

# SYLLABUS

## MASTER OF SCIENCE PHYSIOLOGY

**Choice Based Credit System  
(2019-21)**



## Program Specific Outcome

Department of Physiology offers M.Sc. in Physiology to students with Physiology B.Sc. (Hons) degree. The curriculum deals with human Physiology from both the classical as well as reductionist approach considering organismic scale as well as molecular approach. Ergonomics, occupational, sports and environmental physiology are as much in balance with physiological therapeutics as with human cell biology, its different kinetics and modelling. The techniques and methodologies of Physiology have wide applications in the biological, medical and related sciences. Candidates with Masters in Physiology have special job opportunities in the universities, colleges, schools, research & development centers in industries, medical centers/colleges, research institutes, other government and non-government organizations, especially pathophysiological institutes.



The course outcome (CO) has been appended at the end of each unit.


### **General Instructions:**

The post graduate course in physiology is comprised of four semesters each of 300 marks and 24 credits. There is one Ability Enhancement Course (AECC) in 1<sup>st</sup> semester offered as *Scientific Communication* by this department. There is one Skill Enhancement Course which teaches Physiological and Pathological Monitoring Techniques in 2<sup>nd</sup> semester, 01 General Elective Courses (GEC) in 3<sup>rd</sup> semester is to be chosen from other disciplines. One Discipline Specific Elective (DSE) shall be chosen from each in the 3<sup>rd</sup> and 4<sup>th</sup> semester from the Department of Physiology.

Each theory paper will be evaluated by internal assessment (10 marks) and semester examination (40 marks). For each paper there are multiple internal assessments, which may be evaluated by written test or oral test or seminar presentation and class attendance. The average marks of the assessments shall be credited to the students.

Each student will have to participate in a field study as a part of practical training program in the second semester.

	<b>Name of course</b>	<b>Credits</b>	<b>Marks</b>	<b>Total</b>
<b>SEMESTER I (Course Code)</b>				
PHYPCOR01T	Physiological Homeostasis	4	50	<b>Marks : 300</b> <b>Credits : 22</b>
PHYPCOR02T	Physiological System I (Nervous System, Special Sense, Cardiovascular & Respiratory System)	4	50	
PHYPCOR03T	Ergonomics & Occupational Physiology	4	50	
PHYPCOR04T	Computational Biology, Bioinformatics & Biostatistics	4	50	
PHYPCOR05P	Practical I	4	50	
PHYPAEC01M	 Scientific Communication	2	50	
<b>SEMESTER II (Course Code)</b>				
PHYPCOR06T	Microbiology & Molecular Biology	4	50	<b>Marks : 300</b> <b>Credits : 22</b>
PHYPCOR07T	Biochemistry & Metabolism	4	50	
PHYPCOR08T	Physiological System II (Endocrinology, Reproduction, Gastro-intestinal System, Renal Physiology)	4	50	
PHYPCOR09T	Lifestyle & Stress Management	4	50	
PHYPCOR10P	Practical II	4	50	
PHYPSEC01M	 Physiological Monitoring Techniques	2	50	
<b>SEMESTER III (Course Code)</b>				
PHYPCOR11T	Pathophysiology Toxicology & Pharmacology	4	50	<b>Marks : 300</b> <b>Credits : 24</b>
PHYPCOR12T	Sports & Work Physiology	4	50	
PHYPCOR13T	Environmental Physiology	4	50	
PHYPCOR14T	Haematology & Immunology	4	50	
PHYPDSE01P	A. Diagnostic Physiology or B. Physiological Therapeutics	4	50	

PHYPGEC01T	 (GEC) Community Health Problems & Management (for students not belonging to Dept. of Physiology)	4	50	
<b>SEMESTER IV (Course Code)</b>				
PHYPCOR15T	Epidemiology & Public Health	4	50	<b>Marks : 300</b>
PHYPCOR16T	Biophysics & Biomedical Instrumentation	4	50	
PHYPCOR17T	Cell Biology & Biotechnology	4	50	<b>Credits : 24</b>
PHYPDSE02T	A. Therapeutic Nutrition or B. Transplantation Science	4	50	
PHYPCOR18M	Project, Seminar & Grand viva	8	100	

**AECC, GEC, SEC and DSE are introduced from this session**

## SEMESTER-I

### **PHYPCOR01T** (4 credits)

#### **Physiological Homeostasis**

Control system: physical and physiological control system, Components, Regulatory mechanisms, Different feedback mechanisms in physiological system. Integrated regulation of ions, electrolytes and osmotic balance of the body fluids. Transport and exchange of gases and nutrients. Sensory system - from receptor to perception. Neuroendocrine regulation of metabolism including energy balance, Autonomic control of visceral organs. Stress and adaptation: Neuroendocrine control of body homeostasis and stress, Oxidative stress. Cellular response to stress.

