environment; assessment of thermal conditions.

2) **Measurement of' chemical Environment**

a. Estimation of total hardness of water.
b. Estimation of heavy metals like Pb, Hg in water by spectrophotometer method.
c. Estimation of selenium, Cadmium, Chromium, Arsenic, Fluoride, Copper and iron in water sample.
d. Estimation of silica in water sample.
e. Measurement of BOD and COD in water sample.
f. Measurement of particulate pollutant in air of a specific area.

3) **Effect of pollutants /toxicants on biological systems**

a. Determination of LD_{50}
b. Determination of parameters of oxidative stress – Malon-di-aldehyde, GSH, GSSG, Catalase, Peroxidase, Superoxide dismutase.

Paper: PHY-206

Unit – 23

Studies with cardiac muscles:

1. Perfusion of amphibian heart with Ringer solution, Studies on the heart rate and amplitude of contraction a) in normal Ringer solution b) in Ca^{++} free Ringer solution, c) in K^{++} free ringer solution.
2. Effect of gradient pressure on the perfused heart of amphibian.
3. Study on the heart rate and amplitude of contraction a) with excess amount of Ca^{++} and b) K^{++} on the amphibian perfused heart.
4 Effect of a) acetylcholine, b) adrenaline on the heart rate, amplitude of contraction in perfused amphibian heart in dose dependent manner.
5 Effect of stimulation of Vagus nerve on the perfused amphibian heart and the effect of atropine during stimulation.

Unit – 24

Studies with skeletal and smooth muscle and bioassay:

1. Preparation of physiological solutions like Dale, Locke, Normal saline etc.
2. Experiments on isolated skeletal muscle (Isometric contraction):
a) Effect of load, temperature b) summation and tetanus e) Effect of Acetylcholine
3. Experiments on isolated intestine of rat.
a)Normal movement of isolated intestine b) Effect of hypoxia
c) effect of drugs like substances: i) Acetylcholine ii) Adrenaline iii) 5, hydroxy-tryptamine.
4. Experiments on isolated uterus of rat: effects of drugs like Oxytocin
5. Bioassay: Preparation of standard curves for acetylcholine through bioassay
6. Estimation of nature and potency of unknown drug by using reference standard and blocker.
7. Bioassay of catecholamines

8. Estimation of the potency of the unknown sample (Oxytocin) on rat uterus muscle by using reference standard.

3rd semester

300 marks (Theory: 200+ Practical: 100)

Theory

Paper: PHY-301

Unit – 25

Electrophysiology

Module I

Overview of electrophysiology – different electrical signals in human body, potential of nerve – resting membrane potential –ionic basis, passive and active transport mechanism, pump mechanism , electrognic nature of odium pump, Nernst equation, Hodgekin- Huxley model, Goldman equation

Module II

Action potential- ionic basis, ion channels – molecular structure, gating kinetics and physio-pharmacology, voltage clamp studies, patch clamp method, biphasic and compound action potential, propagation of nerve impulse

Receptor potential- general transduction mechanism, stimulus–receptor relationship, adaptation of receptors, mechano-transduction and adaptation in paccinian corpuscle

Module III

Electrophysiology of heart: Cardiac action potential – ionic basis, pacemaker potential, Electrocardiogram (ECG), ECG lead configuration, source of ECG voltage - dipole theory, electrical axis of heart, vector analysis of ECG , vectorcardiogram,

Changes of ECG potential in different cardiac abnormalities- myocardial ischemia and infraction, hypertrophy, different types of arrhythmias

Module IV

Brain Potentials: Electroencephalogram (EEG), source and mechanism of formation of rhythmic pattern of EEG, characteristics of EEG waves, EEG pattern changes in sleep, clinical application of EEG, event related potential (evoked potential)- types, characteristics and significance

Electromyogram (EMG) –generation of muscle action potential, Motor unit potential, physiological significance and analysis of EMG, clinical application of EMG

Unit – 26

Sensory Physiology

Module I

The Sensory system: sensation and perception, sensory receptor, coding of sensory modality, intensity, localization of sensation, central processing of somatic sensation – spinal cord, thalamus cerebral cortex

Somatosensory areas of cerebral cortex- topographic organization, columnar organization, effect of lesion of primary somatosensory area, pain – CNS in modulation of pain

Module II

The visual system: ultrastructure of retina, retinal neural circuitry, photoreceptor potential – genesis of potential in light and dark phase, recording of potential, molecular mechanism of phototransduction process, electroretinogram (ERG) – characteristics, physiological and clinical significance.
Visual pathway, primary visual cortex – topographic map, organization of infruts; effect of striate cortex lesions in primated spatio temporal organization of retinal and other visual neurons; chromatic properties of retinal, LGB and striatal cortical neurons, binocular and stereoscopic perception

Module III

The Auditory system: ultra structure of cochlea, organ of Corti, central auditory pathway, descending auditory pathway, the primary and secondary auditory cortical areas, resting and stimulus related potentials – endocochlear potential, cochlear microphone potential, summating potential, auditory nerve potential
Sound transmission in auditory system; functions of auditory system – frequency analysis of sound by cochlea and central auditory pathway, intensity coding of auditory system, perception of sound in space

Module IV

Taste system: receptor organs – distribution, ultramicroscopic structure and innervations, taste qualities, taste receptor potential – molecular mechanism of transduction, taste pathway, sensory processing, abnormalities of taste
Olfactory system: Structure of olfactory receptor, olfactory receptor potential – characteristics and molecular mechanism of transduction, elctro-olfactogram, olfactory pathways – olfactory bulb, central olfactory connections, coding of olfactory information, anosmia and dysosmia

Paper: PHY-302

Unit – 27
Microbe Human Interaction

Module I

Historical Developments in Microbiology
Brief history of infectious diseases, developments preceding the germ theory, the germ theory of disease, chemo-therapy, molecular biology and immunization
Classification of Micro organisms
The cell types, classification of micro organisms, major groups of micro organisms, anatomy and physiology of major groups of micro organisms: fungi, algae, bacteria, virus, protozoa.

Module II

Growth and Nutritional Requirements of Bacteria
Growth curve, environmental influences on growth, nutritional requirements of bacteria, culture media, steriliza-tion, identification of bacteria, recent laboratory innovations, counting of bacterial cells
Study of some important genus of bacteria of medical importance:
Staphylococci, Streptococci, Clostridia, Neisseria, Mycobacteria, Salmonella , Vibrio, Shigella.

Module III

Scopes of Microbiology: Microbes in the environment: soil and aquatic microbes, micro organisms in dairy products, micro organisms in food, industrial uses of microbial by-products, micro organisms as biological tools

Chemotherapeutic Agents: Characteristics of chemotherapeutic agents, synthetic agents, antibiotics, antifungal agents, antiviral agents, microbial resistance, treatment and complications

Module IV

Study of Some Important Groups of Viruses: Herpes viruses. Hepatitis viruses, orthomyxovimses, paramyxoviriises, picornaviruses, Retroviruses: HIV and AIDS.

Study of Some Important Groups of Protozoa: General characteristics, the traditional groups of 'protozoa: sarwodina, ciliophnra, mastigophora, sporozoa, some common protozoa mediated diseases: amebiosis, giardiasis, trypanosomiasis, Leishmaniasis, malaria

Unit - 28
Human immune system

Module I

Cells and organs of immune system -

Historical background of immunology, elements of immunity – innate, acquired; interrelation between innate and adaptive immunity; organization of lymphoid organs, immunogens and antigens

Module II

Humoral and cell mediate immunity -

Immunoglobulin structure, classes of immunoglobulin: IgA, IgG, IgD, IgM, Ig, biological properties of immunoglobulin; triggering of the immune response, humoral immunity, adaptive immunity; cell cooperation for triggering T and B cells; iImmunosupression, complement system – alternate, classical and Lectin pathways

Module III

Immunological regulation and disorders, Structure and function of MHC – I and MHC –II, Cytokines, Hypersensitivity, Rejection of grafts, Autoimmunity and immunological disorders.

