SYLLABUS

For

MASTER OF SCIENCE

IN

HUMAN PHYSIOLOGY

Under

Choice Based Credit System (CBCS)

Raja Narendra Lal Khan Women's College (Autonomous)

Items	**Semester I: [300 Marks 24 Credits]**		**Semester II: [300 Marks 24 Credits]**		**Semester III: [300 Marks 24 Credits]**		**Semester IV: [300 Marks 24 Credits]**		**Total Marks: [1200 Marks 96 Credits]**	
	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical
Marks	150	150	200 (including Elective 50)	100	200 (including Elective 50)	100	150	150	700	500
Credits	**12**	**12**	**16**	**08**	**16**	**08**	**12**	**12**	**56**	**40**

Syllabus of Human Physiology

Semester I: 300 Marks

Theory / Practical	**Paper Code**	**Unit**	**Title**	**Marks**	**Credits**
Theory	**PHY 101**	**1**	**Systems Physiology**	**25**	**02**
		2	**Physiological Chemistry and Metabolism**	**25**	**02**
	PHY 102	**3**	**Medical Physics and Chemistry**	**25**	**02**
		4	**Medical Instrumentation and Techniques**	**25**	**02**
	PHY 103	**5**	**Biostatistics and computational Physiology**	**25**	**02**
		6	**Computer Application in Health Statistics and Bioinformatics**	**25**	**02**
Practical	**PHY 104**	**7**	**Bio-Analytical Techniques**	**25**	**02**
		8	**Biochemical Techniques**	**25**	**02**
	PHY 105	**9**	**Human Experiments**	**25**	**02**
		10	**Experimental Physiology**	**25**	**02**
	PHY 106	**11**	**Statistical Treatment of Biological Data**	**25**	**02**
		12	**Computer Application in Biological Problems**	**25**	**02**

Semester II: 300 Marks

Theory / Practical	Paper Code	Unit	Title	Marks	Credits
Theory	PHY 201	13	Community Health: Exercise Physiology and Mass Fitness	25	02
		14	Community Health: Health, Disease, Nutrition and Lifestyle Management	25	02
	PHY 202	15	Advance Microbial Studies	25	02
		16	Advance Studies in Applied Biotechnology & Molecular Pharmacology	25	02
	PHY 203	17	Nerve Muscle and Sensory Physiology	25	02
		18	Physiology of Excitable Cells and Higher Functions of Brain	25	02
	PHY 204 (CBCS)	1	Lifestyle And Health	25	02
		2	Importance of Health Education and Its Promotion	25	02
Practical	PHY 205	19	Anthropometry and Assessment of Community HealthStatus	25	02
		20	Ergonomic, Exercise Physiology and Mass Fitness	25	02
	PHY 206	21	Applied Molecular Biotechnology Techniques	25	02
		22	Applied Microbiological Techniques	25	02

Semester III: 300 Marks

Theory / Practical	Paper Code	Unit	Title	Marks	Credits
Theory	PHY 301	23	Cellular & Molecular Physiology	25	02
		24	Human Genetics	25	02
	PHY 302	25	Endocrinology & Reproductive Physiology	25	02
		26	Human Immune System	25	02
	Special Paper				
	PHY 303 Microbiology and Immunology	27	Advanced Studies in Microbiology	25	02
		28	Cellular and Molecular Immunology	25	02
	PHY 304 (CBCS)	1	Environment and Health	25	02
		2	Human Reproductive Health and Related Issues	25	02
Practical	PHY-305	29	Histochemical and Histometric Techniques	25	02
		30	Experimental Immunology	25	02
	Special Paper(Practical)				
	PHY 306 Microbiology and Immunology	31	Microbiological Techniques	25	02
		32	Experimental Immunology	25	02

Semester IV: 300 Marks

Theory / Practical	Paper Code	Unit	Title	Marks	Credits
Theory	PHY 401	33	Yoga And Stress Physiology	25	02
		34	Modern Techniques In Physiology	25	02
	PHY402	35	Research Methodologies In Applied Physiology	25	02
		36	Industrial And Working Environmental Physiology	25	02
	Special Paper				
	PHY 403 Microbiology and Immunology	37	Microbial Genetics: Advanced Studies	25	02
		38	Clinical Immunology	25	02
Practical	PHY 404	39	Modern Techniques In Physiology I	25	02
		40	Modern Techniques In Physiology II	25	02
	Special Paper (Practical)				
	PHY 405 Microbiology and Immunology	41	Advanced Techniques In Microbiology	25	02
		42	Clinical Immunology	25	02
	PHY 406	43	Project Work	25	02
		44	Project Preparation & Presentation	25	02

The subject of Human Physiology is one of the important interdisciplinary areas in teaching, training and learning that are 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 the analysis of different aspects of the functions of biological molecules, organisms and entities. The techniques and methodologies of Human Physiology have wide applications in the biological, medical and related sciences. Students with Masters in Human Physiology have job opportunities in the Universities, Colleges, Schools, R and D Industries, Medical Centres/Colleges, Research Institutes, and other Government and Non- government Organizations.