**CO:** Deviation in the homeostasis causes disease manifestation hence its understanding would help in the management of disease processes. Homeostasis, the key principle of physiology helps in understanding interconnection between different components within a particular system or across systems.

### **PHYPCOR02T** (1+1+1+1 credits)

**Physiological system-I** (Nervous system, Special Sense, Cardiovascular system, Respiratory system)

**Nervous System:** Brain anatomy, neurogenesis & gliogenesis. Neuronal basis of behavior. Neuroimmunology. Regulatory function of cerebellum with special reference to autonomic function, thalamocortical projections and its influence on evoked cortical activity, Anaesthesia, startle reflex. EEG and brain waves. Neural stem cell and Neural Plasticity. Higher functions of brain and cognition.

**Sensory Organs:** Chemical senses- Taste, Olfaction, Visual sense, Auditory & Cutaneous sense.

**Cardiovascular System:** Evolution of heart on comparative basis, Rhythmicity of heart, Junctional tissue, Role of autonomic nervous system on heart, Cardiovascular reflexes, Cardiac metabolism and the role of hormones, ECG – its principle and significance, ECG in cardiac abnormalities: Analysis of Electrocardiography, Angiogenesis and Angiography.

**Respiratory System:** Anatomy of respiratory system, Lung Mechanics, Neural and chemical regulation of respiration, Non-respiratory functions of lungs.

CO: Physiological systems-based knowledge that helps in systems-based design of therapy. Basic understanding of physiological processes about Nervous system, Special Senses, Cardiovascular system, Respiratory system.

**PHYPCOR03T** (4 credits)

## **Ergonomics & Occupational Physiology**

### **Ergonomics:**

Concept of system design; Effect of man, machine and environment; Failure of system- accident; Management of systems; Work, time and motion study; Ergonomics & safety: Application of ergonomics for the development of safety; Analysis of accident; Unsafe conditions; Occupation health and safety norms; Anthropometry: Definition of anthropometry; Static, dynamic & Newtonian anthropometry; Application of anthropometry in design.

### **Occupational Physiology:**

Occupational Health –factors affecting it. Occupational health hazards.

Occupational hazards in work place – mechanical, chemical, biological, fire, toxic substances, and explosive materials.

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

Occupational diseases – Pneumoconiosis, silicosis, asbestosis, bagassosis, byssinosis, anthracosis. Occupational cancer – skin, lungs, urinary bladder, blood. Occupational health hazards of agricultural workers.

Occupational stress – cause, evaluation and management of stress.

Chronobiology: Photoperiodism, Cellular mechanism of clock, zeitgebers, Synchronizer, Jet lag, shift-work, seasonal affective disorder; Human circadian rhythm and its mechanism of control - cellular and molecular mechanism.

CO: With change in civilization followed by urbanization, different occupational diseases occur. So to combat the occupation related disease, the subject ergonomics have evolved. This subject deals with association between man and environment. To ensure safety of the employees innumerable industries now employ ergonomists.

## **PHYPCOR04T** (4 credits)

### **Computational Biology, Bioinformatics & Biostatistics**

**Computational Biology:** Basic concept of computer hardware, software, Operating System, use of open source software and internet, basics of programming. Word processor - basic operation and its application in biological sciences; MS excel – basic operation and its application in biological sciences; MS PowerPoint – steps of PowerPoint presentation, slide preparation for biological items.

**Bioinformatics:** Concept of Bioinformatics - field of application, common bioinformatics sites in www.biological databases, data acquisition, retrieval of biological data – Entrez , DBGET, LinkDB, Database searches - FASTA, BLAST. Sequence analysis tools.

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), Principles of BLAST, sequence analysis and alignment, primer designing, vector design.

**Biostatistics:** Biostatistics as applied to public health problems principles, use of classical statistical approaches to describe the health of populations. Basic concepts of statistics, approaches and methods, Mean, Median, Mode, t-test (one tail, two tail), Chi-square test, ANOVA (one way & two way), parametric and nonparametric statistics, correlation and regression analysis, trend analysis, operational research, mathematical models, research related to health economics, medical geography, sources of biological information and database.