Module IV

Immunological methods/techniques -

Antigen-antibody reactions, precipitation and agglutination reaction, titre, ouchterlony double diffusion (ODD), single radial immune diffusion (SRID), ELISA, immunoflurescence, monoclonal antibody

Paper: PHY-303

Unit – 29
Systems physiology

Module I

System as a basic unit in physiology: different systems in physiological process, interaction of different systems in normal and stress conditions, principles of system theory as applied in physiology: Orientation to system approach – characterization and prediction of problems, synthesis and analysis, system

characterization, special features of linear systems, time variance and non-linearity, representation of non – linearity to linear equation, representation of chaos.
The cardiovascular control system – spinal cord, medulla, hypothalamus and cerebral cortical areas in the cardiovascular regulation, cardiovascular reflexes baroreceptor, cardiac stretch receptors – ventricular stretch receptors, chemoreceptors

Module II

Cardiac Physiology; Evolution of heart in relation to the development of other systems; Regulation of cardiac function; Cardiac Output – regulation in normal and abnormal conditions, importance of arterial pressure and systemic filling pressure, left ventricular versus right ventricular output, cardiac output curve, venous return curve, ; Cardiac failure – causes, unilateral and bilateral, acute and chronic, circulation dynamics in cardiac failure, cardiac reserve, Mechanics of cardiac valves

Module III

Circulatory system: a) The microcirculation – functional; properties of capillaries, transcapillary exchange, capillary filtration flow- and diffusion-limited transport from capillaries. Vasoactive role of the capillary endothelium. c) The peripheral circulation and its control - vascular smooth muscle, basal vessel tone and myogenic regulation. d) Extrinsic control of peripheral blood flow – sympathetic vasoconstrictor nerves on resistance and capacitance vessels vasodilator nerves, humoral factors – metabolic, hormonal, vasoactive substance. e) regional circulation: cerebral, coronary circulation in health and disease; regulation of circulation in special situation: hemorrhage, exercise.

Module IV

Respiratory system: a) cells of airways and alveoli – ciliated cells, cells for mucous production, alveolar cells, surfactant. c) Control of respiration – respiratory centers, origin of respiratory rhythm, central and peripheral chemoreceptors, chemical control of breathing, breath holding. d) Non-respiratory functions of the lung- The lung as a secondary lymphoid tissue, adaptive immune response, filtration, detoxification of foreign substances, processing of hormone and vasoactive substances. e) Respiration in neonates and children- the lung before birth, events at birth, neonatal lung function, development lung function in childhood. f) Some respiratory problems- Pulmonary oedema-aetiology and mechanism of pulmonary oedema, pulmonary collapse and atelectosis, pulmonary embolism, respiratory distress syndrome, sudden infant death.

Unit – 30
Higher functions of brain

Module I

Higher functions of cerebrum: Association cortex, Habituation and sensitization, conditioning and learning –classical conditioning, conditioning variables, exters – interoceptive conditioning, classical conditioning techniques, Instrumental conditioning – operant conditioning, Intracranial self stimulation behavior, discriminations learning, maze learning
Memory – short term and long term memory, declarative and non-declarative memory, neuroanatomy of memory, cellular and molecular basis of memory, amnesia, Korsakoff's syndrome

Module II

Hypothalamic control of biorhythm: Characteristics of circadian clock- zeitgebers, free running clock, Entrainment–criteria for entrainment, masking mechanism of entrainment, Structural elements of oscillatory physiological system- pacemaker, multiple pacemaker

Neural basis of circadian rhythm- Suprachiasmatic nucleus- cytoarchitecture, electrophysiology, pharmacology, metabolism, Molecular basis of circadian rhythm, alterations in environmental time – Jet lags

Neural control of sleep – wake cycle, genesis of REM – NREM cycle, sleep – active and passive process, sleep substances. REM sleep – tonic and phasic components, neural and biochemical basis, sleep–awake cycle, sleep disorders

Module III

Special Environment of central nervous system: CSF as hydraulic shock absorber, mechanism of **secretion** and absorption of CSF, blood–brain barrier – cellular and muscular basis, Neuroglia in the regulation of internal environment of CNS

Brain chemistry and behaviour: Role of aminergic systems, acetylcholine, opoid peptides on brain functions

Limbic system control on emotion and behavior: Neural circuit of limbic system, Papez circuit, fear and rage, Kluver – Bucy syndrome, Septal rage, Uncinate fits

Module IV

Regulatory functions of cerebellum: Cerebellar cortical neural circuitry, feed back regulation of deep cerebellar nuclei, somatotopical organization of cerebellar cortex, function of vestibular cerebellum. Cerebellar control on muscle tone – α–γ switch, role of cerebellum on voluntary of movements, motor and extra motor predictive functions, cerebellar lesions – deficits in movements

Brainstem reticular formation as a system of muscle tone: Anatomy and connections of brainstem reticular formation, decerebrate rigidity

Motor functions of central cortex: Primary motor cortex, somatotopical organization, coding of movements, motor cortex lesion, premotor cortex, motor functions of other cortical area

Paper: PHY-304
(Special papers)

Special paper A: Microbiology and Immunology

Unit 31
Advanced Studies in Microbiology

Module I

Microbial Ecology

Microorganisms in nature, methods in microbial ecology, the carbon, nitrogen, sulphur and iron cycles, .leaching of ore, heavy metal transformation, biodegradation of petroleum and xenobiotics, microbial interaction in nature: Biofilm, Bioremediation.

Module II

Host-Microorganism interactions

Host parasite relationship, normal microbial flora of humans, transmission of microorganisms, microbial pathogenecity and virulence, determining etiology and host factors

Module III

Microbial Metabolism
Metabolic diversity - anoxygenic and oxygenic photosynthesis, chemolithotrophy, hydrogen and sulphate reduction, fermentations, fermentative diversity, hexose, pentose, polysaccharide and lipid utilization, hydrocarbon transformation

Autotrophic-CO_2 Fixation
The Calvin cycle, reverse citric acid and hydroxy - propionate cycle, the C3 and C4 cycles

Module IV

Nitrogen Fixation
Nitrogen fixing bacteria, the nitrogenase system, genetics and regulation of nitrogen fixation

Unit 32
Cellular and Molecular Immunology:

Module I

B-cell and T-cell structure and function:
Structure of B cell, B-cell-co receptor complex, B cell development, maturation and activation/ signal transduction, immunoglobin superfamily, T-cell structure, coreceptor-CD3, accessory membrane molecules-CD4 & CD8, T-cell development and maturation, immunological synapse, T-cell activation / signal transduction, the co-stimulatory signals.

Module II

Antigen Processing – Presentation and MHC molecule –
Cytosolic and endocytic pathway, structure and function of class I and II molecules, polymorphism, HLA typing.

Module III

Immunological Tolerance and Apoptosis (Programmed cell death): Immunological basis of graft rejection, immunosuppressive therapy, T cell anergy, apoptosis- overview, death receptors, role of mitochondria, caspase and Bcl-2 protein families, apoptosis and Alzheimer's disease.

Module IV

Antibody diversity and cytokines in immune regulation –
Genetic rearrangement, generation of antibody diversity, class switching, Cytokine and cytokine receptor families, mechanism of cell activation, monokines, lymphokines, chemokines, interleukins, cytokine-agonists, and cytokine related diseases.

Special Paper B: Ergonomics and Sports physiology

Unit 31:
General Sports Physiology
Module I

Historical development of sports science- International and Indian context

Role of neuromuscular system in exercise, mechanics of muscle contraction, relationship of different types of muscle fibers with different sports activities, fuel for exercising muscle: metabolism and hormonal Control
Muscle strength and endurance – their role in sports activities.
Bioenergetics of exercise- source and supply of energy for different types of sports

Module II

Cardio-respiratory changes during sports performance as well as during static and dynamic work.
Maximal aerobic capacity - direct and indirect methods of measurements, measurement of VO_2 max during pregnancy; anaerobic capacity - threshold points- factors influencing them and their significance in different sports, improving anaerobic capacity
Fatigue - physical and mental, measurements of fatigue, short term and long term fatigue

Module III

Lung function tests, physical fitness tests, methods for evaluation of strength, power, flexibility, endurance, work capacity, agility, and balance.
Nutrition and sports performance; roles of carbohydrate , protein, and fat during different sport events, glycogen loading, vitamins and minerals in exercise, fluid requirements in exercise, fluid replacement in 3endurence sports, diets for different sports events, pre-game meal, spacing of meals

Module IV

Endocrine system and exercise- importance of hormones in exercise and sports, endocrine effects on performance, pituitary- adrenocortical axis and stress theory, oxidative stress and its management, hormonal regulation of cellular hydration, endocrine regulation of plasma volume, exercise influence on the biological clock mechanism
Immunological system and exercise: exercise and innate and humoral immunity, exercise induced change in Ig and antibody, exercise and cytokines
Genetics and Performance : Life span and gender variability, muscular strength and endurance, motor performance, modeling twin and familial resemblance, responses to training, exercise and gene expression

Unit 32
Applied Sports Physiology

Module I

Body composition- methods and assessments, importance in sports performance, desired body weight in different sports, somatotyping -method of assessment, somatotype and sport performance, desirable body types for high level performance, sport selection and somatotype, somatotype modification
Physical conditioning: importance, principle and methods of physical conditioning, aerobic and anaerobic training, adaptation to aerobic and anaerobic training, resistance training, strength, stability training, and high-intensity interval training (HIT), strength training, farklet training, periodization of conditioning program, over training.
Selection of sportsman: guidelines for competitive sports, scope and involvement of tribal population in participation of different sports activities.