Program outcomes: Upon completion of the course students will be able to have a deep knowledge on the physiology of Human body and its applied fields. This M.Sc programme in Human physiology will provide students with the necessary knowledge and skills to undertake a career in research, either in industry or in an academic setting. The training provided will give students the breadth and depth of scientific knowledge in the important newly developed area of Human physiology.

1. **General science training of students -** provide an intellectual training that enables students to develop a rigorous scientific approach in synthesising information and concepts, exercising evaluative judgement and in making arguments about human physiology. To provide a thorough training in written and verbal communication of scientific information and ideas. To generate in students an appreciation of the importance of the application of human physiology in academic, industrial, economic, environmental and social contexts.

2. **Specific scientific skills -** equip students with practical skills that will prepare them for a future career as a worker or researcher in this important interdisciplinary area.

3. **Transferable skills -** equip students with a broad range of general skills that will transfer to the future workplace.

4. **Knowledge base for students -** provide students with an advanced background in Human physiology which will be of particular relevance to the medical, pharmaceutical and biotechnological industries. Students also receive training in medicinal aspects of drug design and can specialise in a more biological or biochemical area as part of their industrially related research project. Additionally, the project will prepare students to continue with postgraduate research in the form of a PhD or to work in or in association with industry.

5. **Benefit to students of active research -** harness the research expertise of staff in the School of Biosciences to provide a stimulating and current input into teaching and to provide students with training in current research practice.

6. **The learning environment -** provide an attentive, supportive and formative environment for the academic and personal development of our students. To provide high quality education and training through a systematic approach to quality assurance.

Human Physiology

Semester I: (Theory: 150 + Practical: 150)

Theory (Total Marks: 150, 12 Credits)

Paper: PHY 101

PAPER: PHY 101(UNIT-01): SYSTEMS PHYSIOLOGY F.M. 25, 02 Credits

Module I

Cellular organization and signalling:

Membrane structure, function and regulation of intracellular transport, electrical properties of membranes. Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction.

Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, calcium as intracellular messenger, protein-tyrosine phosphorylation, interrelationship among different signaling pathways, nitric oxide as intercellular messenger, programmed cell death: apoptosis, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

Module II

Cardiac physiology and Circulatory system:

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.

Microcirculation – functional; properties of capillaries, trans-capillary 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.

Module III

Gastrointestinal physiology and Renal Physiology:

Gastrointestinal hormones and their interplay, Chemistry and mechanism of action of Defensive and
Aggressive factors, Immune function of GI Tract, Central control of gastrointestinal functions. Pathological Situations of GI

Renal blood-flow, neural control of renal functions, Kidney functions. Renal regulation of electrolytes:
Functions of different parts of kidney and assessment of renal functions.

Module IV

Respiratory system: a) cells of airways and alveoli – ciliated cells, cells for mucous production, alveolar cells, surfactant; c) control of respiration – respiratory centres, origin of respiratory rhythm, central and peripheral chemoreceptors, chemical control of breathing, breath holding; d) non-respiratory functions of the lung- 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 atelectasis, pulmonary embolism, respiratory distress syndrome, sudden infant death.

Course Outcome: This unit highlights the understanding of systems physiology as the computational and mathematical modeling of complex biological systems and focuses on complex interactions within human systems, using a holistic approach. Special emphasis has been given to the cardiovascular and respiratory system.

PHY 101(UNIT-02): PHYSIOLOGICAL CHEMISTRY AND METABOLISM F.M. 25, 02 Credits

Module I

Bioenergetics and biological oxidation: Redox potential, aerobic oxidases, mixed function oxidases, anaerobic dehydrogenises including iron- suffer clusters and cytochromes, mitochondrial electron transport chain, its complex and their roles, extra-mitochondrial electron transport chains; oxidative phosphorylation – chemiosmotic theory, Boyer's binding change model; Q cycle, mechanistic proton translocation, substrate level phosphorylation in aerobic and anaerobic systems, ATP yield – energy conversion and conservation, ionophores in uncoupling oxidation and phosphorylation.

Module II

Enzyme Kinetics: Chemical mechanisms in enzyme catalysis; competitive, non-competitive and uncompetitive inhibition kinetics; allosteric modulation, sigmoid kinetics; regulatory enzymes and their roles; reversible covalent modification; induction and repression; experimental measures of enzyme activity, separation methods in enzyme assays.

Module III

Three dimensional structures of proteins: Ramachandran plot, protein aggregation and protein folding, role of molecular chaperones in protein folding; mis-folding 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: 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: integration of carbohydrate, protein and fat metabolism, TCA cycle: cataplerosis & anaplerois.

Course Outcome: To develop knowledge and understandings regarding concepts of biocatalysts; cellular biochemical energetics; structural features and nature of interactions of several biomolecules in physiological processes; metabolic processes governing physiological systems and also the interrelationships among the different metabolic pathways.