**CO:** This prepares the background for Medical Analytics that are presently important to Pharma-IT industry. Course contents help in understanding of genome, morphological and physiological functional data; its manipulation and analysis.

**PHYPCOR05P** (4 credits)

**Practical I**

Experiments with computational tools and open source software for analysis of anatomy, biostatistics and bioinformatics.

Evaluation of occupational stress - development of questionnaire, quantitative evaluation technique, Measurement of different heat stress indices: WBGT, ET, CET, P4SR; measurement of relative humidity. Determination of hearing loss of different groups of workers by audiometric method. Measurement of illumination level by lux meter in different working areas. Measurements of noise level in different working stations. Measurement of vibration level. Biochemical study of work posture, joint angle study, determination of spinal curvature, analyses of posture by videographic method – OWAS, REBA, RULA, OCRA etc.

CO: This would provide hands-on experience with computer software, biostatistical applications in day-to-day life, application of different sports and ergonomical parameters and practical knowledge of the theoretical units studied.

**PHYPAEC01M** (2 credits)

50 marks

**AECC: Scientific Communication**

Computational skills. Reading, understanding, presenting and writing scientific material for publication.



## SEMESTER-II

### PHYCOR06T (2+2 credits)

#### Microbiology & Molecular Biology

**Microbiology:** Taxonomic classification, nomenclature and identification of bacteria, archaeobacteria, Structure and characteristics of Bacterial cell wall, Gram positive and gram negative bacteria, Bacterial chromosomes and Plasmids, Flagella and Ion pump. Microbial culture, microbial growth, yield and characteristics. Strategies of cell division, stress response, structure of spores, microbial genetics (Transformation, Conjugation, Transduction, Recombination and Transposition), microbial fermentation, industrial production of alcohol, lactic acid, drugs. Microbe-human interaction: beneficial and harmful, mycobacterium.

Virus – structure, classification and replication of Phage virus, Adenovirus, Herpes virus, Retrovirus. Virion. Prion.

Fungus – structure and reproduction of Yeast, Aspergillus, Penicillium, Candida.

Protozoa – Identification and life cycle of malaria, leishmania, filaria.

Biosensors. Prebiotics and probiotics.

**Molecular Biology:** Structure of Chromosome, Nucleic acid Structure and Metabolism.

DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.

Control of gene expression at transcription and translation level. Control of viral, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression. Methylation and gene silencing. Metagenomics.

CO: Microbiological knowledge and its manipulation at the molecular level is the seed for public health, pharmaceutical and biotechnological industry. This course will provide basic principles of microbiology, parasitology and the molecular principles of life process.

### **PHYPCOR07T** (4 credits)

#### **Biochemistry & Metabolism**

Properties of enzyme, Michaelis-Menten kinetics, Allosteric modulation, Mechanisms of enzyme actions. Structure of atoms, molecules and chemical bonds. Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.)

Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds). Conformation of nucleic acids (A-, B-, Z-, DNA, t-RNA, micro-RNA).

Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

Metabolism of carbohydrates, lipids, amino acids, nucleotides; integration of carbohydrate, fat and amino acids metabolism. Regulation and integration of metabolic pathways. Role of vitamins and minerals in metabolism of carbohydrate, protein, fat and nucleic acid metabolism. Bioenergetics in metabolism.

CO: This creates the foundation of employing physiological parameters to therapeutic nutrition. It also helps in understanding of the biochemical basis of physiology and different human diseases.

### **PHYPCOR08T** (1+1+1+1 credits)

**Physiological System II** (Endocrine System, Reproduction, Gastro-intestinal System, Renal Physiology)

#### **Endocrine System:**

Endocrine functions of the hypothalamus; Molecular actions and regulation of Pituitary hormones, Adrenal hormones, Pancreatic hormones, Adipose tissue hormones; Regulation and action of Parathyroid and calcitonin, calcium and phosphate regulation. Non-conventional endocrine molecules in health & disease.

#### **Reproduction:**

Testosterone & male sex hormones –Molecular mechanism, spermatogenesis, prostate function; Male infertility and its treatment; Female sex hormones –cellular and molecular mechanisms of action, gametogenesis, folliculogenesis, embryonic development of gonads and genital ducts, sex determination; Reproductive hormones and their role in fertilization, Implantation, Hormonal regulation of pregnancy, parturition and lactation; Umbilical cord blood and stem cells in health & disease; Placenta and placental hormones; menopause and andropause; Infertility and its treatment, assisted reproduction (IVF, ET), extra-uterine pregnancy, Hyper & hypogonadism; Puberty.