Module II

Ergogenic aids in sports (doping): methods of study, tolerance limits, types of doping, problems of doping, IOC guidelines.
Sports injury and treatment: general causes, sports specific injuries, methods of treatments, protective equipments.
Age and sex differences in sports performance: Women in athletics and sports, the female athlete triad, menstruation and other related factors, exercise and pregnancy

Module III

Altitude training: effect of altitude on sports performance –adaptation to altitude detraining.
Sports for disabled persons, importance, selection of event, method of training
Psychological fitness of general population mass, psychological factors, personality and motivation in sports, arousal, anxiety, and sport performance
Physiology of yoga and its therapeutic application

Module IV

Exercise and sports biomechanics: basic concepts of kinematics and kinetics – vectors, motion, degrees of freedom, force, moment of force, equilibrium, biomechanical considerations in reducing sporting injury rates
Posture: static and dynamic posture, postural diversity within individuals, posture and its relationship to somatotype posture assessment , desirable postures for high level sport performance, modifying posture and technique to improve performance
Image analysis in sports performance: errors in motion analysis, planar video analysis, 3D motion analysis , data filtering

Special paper C: Endocrinology, Reproductive Physiology and Family welfare

Unit 31

Endocrinology

Module-I

Principles of endocrinology
Role of hormones for maintenance of the internal environment , classical and non classical endocrinology , hormone target relationships hormone transport in blood, carrier proteins transport through barriers, genetic control of hormone functions, target cell adaptation and rebound effect, elimination of the signal
Genetic control of hormone formation:
Basic steps in the expression of a protein hormone encoding gene signal hypothesis, cellular processing of prohormones, structure of gene encoding a polypeptide hormone with special reference to exon and intron, regulation of gene expression for protein hormone, generation of biologic diversification

Module-II

Measurement of hormones
Bioassay in general, immunoassay – different types, ELISA-basic steps, antibody coating, enzyme –hormone conjugate preparation, programming for assay in ELISA reader, assay protocol, advantages of ELISA over RIA, RIA- antibody and double antibody preparation, radiolabelling of hormone, assay protocol; Immunometric assay (IRMA) and immunochemiluminometric (ICMA), assay validation, intra assay and inter assay variation, cross reaction
Hormone Receptor

Models of hormone receptors- fixed model and mobile model receptor –their location; different pathways with special reference to growth factor signaling pathway, Cytokine activated JAK/STAT signaling pathways

Prostate as an endocrine gland: General structure, different bioactive molecules of prostate having endocrine function, role of prostatic biomolecules on different physiological systems.

Module-III

Thymus as endocrine gland: General history of thymus, bioactive molecules of thymus, role of thymic hormones –thymosin a.b_4,THF-g_2.thymopoietin-their role on different physiological system.

Molecular basis of Endocrinopathy

Immune-endocrine system: Recent development of the interaction of immuno and endocrine system, influence of immune system on endocrine activities, influence of endocrine hormones on immune system

Module-IV

Hormone and apoptosis: General idea about apoptosis, difference between apoptosis and necrosis, hormonal aspect of apoptosis in physiological system including germ cell apoptosis, lymphoid apoptosis.

Hormone and cancer : Normal cell cycle in cancerous state, molecular endocrine tumor biology, multiple endocrine neoplasia, molecular pathogenesis in pancreatic and gut endocrine tumors, endocrine-responsive cancer, hormonal approach in the treatment of cancer.

Unit – 32
Reproductive Physiology

Module-1

Makers for assessment of male and female, reproductive system:

Gonadal cholesterols , gonadal ascorbic acid, gonadal acid and alkaline phosphates activities, gonadal steroidgenic key enzymes activities, sperm motility

Gametogenesis

Spermatogenil: cycle and its hormonal control , Follicu:ogenic and hormonal contro l- endocrine and paracrinc regulation, first and second meiotic arrest and its withdrawal mechanism for oocyte development, leuteinizaticin and leuteolysis

Module-II

Gonadal Steroidogenesis

Autocrine, paracrine and endocrine regulation of gonadal steroidogenesis, regulation of expression of genes encoding steroidogenic enzymes

Molecular aspect of Sex Differentiation

Location of SRY -gene and its critical period of expression, specific cell type engaged in SRY - gene expression, downstream genes regulation by SRY - gene like AMH gene, arometase gene. AR-gene, 5a-reduc-tase gene, Sox -9 gene and Z-gene

Module-III

Stress and Reproduction : Stress and pituitary gonadotropin, stress and cytokines, oxidative stress and reproductive activities

Reproductive Immunology: in male and in female

Module-IV

Assisted Reproduction Technology (ART)
Difference between infertility and sterility, social causes of infertility, infertility assessment in male and female, role of ART in infertility management, intrauterine insemination (IUI), intracytoplasmic sperm injection (ICSI), invitro fertilization (IVF), super ovulation technique, subzonal insemination, gamete intrafallopian transfer (GIFT), Oocyte and embryo culture, oocyte and pre embryo classification , micro manipulation of humans gametes, zygote and embryo.

Special paper D: Neurophysiology

Unit-31
Physiology neuron and evolution of brain

Module I
Neuroscience: past, present and future: history and development of new science, perspective of neuroscience – scope boundaries and present trends
Evolution of human brain and its development: phylogenetic development of nervous system from invertebrate to mammals.
Development of human brain: embryological development of human brain, genesis of cerebral cortex.

Module II

Neuron: morphological and organization of neuron, axonal transport, myelin and myelinogenesis, evolution of human brain.
Neuroglial cells: type, structure and physiological properties of neuroglial cell membranes, function of neuroglial cells, effect of neuronal activity of glial cells
Excitation and electrical properties of nerve fibers: origin of membrane potential, electronic potential, action potential- voltage clamp and patch clamp analysis, voltage gated channels, conduction of impulses.

Module III

Synaptic transmission: chemical and electrical synapses, morphology and molecular organization of synapses, the neuron as a secretary cell synthesis perikaryon, transport along axon, exocytosis and endocytosis at the synaptic terminal, molecular basis neurotransmitter release in the synaptic cleft, post synaptic events, initiation of impulse.
Neurotransmitter and Neuromodulator: criteria for neurotransmitter, acetylcholine, GABA, glycine, serotonin, catecholamine, purine, peptides, nitric oxide, Neuromodulators and their functions.

Module IV

Ionotropic and metabotropic receptors: Ionotropic receptors- nicotinic acetylcholine receptor, GABAreceptor, glycine receptor, purino receptor- AMPA, KA, NMDA, tACPD. Metabotropic receptors: GABA, mAchR, adrenergic receptors, Neurokinin A receptors, pharmacology of neurotransmitter- agonist and antagonists
Subsynaptic cell: Subsynaptic density, electrophysiology of Subsynaptic membrane- EPSP, IPSP, IS AND SD spike, second messenger control, second messenger and gene expression, the pinealocyte.
Plasticity of brain: Plasticity of normal adult brain- reorganization in human cortex, cortical maps and experience, morphological changes, synaptic plasticity.

Unit – 32

Development of brain and molecular neurobiology

Module I

Sensory transduction: Chemoreceptors, photoreceptor and mechanoreceptor, contractile mechanism of muscle and neuromuscular junction, molecular mechanism of conteraction in skeletal, visceral and cardiac muscle, Neuromuscular transmission in different types of muscle, EPP, MEPP. Pharmacology of N-M transmission.

Module II

Genetics if brain: Establishing AP axis in drosophila and vertebrate CNS, homeobox gene and early development of brain, POU genes neuronal differentiation, other genes in neuronal differentiation,
Epigenetics of the brain: the origin of neuron and gila, morphogenesis of neurons, growth cones, pathfiniding and neurotrophins, CAMs, morphopoietic field, functional sculpting.