### **Gastrointestinal System:**

Histomorphology of Gastrointestinal tract, Gastrointestinal hormones, Role of hepato-biliary system in gastrointestinal functions, Hepatic circulation, Endoscopy.

### **Renal System:**

Electron microscopic and molecular structure of filtering membrane. Peculiarities of glomerular circulation. Transport mechanism of ions and molecules in kidney during physiological and pathological condition. Tubulo-glomerular feedback. Renal blood flow. Counter-current-exchanger and multiplier system, Assessment of renal functions. Kidney perfusion techniques, Peritoneal dialysis, Artificial kidney, Non-excretory functions of kidney. Urine formation, Waste elimination. Respiration and excretion on comparison.

CO: Physiological systems-based knowledge helps in therapy based on system organizations. Basic understanding of physiological processes of Endocrine System, Reproduction, Gastrointestinal System and Renal Physiology.

## **PHYPCOR09T** (4 credits)

### **Lifestyle & Stress Management**

Lifestyle: Definition, components, factors influencing, importance of lifestyle on health and environment. Health and disease: definition of health (WHO), dimension and determinants of health, physical health, mental health, psycho-social health. Current Issues in health and fitness.

History of stress. Anatomy and Physiology of human physiological stress and its effects, mechanism of stress response, etiology and indicators of stress, stress hormones and pathophysiology, with special reference to reproduction, gonadotropins, cytokines and oxidative

stress. Neurobiology of stress and adaptation, acute and chronic stress, impact on motor and sensory performance, stress management and adaptation. Prenatal stress. Psychological response to stress.

Homeostasis vs stress vs diseases: general concept, concept of risk, risk factors, risk groups; lifestyle components related to development of diseases.

Lifestyle modification and management of diseases, risk factors, mortality, impact on community health. Coronary heart disease, obesity, hypertension, diabetes mellitus, hypertension, osteoporosis, back pain, hypokinetic diseases. Drug abuse and addiction. Reduction of stress hormones.

Physical education, types, need and importance of physical activity and health benefits, recreational physical activity and its importance. Physical fitness and health promotion: assessment, components, activities, cosmetic fitness.

Sports, lifestyle and recreation: yoga, meditation and relaxation, sports and socialization, stress management. Nutrition as a lifestyle factor; concept of malnutrition and deficiency disorders, balanced diet, meal planning, energy intake, therapeutic diet. Physiological effects of exercise: cardio-respiratory endurance, muscular strength and endurance, free radicals, body composition and weight control. Exercise and aging: joint flexibility, physical work capacity, aging and exercise training.

CO: This gives an overview of different aberrant lifestyles and possible methods to deal with resultant diseases. This would equip one with personal knowledge regarding good style for better health and scientific knowledge to disseminate the same among others.

## **PHYPCOR10P**

### **Practical-II**

**4 credits**

Students are to individually prepare and present two *peer-reviewed* publications of high repute. Students are to submit the review documents and present them.

For group activity, students may be taken for visit to industrial establishments for ergonomic evaluation of man-machine-environment system or 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.

A community survey maybe undertaken considering growth monitoring of children, anthropometry and/or nutritional status.

CO: This includes practical activities beyond laboratory work. This unit helps students to be at par with the latest research, comprehend and present it. Scientific writing skill is also developed. Group activities also develop interpersonal relations necessary for adjustment at multiple levels.

## **PHYPSEC01M**

### **SEC**

**2 credits**

### **Physiological and Pathological Monitoring Techniques**

Estimation of ascorbic acid in biological samples (blood, tissues etc.) by methods using different oxidizing agents, Bio-assay of oxytocin and epinephrine, Hormone assay-ELISA. Study of localization steroidogenic enzymes in testis, ovary and uterus by histochemical methods.

Separation of amino acids and sugars by paper chromatography; Separation of amino acids and lipid fractions by thin layer chromatography. Separation of proteins by Polyacrylamide Gel Electrophoresis (PAGE). Agarose gel electrophoresis of plasmid DNA.

Anthropometric measurements - static and dynamic, anthropometric measurements for different design consideration- design of seat, work station, consumer products, personal protective equipments hand-tools, etc. Static and dynamic balance test, Determination of steady state, endurance time. Measurement of body temperature, (oral, axial, skin) at rest and different working condition. Recording and interpretation of ECG at rest and working condition, effects of posture on ECG. 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. Perimetry: visual field determination with different colours in perimeter in resting and stressful condition. Audiometry: study of frequency threshold curve in humans. Biofeedback: EMG biofeedback studies. Spirometric analyses of lung function test. Experiment on Chronobiology: Recording of 24 hours body temperature to study circadian rhythm of body temperature a) Recording of heart rate to study circadian rhythm of resting heart rate.

CO: This unit deals with hardcore physiological techniques. This would provide opportunity to work in industries based on ergonomic designing or undertake research work. Here students will learn different techniques that are associated with routine clinical laboratory work. This would help one to be a researcher or pathologist.

## SEMESTER-III

### **PHYPCOR11T** (4 credits)

#### **Pathophysiology, Toxicology & Pharmacology**

Symptoms and syndromes, Pathophysiology, pharmacology and toxicology (if any) of different communicable and non-communicable diseases.

Pathophysiology and pharmacological management of common diseases in community – herpes, encephalitis, common fever, diarrhea, amoebiasis, malaria, filarial, leishmaniasis.

Antibacterial drug against gram positive and gram negative bacteria. Gastritis, cholitis, ulceration, pancreatitis and cirrhosis of liver.

Hormonal and metabolic diseases - Hypo- and hyperthyroidism, diabetes, hypertension, osteoporosis, constipation, fatty liver, kidney stones, gall stones, polycystic ovarian syndrome.

Macular degeneration, glaucoma, cataract. Cancer and autoimmunity. Types of pain, pathophysiology of pain and its management. Pathophysiology of hemophilia, thalassemia, Alzheimer's disease, Huntington's disease. Pharmacogenetics. Stages of drug development – up to clinical trials, Principles of toxicology Effective dose of drug, therapeutic dose. Drug receptor interaction and drug resistance. Toxicity assessment of drug – acute and long term.

Effects of toxicants on different organisms; xenobiotic-induced oxidative stress, hepatotoxicity, reproductive toxicity, nephrotoxicity, neurotoxicity, genotoxicity, immunotoxicity, endocrine disruption.

**CO: This unit disseminates knowledge on molecular basis of pathological manifestation and thereby the pharmacological principles of its management. Understanding pathophysiological shift in disease and pharmacological principles in the management of different diseases opens up avenues to pharmaceutical industries.**

### **PHYPCOR12T** (4 credits)

#### **Sports & Work Physiology**

Historical development of sports sciences.

Muscular Systems in Sports and Exercise Physiology: The Neuromuscular system and exercise: Striated muscle, Contraction mechanics, Muscular strength, Muscular fatigue, Neuromuscular Integration, motor unit, motor unit recruitment, motor learning, skill learning, and muscle involvement in different actions.

Nutritional Aspects in Sports and Exercise: Bioenergetics and exercise metabolism  
Nutrition and Sporting Performance; Existing and current research for optimal nutrition for sporting performance. Current nutritional guidelines for sprint athletes, endurance athletes and games players. Nutritional supplementation, biochemistry action, proposed benefits and potential health risks associated with various nutritional supplements and ergogenic aids. Dietary assessment. Accuracy, prescription, reliability and validity of the available nutritional measurement tools

Sports and Exercise in Different Physiological Aspects: Applied physiological aspects of specific sports. Physiological demand of sprints, middle and long distance running, amateur boxing, rowing, cycling, badminton, field hockey, football (soccer)

Sports and Exercise in Different Environmental Conditions: Effect of biological rhythm, jet lag on sports performance. Sports and Exercise at Altitude, thermal extremes - Hot and Cold environment and sports performance

Factors influencing physical activity: Season, Altitude, Temperature, Humidity, Food habits, Drugs, Altitude training and sports performance, Diving physiology

Sports in Children, Women, Otherwise-abled People: Children- Pediatric exercise physiology. Function vs. body size during growth, anaerobic performance, Aerobic performance. Women –exercise in different phases of menstrual cycle, pregnancy adapted physical activity- Sports and Exercise for otherwise-abled people,

Principles of Training with Modern Techniques in Sports and Exercise Physiology: Assessment of Body profiles. Physiological principles of training, training methods, training cycles – effect of training on body systems, Training equipment. Warm up, cooling down, stretching exercise

Methods in sports training and assessment of sports performance. Physiology of training: effect on  $VO_2$  max, aerobic and anaerobic threshold level and performance

CO: This is an integral part of voluntary movements at professional or recreational level. Knowledge of this aspect of physiology would be helpful even at mundane level. It is an integral part of classical physiology which would help gain access to any sports related job or research.