Module III

Neurochemical Neoroanatomy : Neural pathway carrying glutamate, glycine, GAVA, acetylcholine, dopamine, norepinephine, serotonin, endorphine, tachykinin, NO, CO, distribution of the receptors of these neurotransmitter.
Circulation of brain and Blood brain barrier

Module IV

Automatic Nervous System: Anatomy of ANS, functions of ANS, evolution of ANS- heart rate and BP responses to deep breathing, standing, passive heap-up lilt, valsalva maneuver, disautonomia
Molecular Neurobiology Techniques: Restriction map, genomic gene library, cDNA gene library, fishing of gene in cDNA library, PCR,RT-PCR, site directed mutagenesis, gene targeting and knockout genetics

3rd semester
Practical

Paper: PHY-305

Unit – 33
Histological and cytological techniques

1. **Histological experiments:** Fixation, dehydration, embedding and preparation of sections (paraffin, collodion or cold): micrometry, photometry; staining.
2. **Staining of smear for cytological evaluation**: Papanicolaou staining, Cresyl violet staining.
3. **Study of estrous cycle by different staining techniques**: special and differential staining.
4. **Vital and supravital staining**: platelet count, erythrocyte count, must cell.
5. **Histipathology :** Effect of toxicity on the different organ histology

Unit – 34

Histochemical and histometric techniques

1. **Histochemistry of carbohydrates:**
   a) Detection of glycogen in liver by Best Carmine method
   b) Detection of glycogen using PAS method of Hotchkkin.
   c) Detection of glycogen using Lugol's iodine test

2. Histochemistry of proteins:
   a) Histochemical localization of proteins in the animal tissues using Mercury – Bromophenol Blue method
   b) Histochemical detection of proteins in animal tissues using Baker's method
   c) Histochemistry of liplds :

3. Histochemical detection of lipids in animal tissues using Blue method.
   a) Detection of lipids in animal tissues using Oil Red O method.
   b) Detection of lipids in the animal tissues using Acid Haematin method .

4. Histochemistry of nucleic acids:
   a) Detection of DNA in animal tissues using Fuelgen reaction
   b) Detection of DNA in animal tissues using Pyronin-Methyl green method
   c) Detection of RNA in animal tissues using HCl method followed by Pyronin-Methyl green method

5. Histochemistry of Enzymes:
   a) Detection of alkaline phosphatase
   b) Detection of ATPase
   c) Detection of cholinesterase

6. Histometry (Demonstration) :
   a) Measurement of testicular Leydig cells.
   b) Measurement of Liver cells
   c) Measurement of Thyroid follicular cells etc.

7. Histipathology :
Effect of toxicity on the different organ histology

8. Immunohistochemistry (Demonstration):

Paper: PHY-306
Practical

Special paper A: Microbiology and Immunology

Unit 35

Microbiological techniques

1. Fermentation of carbohydrates by bacteria: glucose, fructose, lactose, sucrose.
2. Production of acetyl-methyl carbinol by bacteria.
3. Production of indole by bacteria.
4. Determination of amylase activity of the supplied bacteria by hydrolysis of starch.
5. Determination amylase activity of the supplied bacteria by hydrolysis of starch.
6. Determination of catalase activity of the supplied bacteria.
7. Determination of urease activity of the supplied bacteria.
8. Determination of the protein hydrolysing ability of the supplied bacteria by preparing casein plate.
9. Isolation, purification and characterization of bacteria from soil sample.
10. Isolation, purification and characterization of bacteria from water sample.

11. Determination of the concentration of viable bacteria in supplied solution by plate count method.
12. Isolation and purification of microbial enzymes from yeasts.
13. Isolation of plasmid DNA from bacterial cells.
14. Separation, visualization and determination of molecular sizes of isolated DNAs by agarose gel electrophoresis.

Unit: 36

Experimental Immunology practical

1. **Separation of different types of blood cells by Histopaque (gradients)**.
Identification of (a) B-cells by rosetting (b) T-cells by rosetting (c) Macrophages, isolations of macrophages, B-cells, T-cells, polymorphonuclear cells
2. Isolation and culture of peritoneal cells from experimental animal
3. Preparation of Antigen and Development of antibody
Development of antibody in rabbits by injecting complete-incomplete Freund's adjuvant with BSA,
Ouchterlony double diffusion (ODD), Single radial immune diffusion (SRID), agglutination test. haemolytic Plaque assay.
4. Subcellular fractionation (a) mitochondria, nuclei etc. (b) centrifugation - differential and density gradient (sucrose, percoll, CsCl).
5. Endonuclease digestion of nuclei and analysis of DNA by Agarose Gel Electrophoresis, thermal melting of DNA.
6. Isolation of plasmid DNA: mini preparation, large-scale isolation.
7. Glassware decontamination, washing-sterilization, packing and sterile handling for animal cell tissue culture.
8. Media and reagent preparation, sterility checks, CO_2 incubator.
9. Maintenance of cell cultures.
10. Preparation of primary cell cultures (CEC).
11. Peripheral blood lymphocytes culture, demonstration of other tissue culture experiments.
12. Chick embryo fibroblast primary cell cultures and mouse choronic villus cells.
13. Induced ovulation in mouse, collection of oviducal eggs and in-vitro fertilization, culture in-vitro of mouse embryos to the blastocyst state
14. Transferring foreign gene (e.g. chicken globin gene) into mouse fertilized eggs and transplantation to foster mother
15. Microinjection or electroporetion of ES cells with foreign DNA and transplantation to foster mother

Special Paper B: Ergonomics and Sports physiology

Unit 35

Experiments on work and Sports Physiology I

1. Measurements of heart rate at rest and different working conditions.
2. Classification of workload, continuous recording of heart rate by heart rate monitor
3. Determination of maximal heart rate, cardiac cost and cardiac efficiency by step test method, bicycle ergometer and treadmill
4. Determination of steady state
5. Determination of endurance time
6. Measurement of body temperature, (oral, axial, skin) at rest and different working condition.
7. Recording and interpretation of ECG at rest and working condition, effects of posture on ECG
8. Recording and interpretation of EMG at rest and working condition.
9. Determination of pulmonary ventilation, static and dynamic lung function tests
10. Static and dynamic balance test

Unit 36
Experiments on work and Sports Physiology II

1. Determination of VO_2 max by direct method; determination of VO_2 max by indirect method : Queen's college test, 12 min-run test, non exercise test, Astrand rhyming nomogram method
2. Determination of lactic acid and pyruvic acid in blood before and after exercise.
3. Determination of Haemoglobin level before and after exercise.
4. Anaerobic power test (modified Margaria method).
5. Measurement of flexibility, agility, power and maximal work capacity
6. Measurement of reaction time (hand, foot) and movement time, determination of simple and choice reaction time
7. Measurement of blood pressure, sweat rate during exercise.
8. Determination of muscle strength by dynamometer - hand grip strength, pinch strength, leg and back strength
9. Measurements of body fat in human by (a) skinfold method , (b) anthropometric method densitometric method, determination of body composition
10. Determination of somatotypes
11. Gait analysis

Special paper C: Endocrinology, Reproductive Physiology and Family welfare
Unit – 35

Experiments on Model Animals

1. Study of drugs (elicit hypo and hyper condition) on functional activities of thyroid, testis and ovary
2. Experiments on thyroidectomy, adrenalectomy on gonadal functions- cholesterol, acid and alkaline phosphatase, ascorbic acid in gonads.
3. Study of experimental diabetes induced by alloxan, streptozotocin in experimental model animals. Assay of SGOT, SGPT, amylase, and glycogen, Glucose-6-phosphate dehydrogenase, blood sugar
4. Experiment on thymectomy - T lymphocyte and macrophage isolation

Unit – 36

Experiment on Male Reproduction

1. Study of the effect of cryptorchydism on markers of male reproduction.
2. Study of sperm count, sperm motility, sperm morphology and sperm viability and effect of some Anti-fertility drugs
3. Study of castration (unilateral) on cholesterol in intact testis, Adrenal cholesterol, acid and alkaline phosphatase activities in accessory sex glands.
4. Assay of the activities of oxidative stress sensitive enzymes and free radicals quantification in male sex glands.
5. Quantitative study of spermatogenesis measurement of somniferous tubular diameter and leydig Cell nuclear area.