### **PHYPCOR13T** (4 credits)

#### **Environmental Physiology:**

Human health and environment - environmental factors and general health, effects on growth and development. Environment and allergy – different allergens, Allergic reaction on skin and respiratory tract- immediate and delayed reactions. Environmental diseases – cancer, birth defects, reproductive damage, respiratory diseases, etc.

Metallic pollutants-mercury, lead, cadmium, arsenic and fluoride toxicity. Acute and chronic effects on health. Chelating agents and their characteristics, use of chelator to control metal pollution.

Environmental noise: sources – industrial, transport, construction services, domestic, Noise induced hearing loss, cardiac effects, sleep disturbances, noise and body stress, noise and unborn, Management of noise pollution – noise exposure mapping, control approaches, precautionary measures.

Waste disposal: Human excreta disposal; Solid waste disposal-hazards & protection; Hospital and biomedical wastes – hazards & protection, Recycling of waste, Radioactive waste, electronic waste & techno trash hazards and protection.

CO: Environmental aspect is a major knowledge point that would help know the effects that the ever-changing climatic conditions would have on human. Equipped with the knowledge of environmental toxicants that are harmful for human health, helps in increasing awareness about pollutants and importance of conservation of nature. This would also assist in gaining access to jobs in authorities concerned with environmental issues.

### **PHYPCOR14T** (4 credits)

#### **Haematology & Immunology**

Erythrocytes development, haemoglobin, iron-ferritin-transferrin system. Erythropoietin. Blood transfusion. Leukocytes development, Homeostatic regulation of blood cells development. Role of transcription factors in blood cell development, cross-talks between immunocytes.

Innate and adaptive immunity, Cell-mediated immunity. Humoral immunity. Antibody types and structure, Vaccination, Lymphatic system, Major Histocompatibility Complex-Types and detection techniques, Regulation of its expression, Immunogenetics and its applications. Role of Complement in immunological defense, Evolution of immune system. Haematological & Immunological techniques. Cell and Tissue Culture, Role of Cytokines on

immunocytes. Infectious immunity, Cancer immunity, Reproductive Immunity, Brain immunity.

Basic mechanism of autoimmune disorder

CO: Most of the pathological investigations are blood based. This course is the foundation of diagnostic and disease preventive area. Combined knowledge of hematology and immunology is the foundation of different diseases – from infectious diseases to cancer and autoimmunity.

### **PHYPDSE01P** (4 credits)

#### **A. Diagnostic Physiology:**

**4 credits 50 marks**

Documentation procedure of human diseases. Systematic Review - Linear versus nonlinear – pathology versus patho-physiology based decision. Case study on etiology of human disease cases, static and dynamic data. Empirical versus quantitative analysis of human disease data – population versus individual data. Application of Bayes' theorem for analyzing transcriptomic and expression data. Pathological diagnosis through computer vision, Image processing and analysis. Predictive model, physiology and population based therapy modelling. Optimization techniques – clinical domain knowledge, off-target toxicity, socio-economic perspective, cost-effectiveness analysis.

CO: Technicality of integrating clinical data, population data helps in Medical Analysis towards rational therapeutic design for individual cases that enhances opportunity in Pharma based IT industry. Course content exposes towards technicality of amalgamation of qualitative clinical data, population based data and superimposition of individual case data help in clinical decision making.

**Or**

### **PHYPDSE01P** (4 credits)

#### **B. Physiological Therapeutics:**

**4 credits 50 marks**

Linear and non-linear analysis of dynamical physiology – daily and monthly variation of physiological parameter. Identification of trajectories using heart rate and body temperature variation. Human deep tissue lymphatic system – anatomical localization of distribution of lymph glands, histopathology of bone marrow, spleen, placenta and thymus, radiodiagnosis of lymphatic nodes, polyp and ulcer. Identification of different species of malarial parasite within immune system. Expression (genomic and proteomic) data analysis. Computational designing of antigen and peptide vaccine or cell based method designing.

Dietary management of patients and formulation of their diet chart. Growth chart in different stages of child growth. Child nutritional / Geriatric health survey or physiological adaptation at high altitude / cold / high temperature survey.