Special paper D: Neurophysiology

Unit – 35
Experiments on neurophysiology I

1. Gross examination dissection of human brain:
   Identification of cerebral cortical sulci and gyri, caudate, putamane, globus pallidus, septal area, hypothalamus, thalamus, corpora qudrigemina, corpus callosum, anterior/ posterior commissure, cerebeller peduncle, cerebral ventricles, crus cerebri, pyramid, hippocampus, amygdala fornix
2. Desection and study of animal brain :
   Study of serial sections of brain of rat, cat, dog to identify neuclei of basal ganglia, thalamus, hypothalamus, amygdale; study of the structure of mid brain , pons, medulla oblongata, spinal cord.
3. Study of spinal preparation in rats and cats :
   Spinal preparation by surgical method and observation of physiological parameters and behaviour in the stage of spinal shock and stages of recovery, study of decerebrate preparation in rats and cats : study of cerebellectomy in rats and cats : observation of changes in muscle tone and behaviour after complete of partial removal of different parts of cerebellum
4. Study of neuronally isolated cortex in cats :
5. Stereotaxic technique : Principle and use of stereotaxic apparatus
6. Experimental animal preparation by different methods in animals (rat /cat) :
   a) Aspiration
   b) Electrolytic
   c) Chemical lesioning

Unit – 36
Experiments on neurophysiology II

1. Experimental electrical stimulation in animals (rat/cat): Study of electrical stimulation of different portion of brain, by electrical stimulation and observation of changes in muscle tone, behaviour, heart rate, respiration, blood pressure, evaluation of electrolytic lesion.
2. Experimental chemical stimulation of brain: Microinjection of acetyl choline, epinephrine, nor-epinephrine, serotonin, histamine, kainic acid in different regions of brain and cerebral ventricles and study of changes in physiological parameters.
3. EEG and ECoG in experimental animals: recording of spontaneous electrical activity of surface and deeper parts of brain of experimental animals in acute and chronic condition. effect of stimulant and depressive drugs on ECoG;
4. Evoked potential study in experimental animals , recording of auditory and visual evoked potential in rats
5. Study of experimental epilepsy rat
6. Behavioural study in experimental animals:
   a) Exploratory behaviour in open field
   b) Exploratory behaviour in hole board
   c) Light dark transition test.
   d) Active social interaction test.
   e) Pento barbital sleeping time
   f) Maze tests
7. Locomotor movements in rats: Recording of locomotor movements in rats by Kymograph at rest and after injection of stimulant drug.
8. Study of neuroendocrine functions:
   a) Effect of stress on estrous cycle, ovary, adrenal, thyroid, and pineal.
   b) Effect of lesion of different neural structure of endocrine function

9. Studies of blood pressure and heart rate in experimental animals:
   a) Effect of bilateral carotid occlusion on blood pressure and heart rate in cats.
   b) Effect of stimulation of medullary pressure area on heart rate and blood Pressure

4th semester

300 marks (Theory: 150+ Practical: 150)

Theory

Paper: PHY-401

Unit – 37
Endocrinology

Module-1

General concepts of Endocrinology and hormonal action:
Endocrine, paracrine and autocrine secretion; biosynthesis, chemical nature, storage, release and transport of hormones; Hormone receptors-types, properties, synthesis and life cycle, protagonists, antagonists and up down regulation of receptors; mechanism of hormones that act on nuclear receptors and the hormones act at the cell surface, laboratory evaluation of the endocrine system.

Neuroendocrinology:
Neural control of glandular secretion – neurosecretion; hypothalamus-pituitary unit, hypophyseotropic hormones and neuroendocrine axes –TRH, CRH, GHRH, somatostatin, prolactin regulatory factors, GnRH and control of the reproductive axis; effect of leptin on the hypothalamus and neuroendocrine axis, neuroendocrine related diseases

Module-2

Hypothalamo-hypophysial axis and anterior pituitary hormones :
Functional significance, pituitary transcription factors and anterior pituitary control, physiology and disorders of different pituitary (anterior) axes: hypothalamo-hypophysial-gonadal axis, hypothalamo-hypophysial-adrenal axis, GH-IGF-1 Axis

Neurohypophyseal hormones:
Synthesis, release and regulation of neurohypophyseal hormones, role in osmoregulation and smooth muscle movements, clinical aspects

Module-3

Pituitary Thyroid axis
Synthesis and secretion of thyroid hormones – role of Iodine, T3 and T4 - plasma transport, cellular uptake, intracellular binding, activation and inactivation and mechanism of action; regulation of thyroid function; role of thyroid hormones in growth , differentiation and metabolism, thyroid functions in pregnancy, and in the fetus and newborn; thyrotoxicosis endemic and exopthalmic goiter and autoimmune.

In vivo action of corticoids and catecholamines
Roles in metabolic, vascular, physical and emotional stress , anti inflammatory role; mineralocorticoids in sodium and potassium metabolism, general idea about cushing syndrome, pheochromocytoma –diagnosis and management.

Module-4

Hormones involved in calcium metabolism.
Role of parathyroid hormones, dihydrocholecalciferol, calcitonin and sex hormones – cytockines and growth factors in calcium metabolism; Osteoporosis - primary and secondary type; Phosphorus metabolism.

Pancreatic and gastro intestinal hormone
Role of insulin on ribosomal activity for protein synthesis, role of insulin and glucagons on carbohydrate and lipid metabolism, gastrointestinal hormones
Immunity and endocrine system
Thymic hormones; Autoimmunity – tolerance of self antigens; mechanism of autoimmunity genetics of autoimmunity of the MHC, examples of autoimmunity in endocrine system like, Hasimato diseases-Graves disease, Juvenile diabetes mellitus.

Unit – 38
Reproductive physiology
Module-1

Male and female reproductive system
Sex differentiation– role of SRY antigen, AMII and other hormones, disorders of sex, gonadal differentiation, female and male pseudohermaphroditism, sexual infantilism, folliculogenesis, ovulation, spermatogenesis, hormonal control, menstrual cycle with special reference to biochemical aspects; steroidogenesis - its different pathways, two cell-two gonadotrophin hypothesis for ovarian steriodogenesis and its hormonal regulation; environmental factors like temperature, hypobaric atmosphere, light-dark cycle on reproduction, effects of nutrition, stress and exercise on reproductive functions

Module-2

Physiology of pregnancy and lactation:
Physiology of implantation, pregnancy maintenance, sex biorhythm, role of endocrine, autocrine, paracrine factors in pregnancy regulation, ectopic pregnancy, endometriosis, foeto-placental unit, role of blastocyst in pregnancy maintenance.maternal adaption to pregnancy endocrinology of parturition physiology of lactation and physiological importance of lactation, application of molecular biology to reproduction

Module-3

Contraception: Principle of contraception, hormonal contraceptive and their molecular action, IUD and their molecular action, principle of the development of herbal contraceptive
Oxidative stress and reproductive activities: Oxidative stress markers, role of oxidative stress on reproductive system

Module-4

Foetal and neonatal physiology: Cardiovascular and respiratory physiology of foetus and their changes at birth, fetal and neonatal nutrition, factors in embryonic and fetal tissue differentiation
Pineal gland and reproduction : Role of melatonin on reproduction, antigonadal and progonadal role of melatonin, Pinea-clinical application of melatonin

Paper:PHY-402

Unit – 39

Cell and Inheritance Biology

Module I

Cells: Evoloution of cells, basic properties and classification
The Plasma Membrane: Brief history of studies on plasma membrane structure, the membrane proteins and lipids, membrane fluidity and dynamic nature of plasma membrane, membrane transport

Module II

The Cytoskeleton: Overview of cytoskeletal functions, roles of microtubules, microfilaments and intermediate filaments, cilia and flagella
Subcellular Organelles and Cellular Interactive Structures: Endomembrane system, endoplasmic reticulum, golgi complex, lysosome, vesicular traffic (secretion and endocytosis), the endocytic pathway: phagocytosis, mitochondria-peroxisome-chloroplast: protein sorting; cellular interactions: with extracellular materials, with other cells; tight junctions, gap junctions and plasmadesmata, cell wall

Module III

Cell Signaling and Signal Transduction: Basic ideas about cell signaling, extracellular messengers and their receptors, G protein–coupled receptors and their second messengers, calcium as intracellular messenger, protein-tyrosine phosphorylation, interrelationship among different signaling pathways, nitric oxide as intercellular messenger, programmed cell death: apoptosis

Module IV

Cell Cycle and Differentiation: In vivo cell cycles and their control, M phase, meiosis and gamete formation, recombination and genetic variability, DNA repair, cancer and oncogenes; fertilization and early development, stem cell biology, embryonic stem cells and cloning; cell culture, fluorescence activated cell sorting.

Unit – 40
Biotechnology

Module I

Cloning vector: Biology of cloning vectors- plasmids, cosmids, lambda phage, single stranded DNA phages, M-13 phage, animal viruses, Ti-plasmid, BAC, YAC, how to choose a right type of vector

Module II

Genetic engineering and Biotechnology:
Restriction endonucleases, recombinant DNA technology; transformation, transfection, microinjection and shot gun method; genetic mapping; transposomes and their uses in genetic manipulation, site directed mutagenesis; genomic library, c-DNA cloning. transgenic animal; gene targeting; mobile genetic element, general recombination, restriction mapping; RFLP, RAPD, AFLP techniques

Module III

Stem cell and Tissue culture: Stem cell for therapeutics - diseases like diabetes, heart disease etc, reproductive cloning and its applications, cloning model as- DOLLY; animal and cell culture**,** primary cell lines, cell clones, organ culture; cell types in culture, cell environment- nutritional requirements, substrates; cell characterization- karyotyping, growth rates, isoenzymes and differentiation- normal and transformed cells; brief history of the human genome project, utility of the project, future challenges of the project