Determination of maximal heart rate, cardiac cost and cardiac efficiency by step test method, and treadmill. Recording and interpretation of EMG at rest and working condition. Monitoring of physiological variables associated with yoga and exercise in preventing and curing of diseases. Determination of pulmonary ventilation, static and dynamic lung function tests during yogic postures.

Diagnostic and rehabilitation guidelines for burnt and recurrent spontaneous abortion. Determination of pain sensation by hot/ cold exposure within physiological limit by pain mapping.

CO: This unit equip for diseases prevention through the application of knowledge of physiology, thereby to act as independent professional in the field. Course contents expose students towards disease prevention and management at pre-clinical level.

### **PHYPGEC01T**

#### **(GEC) Community Health Problems & Management: (4 credits; 50 marks)**

Communicable and non-communicable diseases. Disease and syndrome. Brief idea about etiology, pathophysiology and management of different community prevalent diseases (communicable and non-communicable) - Fever, cough and cold, indigestion and acidity, diarrhoea, amoebiasis, giardiasis, malaria, tuberculosis, dengue, fatty liver, obesity, PCO syndrome, spontaneous abortion, kidney and gall bladder stone, diabetes, asthma, hypertension, seizure, cataract, macular degeneration, glaucoma, Parkinson's disease, osteoporosis, LBP. First hand management in burn and fracture. Brief idea about cancer and autoimmune diseases.

CO: This is to share knowledge of physiology among community, so that non-specialized people can take right step towards disease prevention and necessary steps to reach to clinical professionals in time. Commonly seen diseases that are seen in community is addressed in this unit so that right judgements can be taken towards that disease.

## SEMESTER-IV

**PHYPCOR15T** (4 credits)

### **Epidemiology & Public Health**

Definition and concept of epidemiology, health and disease, role of genetics in health and disease, screening, genetics, and role of environment. The influence of epidemiology and biostatistics on legal and ethical issues. Epidemiologic study designs for investigating associations between risk factors and disease culminating with criteria for causal inferences.

Basic methods for infectious disease epidemiology and case studies of important disease syndromes and entities, Methods, definitions and nomenclature, outbreak investigations, disease surveillance, case-control studies, cohort studies, laboratory diagnosis, molecular epidemiology, dynamics of transmission. Vaccination program. Holistic approach.

Epidemiology, etiology, pathogenesis, prevention and control of communicable diseases viz., malaria, cholera, tuberculosis, leprosy, diarrhoea, poliomyelitis, viral hepatitis, measles, dengue, rabies, AIDS, plague, etc. Case-studies focus on acute respiratory infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, malaria, and other vector-borne diseases.

Non-communicable diseases viz., coronary heart disease, hypertension, diabetes mellitus, cancers, etc.

Occupational disorders viz., pneumoconiosis, hearing loss, accidents, dermatosis, etc., unorganised sector. Role of alternative medicine system in disease control.

Techniques of social sciences research relevant to health fields, definition and scope of social and behavioural sciences in health. Concept and significance of social structure and social organization, role of culture and behaviour related to health and disease, political and economical aspects of health, concepts and techniques of information, education and communication including counselling methodology.

**CO: This unit deals with health problems of various etiology at the community level. Equipped with the merits and demerits of community lifestyle, strategies may be created to prevent the diseases at the societal level. This would increase self-awareness as well as help disseminate the critical information.**

## **PHYCOR16T** (4 credits)

### **Biophysics & Biomedical Instrumentation**

Colligative properties, Filtration, Centrifugation, pH and Buffer, Thermodynamics – adiabatic, isothermal, quasibatic changes, Entropy & Enthalpy, Information Entropy. Bioenergetics and energy transduction.

Tracer techniques in biological experimentation and medical applications.

Recording instruments – Galvanometers. Microscopy – Light, Phase contrast, fluorescence and confocal; Electron microscopy; Staining Techniques; Spectroscopic principles – UV/light, fluorescence, ORD/CD, Magnetic resonance imaging; IVP, PET and CT scanning. Image analysis.

Use of sound in diagnosis: Echocardiography, ultrasound.

Chromatography and Electrophoresis – application in separation and characterization of biomolecules. Biophysical principles and applications of blotting techniques. Amino acids, Protein and Nucleic acid sequencing. Genomics. Gene amplification – PCR. Gene knockout and In vitro mutagenesis Technique. Endonuclease, Plasmid map. Gene Expression Analysis, Post-translational modification – application of Proteomics.

**CO: This unit deals with the biophysical principles for understanding of physiological parameters and measurement technology. This prepares for an advanced research and professional field.**

## **PHYCOR17T** (4 credits)

### **Cell Biology & Biotechnology**

**Cell Biology:** Structure function correlation of cell membrane, extra-chromosomal inheritance, lysosomes diseases, function of peroxisomes, cytoskeleton proteins. Cell movement and chemotaxis analysis. Chromatin structure. Apoptosis. Cellular differentiation. Regulation of cell cycle. Regeneration and degeneration. Cellular cross-talk. Receptor mediated signal transduction - growth factors. Transport across membranes; Endocytosis. Hybridoma technology. Cellular dynamics - Movements of macromolecules, organelles and whole cells. Protein targeting.

Stem Cell Biology (renewal, potency, differentiation, plasticity etc). Embryonic and adult stem cells. Induced pluripotent stem cell (iPS). Tissue regeneration for regenerative medicine, Tissue specific stem cells. Telomeres and stem cells, Planaria stem cells, Regeneration in vertebrates. Mesenchymal stem cells, Hematopoietic stem cells. Stem cells and cancer.

Technology for isolation and purification of RNA, DNA (genomic and plasmid) and proteins. Molecular cloning of DNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors. Isolation of specific nucleic acid sequences. Genomic and cDNA libraries. Plasmid map, phage, cosmid, BAC and YAC vectors. isolation, separation and analysis of carbohydrate and lipid molecules. Microarray. Transcriptomics and Proteomics. Gene Therapy. CRISPR technology.

**CO: This prepares for an advanced research field with modern technology. This would help pursue cutting edge research or join R&D of biotechnology industry**

### **PHYPDSE02T (4 credits)**

#### **A. Therapeutic Nutrition**

**4 credits**

Therapeutic nutrition and dietetics, purpose and principles, modification of normal diet into therapeutic diet. Nutritional assessment in patient care, physical and psychological aspects of patient's feeding. Nutrition and Complementary Alternative Medicine (CAM) – Homeopathy, Ayurveda and Siddha, Concept of Integrative Medicine, dietary fibers, phytochemicals, nutraceuticals, antioxidants and nanoceuticals.

Routine hospital diets: basic concepts and method of oral feeding, tube feeding, parental feeding, intravenous feeding, pre and post-operative diets, diets in surgical conditions and burns.

Incidence, etiology, pathology, metabolic changes, clinical manifestations, complications, dietary management and counseling for the following disorders: diabetes, cardiovascular disease, obesity and underweight, metabolic disorders (inborn error of metabolism), arthritis, gout, osteoporosis, cancer, AIDS, renal disorder, GI system disorder and mentally retarded patients.

Planning of diets for the following diseases: obesity, diabetes mellitus, hypertension and atherosclerosis and acute glomerulonephritis. Geriatric nutrition.

**CO: This knowledge encompasses the nutritional management of common diseases. Diet planning for disease conditions shall be a practical approach for training as a nutritionist or dietician.**

**OR**

**PHYPDSE01T (4 credits)**

**B. Transplantation Science:** Differences between different organs in transplantation. Role of HLA in transplantation - receptor density. Concept of alleles. Forms of matching and grafting - autologous, allogenic and xenogenic. Method of tissue typing - serological and DNA. Techniques of DNA based typing - SSP, SSOP. Different DNA based typing - exon, intron and microsatellite. Microarray. Importance of typing in forensic. Bone marrow and stem cell transplantation - precautionary measures. GVHD. Transplantation in different diseases. Organ registry. Case studies. Minor alleles.

CO: This prepares for an advanced research field. Transplantation Science exposes about the molecular immunological technological aspects of transplantation and cell based therapy.

**PHYPCOR18M (8 credits)**

**Project, Seminar & Grand Viva Voce**

**Project** shall be carried out under the guidance of a teacher for a period of maximum four months. Students will have to prepare the project report in a standard format and submit the same in duplicate well before the examination. The report should not be less than 20 A4 size typed pages.

**Project presentation:** 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 before the external examiners.

There shall be a separate grand viva-voce encompassing the knowledge of Physiology in a greater sense.

CO: Objective of the course is to prepare students for research. This will provide practical training on data collection and analysis for further research work or survey compilation. This would help students realize the vitality of proper presentation of a work. Besides recollecting all the study materials, this would help prepare students for interview.

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