Module IV

Methodology in Genetics and Biotechnology:
Fermentation and their use, biofermenter, agarose gel electrophoresis; southern, northern and western blotting and hybridization techniques, autoradiography, immuno-autoradiography; gene toxicity testing; DNA finger printing and foot printing; Dot-blot; nucleic acid sequencing; polymerase chain reaction. RT-PCR, nested PCR, FISH, GISH, microarray technology, bioinformatics, Genomics, Proteomics and Computational biology

Paper: PHY-403
Special paper Theory

Special Paper A: Microbiology & Immunology

Unit – 41
Microbial Genetics: Advanced Studies

Module I

Bacterial Genetics
Chromosome and plasmids, genes, genetic recombination, conjugation and chromosome mobilization, high frequency transconjugants, transduction: generalized vs specialized, transformation, comparative prokaryotic genomics
Virology:
General properties of viruses, nature of virion, virus host, classification, reproduction and multiplication, bacteriophages, single stranded filamentous DNA bacteriophages, lytic phages, temperate bacteriophages - lambda, transposable phage, RNA bacteriophages, animal viruses, viriod and prions, classical bacteriophage T_4 and T_7 genetics

Module II

Genetics in Eukaryotes
Genome complexity, composition of eukaryotic chromosomes, one giant DNA molecule per chromosome, packaging of chromosomes, repetitive DNA, satellite DNAs, DNA renaturation kinetics, replication of DNA and replicon in eukaryotes, linkage, molecular mechanism of crossing over, gene conversion , chromosome mapping, the yeast genetics

Module III

Regulation of Gene Expression
External signals influencing gene expression, the steps of gene expression to be regulated, protein in gene regulation, the DNA binding motifs, activity of genetic switch, the regulation of transcription in prokaryotes and eukaryotes, chromatin structure and the control of gene expression. DNA methylation and gene silencing

Module IV

Transposable Genetic Elements
Discovery of transposable elements, transposable elements in bacteria, IS elements, transposable elements in eukaryotes, genetic significance: mutation and genetic analysis, evolutionary significance of transposable elements.
RNA and Gene Expression

RNA in regulation of gene expression: attenuation, anti- sense RNA, RNAi, micro RNA.

Unit – 42
Clinical Immunology

Module I

Infection immunity and inflammation:
Infection immunity in bacteria, viruses, fungi, and parasites; types of cell adhesion molecule (CAM), mechanism of inflammation

Module II

Hypersensitivity and autoimmunity:
IgE-mediated (type-I), Ab-mediated cytotoxic (type-II), immune complex mediated (type-III), delayed type hypersensitivity (type-IV), auto immune disease, (a) organs specific autoimmune disease- Hashimoto's thyroiditis, Good pastures syndrome, insulin dependent diabetes mellitus, Grave's disease, and Myasthenia gravis. (b) systemic autoimmune disease- SLE, multiple sclerosis, rheumatoid arthritis.

Module III

Tumor & transplantation immunology and AIDS:
Tumor immunology, oncogene and cancer induction, tumor antigens, immunotherapy; types, mechanism of transplantation rejection, prevention of graft rejection, Immuno Deficiency Diseases including AIDS

Module IV

Vaccination and immunological techniques:
Vaccine and vaccination, immunological technique: Sandwitch and competitive ELISA, Chemiluminescence, ELISPOT assay, immune electron microscopy- SEM and TEM, flow cytometry (FACS), fluorescence, microscopy, gel-shift analysis, CAT assay

Special paper B: Ergonomics and sports physiology

Unit 41
General ergonomics

Module I

Brief history and components of ergonomics: Brief history of the development of Ergonomics. Role of the subject in community development, definition of Ergonomics, role of the subject in industry and agriculture; characteristics of man-machine-environment system, fitting the man to the task and fitting the task to the man, human factor application in system design
Cognitive ergonomics- cognitive process, cognitive task analysis, cognitive ergonomics in problem solving and decision making
Psychological factors in ergonomics: Psychological variation in ability and attitude to work- work management and productivity. Psychological factors in performance enhancement;
Physiological factors: Physiological variation during work, fitness, health, work load and work capacity; effects of nutrition, sleeplessness and disease on physical work

Module II

Work rest cycle:
Physiological parameters during work and rest, rest and other allowances
Kinensiological factors:
Kinensiological analysis of human body movement, scientific basis of human body movement, biomechanics of human spine, lower and upper extremity
Man-machine interaction.
Interaction of man and machine through control and display; different types of controls and displays- visual, auditory and tectile, control –movement stereotype, Compatibility – types, relationship with control and display design, coding of controls, design of symbols and labels

Module III

Environmental Ergonomics
Illumination- Effect of illumination on visual performance, factors related to illumination and visual performance, standards of illumination for working and living aspects: other aspects of visual environment, glare, flicker, colour etc, principles of lighting in VDT work station. Illumination and reading performance
Noise- definition and measurement of noise, sound pressure level: continuous, intermittent and impulsive noise; physiological effects of noise, noise and health hazards, noise induced hearing loss; noise and performance, noise reduction techniques.
Vibration- transmission of vibration, resonant frequencies of human body and organs; effect of vibration on comfort, performance and health; vibration of hand tools, measurement of vibration, preventive measures against vibration

Module IV

Thermal ergonomics: Thermal balance -factors, temperature and climatic factors- thermal indices; scale of comfort and heat stress indices- effective temperature, WBGT, wind-chill index, heat stress index, , 4 hour predicted sweat rate; heat stress and performance, control measures against heat stress; Cold stress and performance
Protective clothing and equipment: Physiological aspects of clothing comfort, indicator of comfort or stress, effects of the environment, the clothing microenvironment.
Chemical environments – harmful chemical in industries and their effects on health and performance, preventive measures

Unit 42
Applied Ergonomics

Module I
Anthropometrics- structural and functional anthropometry; principle of applied anthropometry in ergonomics – maximum dimension, minimum dimension, cost-benefit analysis, three dimensional digital anthropometry and its application
Work station design –general principles, work space design for standing and seated workers, requirements on Physical dimensions variability, reach posture, clearances, protection etc, application of anthropometric data to the layout of work space, biomechanical aspect of workplace design, human factors in VDT workstation design.

Module II

Seat design: Problem of seating, design for seating for support and comfort in sitting posture- principle of back rest design, role of anthropometric dimensions in seat design, concept of dynamic chair
Design of equipment and hand tools - general ergonomics principle, design criteria

Working posture- variation in different tasks, spine and pelvis related to posture; musculoskeletal problems in different postures; different methods of analyzing work posture, biomechanical methods of posture analysis, behavioural aspects of posture

Module III

Human computer interaction – text characteristics of VDU, illumination, error analysis; design of computer terminal workstations, software- user interface design, virtual environments, problem of VDT workers.
Musculoskeletal disorders (MSD) – causes, relation to the tasks, management of MSD, repetitive motion injuries- types and management
Job design- principle of job design, physical and mental capabilities, task analysis- time and motion study.
Design of manual handling tasks -health effects, type of task, biomechanical models of lower back trouble, recommendation of load handling, acceptable work load, design of manual handling tasks –lifting , carrying ,pulling and pushing

Module IV

Occupational diseases: Occupational diseases of workers in agriculture, industry and mines; occupational stress and its management, evaluation of occupational stress.
Shift work – circadian rhythm, problems with shift work, night work and health, organization of shift work.
Selection and training of workers; Methods, models of training and instructions
Human factors application in industries - in manufacturing, process control, and transportation

Special paper C: Endocrinology, Reproductive Physiology and Family welfare

Unit – 41
Endocrinology

Module-1
Hormonal basics of hypertension: Hypertension and its classification, hormones involved in hypertension with special reference to role of aldosterone, physiological disorders in endocrine system related to hypertension, management of hypertension.
Hormonal basis of Diabetis mellitus: Nomenclature and classification –IDDM, NIDDM demography, diagnosis of diabetes - fasting plasma glucose oral glucose tolerance test – intravenous glues tolerance test, glycosylated hemoglobin, muscle capillary basement membrane thickening,
Insulin receptor signaling in relation to the development of insulin resistance, genetics of diabetes, MHC class-I and class-II molecules, association of IDDM with TAP and LMP alleles, inheritance , environment–genetic interaction: maturity onset diabetes of the (MODY) and its subtypes and MODY I,II,III ; pathophysiologic features regarding the complication of diabetes mellitus, Beta cell failure in NIDDM ; immune reaction for diabetes development – autoantibodies in IDDM-ICA,GADA,IAA,PIAA,GTA etc , cellular killing
Management of diabetis –insulin therapy, immuno suppression, diet therapy, chemotherapy, transplantation therapy, herbal therapy

Module-2

Hormone and cholesterol metabolism and obesity and regulation
Cholesterol, lipoprotein –their synthesis, lipid and atherosclerosis, hormones involved in cholesterol and lipoprotein synthesis, adipose tissue as an endocrine organ, pathogenesis and clinical features and complication, treatment and management of lipid disorders and obesity
Drug abuse:

Different types of drug abused in community, effect of drug abuse on different physiological system on different group of family, management of drug abuse

Module-3

Alcohol Addiction
Social causes *of* alcohol addiction, effect of alcohol on different age group in family, management of alcohol addicted family members
Aging:
General aspect of aging, different theories of aging, aging - its effects on endocrine and reproductive system

Module-4

Recombinant DNA technology in endocrinology
Gene transfer methods, application of transgenic mice, application of cloning in gene analysis, production of recombinant insulin, recombinant human growth hormone

MCH care Package
Care of pregnant stage, antenantal, antranatal care, feeding of infants, school health care, and indication of MCH care, community care of handicapped and mental retarded children, child welfare agencies AIDS-causes, transmission, and preventive measures

Unit – 42
Reproductive Physiology

Module-1

Fertilization:
Basic step of fertilization, role of zona pellucida protein in fertilization, molecular aspect of fertilization with special reference to intigrin, complement, egg peptide receptor, indication of fertilization, acrosome reaction and cortical reaction
Implantation:
Physiology of Implantation, implantation window, role of mate mal hormone and bastocyst in implantation , role of uterine agglutinin in implantation

Module-2

Maintenance of Gestation:
Molecular aspect of hCG synthesis, molecular aspect of placental steroidogenesis, GnRH- gonadotrophin axis in placenta, detection of gestation from immunological aspect
Intratesticular regulation of Testicular Function:
Sertoli cell-leydig cell axis for steriodogenesis, Sertoli cell-leydig cell cross talk in spermatogenesis, tight junction in testis-structure and function.

Module-3

Contraception:
Principle of contraception, hormonal contraceptive and their molecular action, IUD and their molecular action, principle of the development of herbal contraceptive
Pedigree Analysis
General aspect of pedigree analysis, different types of pedigrees, problems of autosomal dominant, autosomal

recessive ex chromosomal dominant and sex chromosomal recessive pedigree

Module-4

Animal cell culture and reproduction

Culture media, animal cell line, cloning and selection of specific cell types, organ culture, transfection of fertilized egg or embryos

Special paper D: Neurophysiology

Unit – 41
Neurophysiology of brain

Module I

Sensory functions: Sensory coding, conscious perception, sensory cortical column, Audition: Fourier analysis by cochlea, responses of auditory fibres, spatial localization; Vision: retinal interneurons, mechanism of adaptation, visual fonn recognition, akineptosia, achromatopsia; Smell and taste: neural processing in olfactory and taste pathways; Pain: higher neural processing of pain, hyperalgesia and allodynia, neuropathic pain; Neurophysiology of human attention

The control of posture: Vestibular contribution to posture, visual and other contribution to posture

Module II

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Motor functions: Local motor control, sensory feedback from muscle, descending pathways; global motor contro: Motor cortex - motor cortical column, cerebellum - neural processing in cerebellar Cortex, basal ganglia neural circuitry through components of basal ganglia; initiation of motor movements, movements of the eyes

Sleep and cortical arousal: Reticular formation, thalamocortical circuitry, EEG, evoked potential, , sleep stages, neural mechanism of REM sleep, magnetoencephatography

Module III

Conditioning and learning: Classical conditioning procedure, measurement of conditioned response, conditioning controls, conditioning-variables; exteroceptive and interoceptive conditioning; classical conditioning techniques - autonomic nervous system and central nervous system techniques, instrumental conditioning, escape and avoidance conditioning, operant conditioning-reinforcement, intracranial self-stimulator, discrimination and maze learning; conditioning and psychopharmacological investigations

Memory: Theories of memory - sensory, short term and long term memory, declarative and non- declarative memory, neuroanatomy of memory, neuronal basis of memory - LTP and hippocampus, molecular biology of memory, amnesia, Korsakoffs syndrome

Module IV

Emotion and Behaviour: Neural systems in emotional processing-limbic systems, orbito-frontal cortex and amygdale, fear and rage; sexual behaviour; aggression, brain chemistry and behavior; neurobiology of motivation

Cerebral lateralization and specialization: Anatomical asymmetries of brain, split brain, functional asymmetries of brain, variation in hemispheric specialization

Unit – 42

Applied and Clinical neurophysiology

Module I

Cognitive Development: A classic theory of cognitive development, object recognition, development of attention system , language acquisition during development
Plasticity of brain: Plasticity in normal adult brain- reorganization in human cortex; cortical maps and experience, morphological changes, synaptic plasticity
Neuroendocrinology: Hypophysiotropic honnones and neuroendocrine axis, Hypothalamo- hypophyseal axis in .stress and depression, neurogenic precocious puberty, anorexia nervosa, Circumventricular organs, Pineal gland

Module II

Neuroimmunology: Neural-immune interactions- autonomic nervous system and lymphoid organs, neuroendocrine-immune system interactions; interactions of cytokines with brain, central nervous system lesions and intra cerebroventricular infusions, effect of stress and depression on immunity
Neural regulation biorhythm: Characteristics of circadian clock- free running clock, entrainment, Zeitgebars, phase relation to zeitgebers; Biorhythm: sleep- wake cycle, feeding, thermoregulation, endocrine and reproductive rhythms; neural .basis of circadian rhythmicity -pacemakers, suprachiasmatic nucleus, alteration in environmental times- Jet lag, shift work
Metabolism of brain and effect of malnutrition: Brain metabolism, and Undernutrition and the developing brain, malnutrition on learning and behaviour

Module III

Aging of brain and associated dysfunctions: Structural and chemical changes of the aged human brain
Neurobiology of Drug abuse: Long term effects of drug of abuse on CNS; tolerance, dependence and withdrawal
Neurotoxicology: Effect of neurotoxicants- lead, mercury, arsenic, manganese, carbon disulfide, toluene, trichloro ethylene, insecticides

Module IV

Disorders of Brain: Epilepsy, prion, fragile x-syndrome, Parkinson's disease Huntington's chorea, Alzheimer's disease, depression, autism.
Methods of study of brain: Functions and instruments used in neurophysiology: Stereotaxic technique, aspiration and electrical lesion, electrical and chemical stimulation; EEG, Evoked potential. Neurobehaviour. Neurochemistry. Principle and use of CAT, MRI, PET, CRO, poly-writer.
Consciousness and Brain Mind interaction: Hypothesis relating to brain mind problem, Conscious versus unconscious processing, neuronal groups and conscious experience

4th semester
Practical
Paper:PHY-404

Unit – 43
Advanced Physiological studies I

1. EEG recording of normal human subject in different status by multichannel recorder
2. Determination of Vo_2 max by Queen's college test.
3. Determination of hearing threshold by audiometer.
4. Estimation of physiological active substance by HPLC.
5. ECG recording and interpretation, determination of electrical axis of heart
6. Determination of percentage of body fat and desired body weight
7. Electroencephalographic study in humans in different stages of sleep and awakefulness
8. Measurement of GSR in resting and different stressful condition.
9. Measurement of dark adaptation time
10. Colour perimetry, measurement of visual acuity.
11. Steriotaxic technique lesioning of a specific brain area.
12. Determination of critical fusion frequency

Unit – 44
Advanced Physiological studies II

1. Identification of Urease activity for a supplied bacteria
2. Determination of antibiogram of a supplied bacteria
3. Amplification of a target DNA by polymerase chain reaction and identification of amplified DNA by Agarose gel electrophoresis.
4. Tissue processing and staining by automatic tissue processor and stainner.
5. Determination of Abs by Ouchtulony double diffusion test. (Demonstration).
6. Delayed type of hypersensitivity response(DTH).(Demonstration)
7. Study of the effect of cryptorchidism on testicular and adrenal cholesterol
8. Study of estrous cycle after administration of synthetic estrogen or hCG
9. Measurement of hormone by ELISA techniques

Paper: PHY-405
Special Paper Practical

Special Paper A: Microbiology & Immunology

Unit 45

Advanced techniques in microbiology

1. Determination of sensitivity of bacteria to different antibiotics
2. Determination of minimum inhibitory concentration (MIC) of aintibiotics
3. Assay of antibiotic and vitamins
4. Isolation, purification and identification of enteric bacteria from water and food samples
5. Isolation of antibiotic resistant mutants of *E.coli* by replica-plating technique
6. Estimation of toxoid by bioassay
7. Experiment for demonstrating bacterial conjugation
8. Virology: Isolation of bacteriophage by dilution plating in soft agar
9. Determination of host range of *Virbio cholerae* phages
10. Lysogenic phages and their induction by UV-light/Mitomycin C.
11. Isolation of chromosomal DNA of bacteria and visualization by agarose gel electrophoresis.
12. P.C.R. (Polymerase chain reaction). (Demonstration)
13. Observation of DNA (autoradiography) Southern, Northern and Western blotting techniques (demonstration).

14. DNA, RNA and Protein Sequencing (Demonstration)
15. P.C.R. (Polymerase chain reaction). (Demonstration)

Unit 46
Clinical Immunology

1. Type I hypersensitivity reaction from anaphylactic shock patients, C - reactive protein measurement. Delayed type of hypersensitivity response (DTH) (Mouse model).
2. Phagocytosis experiments, cell isolation from floral effusion and study the functional activity of cell.
3. Cytology and histology of major organs and endocrine glands (permanent slides and fresh preparation).
4. Histological changes of lymphoid organs after the BSA-primed or LPS-primed animals.
5. DNA fragmentation and apoptosis
6. Blood grouping, ABO blood grouping and Rh typing.
7. Giemsa stain of blood films (Thick and thin) for detection of malaria parasites, filarial parasites, and abnormality in WBC count (Leukemia, different type of anemia disorders in platelet).
8. Commercial kits-based diagnosis of malaria patients, measurement of IgE level
9. Southern, Northern and Western blot technique
10. 2-D gel electrophoresis of proteins
11. Haemagglutination test
12. **Field study/Laboratory visit** :Student shall be taken to visit different advanced laboratories such as IIS, Bangalore; CCB, Hyderabad; TIFR, Bombay; Industrial Toxicological Research Centre, Lucknow; IICB, Kolkata; Institute of Microbial technology, Chandigarh; National institute of Immunology, Delhi; NICED, Kolkata; NCCS, Pune. Twenty marks (20) will be allotted field study/ laboratory visit in the practical examination (compulsory). The student shall submit a report during practical examination for special paper.

Special paper B: Ergonomics and Sports Physiology

Unit 45
Experiments on general ergonomics and environmental ergonomics

1. Evaluation of occupational stress- development of questionnaire, quantitative evaluation technique, pain mapping
2. Measurement of different heat stress indices: WBGT, ET, CET, P_4SR; measurement of relative humidity
3. Determination of hearing loss of different groups of workers by audiometric method
4. Measurement of illumination level by lux meter in different working areas.
5. Measurements of noise level in different working stations
6. Measurement of vibration level
7. Determination of environmental conditions surrounding the workers determination of concentration of dust and particulates in air
8. Product analysis- Pair comparison test
9. Determination of center of gravity of human body under resting and working conditions.
10. Biochemical study of work posture, joint angle study, determination of spinal curvature, analysis of posture by video graphic method – OWAS, REBA, RULA, OCRA etc.
11. Time and motion study, job analysis
12. Peg board test

Unit 46
Experiments on ergonomic design and group projects

1. Anthropometrics measurements- static and dynamic, anthropometric measurements for different design consideration- design of seat, work station, consumer products, personal protective equipments hand-tools, etc.
2. Workshop on biomathematics and biostatistics.
3. Simulation of work and sports model by the computer
4. Group Projects* -

* Field study in industrial establishments and other work stations to study man –machine interactions

*Students are to be taken for visiting different industrial establishments for ergonomic evaluation of man-machine-environment system and they are also to be taken for visiting different advanced laboratories such as - Central Labour Institute (Bombay), Ergonomic Laboratory, IIT (Bombay), Defense Institute of Physiology and Allied Sciences (Delhi), Netaji Subhas National Institute of Sports (Patiala), Sports Authority of India (Bangalore). Rani Lakshmi Institute of Physical Education (Gwalior). Central Mining Research Institute (Dhanbad), National Institute of Occupational Health (Ahmedabad), Regional Labour Institute (Calcutta) etc. The student shall submit a report during practical examination for special paper.

Special paper C: Endocrinology, Reproductive physiology and Family Welfare

Unit – 45

Techniques in Endocrinology

I. Assay of Bio - molecules

a) Bio-assay of oxytocin and epinephrin
b) Study or hoqnone assay-ELISA. RIA
c) Measurement of hormones by spectroflurometer
d) Radial immunodiffusion techniques for measurement of antibody biomolecules
e) Chromatographic separation of amino acid and peptides
f) Study of immunoglobulin assay in ELISA READER
g) Study of localization steroidogenic enzymes in testis, ovary and uterus by histochemical methods.
h) DNA and chromosomal studies in endocrine and reproductive disorder

II.Family Counseling and Family Welfare

a) Pedigree analysis-Autosome and sex chromosome related pedigree
b) Family counseling related to age of marriage, proper maintenance of sexual life, pregnancy and abortion. Contraception and related parameters
c) Water quality test
d) Assessment of food pollution by using kits, general screening for alcohol and acetone in blood and urine, drug screening in urine, heavy metal screening in urine
e) Karyotypic study

Unit 46
Techniques in Reproductive Physiology

I. Experiments on female reproduction
   a) study ovariectomy (unilateral and bilateral) on cholesterol Cl1lltent in adrenal ovary and plasma
   b) Study of acid and alkaline phosphatase activities in uterus of ovarietlomised animal.
   c) Study of estrous cycle-effect of synthetic estrogen and hCG injection.
   d) Study of immunological methods for pregnancy detection.
   e) Basic experiment on superovulation study in mice and rat

f) Quantitative study of folliculogenesis
g) In vitro fertilization in experimental model animals

II. Training Programme

Training in higher research institute are to be arranged for the students to learn some advance techniques in reproductive physiology and they are also to be taken for visiting different national laboratories. The student shall submit a report during practical examination for special paper.

Special paper D: Neurophysiology

Unit – 45

Advanced Neurophysiological studies I

1. Study of the nerve cell: staining of neurons by crestyl violet and Nissl fast violet stain in the paraffin section of the spinal cord and cerebellum.
2. Study of central nervous system architecture by hematoxylin van Giessen method and Mallory's phosphotungstic acid hematoxylin method.
3. Experimental neuroanatomical studies:
    a) Nauta – Laidlaw method / Marchi's method
    b) Fink – heimer procedure.
    c) Cupric silver method.
    d) Rapid Golgi cox method / Bulchawosky method.
4. Tracing nerve tract horseradish peroxidase techniques.
5. Vital staining of nerve fibre by Methylene blue method.
6. Measurement of neurotransmitters:
    a) Spectroflurometric method for measuring acetylcholine, epinephrine, non- epinephrine, dopamine, serotonin in microdissected brain regions of rats
    b) HPLC method for measuring neurotransmitter.
7. Electrocardiographic study in humans in resting and stress condition.
8. Electromyographic study in humans in different stages of sleep and wakefulness
9. Electroencephalographic study in humans: recording of EEG in humans in different stages of sleep and wakefulness.
10. Evoked potent study in huans: Brainstem evoked potential and auditory evoked potential in humans.

Unit 46

Advanced Neurophysiological studies II

1. Studies of blood pressure in humans:
    a) Effect of posture changes on blood pressure and heart rate.
    b) Effect of vestibular stimulation on blood pressure and heart rate
    c) Valsalva maneuver.
2. Perimetry: visual field determination with different colours in perimeter in resting and stressfull condition.
3. Audiometry: study of frequency threshold curve in humans.
4. Biofeedback: EMG biofeedback studies.
5. Study of galvanic skin response (GSR): measurement of GSR in resting and different stressful condition.
6. Experimental of Chronobiology:
7. Recording of 24 hours body temperature to study circadian rthythm of body temperature
    a) Recording of heart rate to study circadian rthythm of resting heart rate
8. Neuroimmnological studies: PMN assay, cytotoxic assay, PLN assay, phagocytotic assay in experimental animals in resting condition and after stress
9. Training programme / Laboratory Visit: Students will submit a report on the basis of their visit training in some advanced national laboratories such as NBRC, New Delhi: NIMHAN, Bangalore; NCBS, Pune; AIIMS, New Delhi etc as a part of their practical syllabus.

Paper: PHY-406
Project

Unit – 47
Project report

Under the guidance of a teacher each student shall have to carry out a project work (laboratory based or field based) for a period of 2 months. Students shall have to prepare the project report in a standard format and to submit the same in triplicate well before the date of examination (date will be announced by the department). The report should not be less than 20 A4 size typed pages and the maximum size of the report should not generally be exceeded 50 pages (A4 size). Each student will be allotted a project reference number. The students shall have to take a project report number from the department and the number should be written in the front page of the report.

Unit – 48
Project Evaluation

The project work will be evaluated on the basis of the internal assessment, seminar delivered by the student as well as viva-voce on the project report.

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Note:

1. **For semester examination four questions each of 5 marks are to be set for each unit of theory papers, taking one question from every module, with one alternative to each question from the same module.**
2. **For the project of 4th semester 10 marks will kept for internal assessment and the remaining 40 marks will be evaluated during semester examination.**