Paper: PHY 102

PHY 102(UNIT-03): MEDICAL PHYSICS AND CHEMISTRY F.M. 25, 02 Credits

Module I

Viscosity of liquids and gases: use of viscometry, visco elasticity, laminar and turbulent flow, Viscosity coefficient; Newtonian and Non-Newtonian fluids, significance of Reynolds' number in hemodynamics, measurement of viscosity by Oswald's viscometer; models for flows of liquids: Bernoulli and Poiseuille's equations and their applications.

Module II

Electrophysiological techniques-Electrical properties of the cell membrane- membrane potential- driving force, membrane resistance, membrane capacitance; Electronic model of the plasma membrane. Patch clamping- recording modes: voltage clamp and current clamp. Patch clamp configurations and their equivalent electronic circuits.

Module III

Mechanics in breathing work of breathing, Dalton and Henry's laws of partial pressures in gas mixtures, gas exchange: Fick's law of diffusion, ventilation, and perfusion.
Physics of vision: light and field of view, illumination of retina, eyes as an optical instrument, reduced eye, Critical fusion frequency (CFF).

Module IV
Fundamental physics of ultrasonic waves: beam patterns of a transducer, piezoelectricity, ferroelectricity and magnetostriction, emission and reception of ultrasounds, ultrasound therapy, and 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.

Course Outcome: This unit highlights the relation between physical principles and biological systems and explains how biophysical principles are deeply related to physiology. It is designed to describe the physiological mechanism on the basis of physical laws and the bio-application of different physical principles. In the present unit involves the application of physical techniques to achieve an understanding of life processes at a molecular level and helps to achieve a mechanistic understanding of biological processes.

PHY 102 (UNIT-04): MEDICAL INSTRUMENTATION AND TECHNIQUES F.M. 25, 02 Credits
Module I
Medical imaging techniques
Modern techniques and Principles for studying nervous mechanism including neuroimaging, CT, MRI, PET, SPECT, BOLD.
Module II Biomedical instrumentation
Blood flow meters: Electromagnetic, Ultrasonic, NMR, Laser Doppler.
Bioelectric electrodes: ECG, EEG, EMG, microelectrodes.
Biomedical recorders: ECG, EEG, EMG, cardiac pacemaker, defibrillators.
Module II
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
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.
Pulmonary function analyzers: Spirometry, respiratory gas analyzers, blood pH, blood pCO2, blood pO2 analyzer.

Course Outcome: The main objective is to introduce the basic biomedical engineering technology explains the canonical structure of biomedical instrumentation systems as well as the principle and application of biomedical instruments. This will help the students to understand, design and evaluate systems and devices that can measure, test and/or acquire biological information from the human body.

Paper: PHY 103

PHY 103(UNIT-05): BIOSTATISTICS AND COMPUTATIONAL PHYSIOLOGY F.M. 25, 02 Credits

Module I

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

Testing of hypothesis: null hypothesis, levels of significance, errors of inference, one- tail and two-tail tests.

Module II

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.

Course Outcome: This unit will encompass the methodology and theory of statistics as applied to problems in the field of life sciences. The course will provide students with basic understanding and application of statistics as a tool for testing hypothesis and experimental design for research studies.

PHY 103(UNIT-06): COMPUTER APPLICATION IN HEALTH STATISTICS AND BIOINFORMATICS

F.M. 25, 02 Credits

Module I

C**omputer 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, Neuralcircuitry, immunological system; biochemical pathways; drug design etc.

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. 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 and 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).

Course Outcome: This unit provides basics knowledge of computer hardware and software and the learners can develop skills of programming for solving biological science oriented problems. The student will be able to learn the importance and application of bioinformatics.

PRACTICAL PAPER

Paper: PHY 104

PHY 104(Unit-07): Bio-Analytical Techniques **F.M. 25, 02 Credits**

1. Studies on General Enzymology
   a) Effects of pH and temperature b) Determination of Q_{10}
   c) Effects of substrate concentration, d) Determination of Km, Vmax
   e) Determination of Vmax
2. Separation and identification of amino acids by paper chromatography
3. Separation and identification of amino acids by thin-layer chromatography
4. Separation of protein by polyacrylamide gel electrophoresis (PAGE).
5. Separation of DNA by gel electrophoresis.

Course Outcome: To train the students on bio-analytical methods relating to isolation and assay of biomolecules associated to diverse physiological processes. Additionally, training to be provided to the students on microbiological culture and analysis techniques to detect microbes.

PHY 104(Unit-08): Bio- Chemical Techniques **F.M. 25, 02 Credits**

1. Blood calcium and blood lactate estimation.
2. Estimation of triglyceride content of blood.
3. Estimation of urea, uric acid, creatine and creatinine.
4. Acid and alkaline phosphatase, bilirubin, free fatty acids, SGOT and SGPT (transaminases) for liver function test from tissue homogenate.

Course Outcome: To train the students by hand-on experiments on biochemistry to pursue metabolic heath assessment and analysis.

Paper: PHY 105

PHY 105: (Unit-09): Human experiments **F.M 25, Credits 02**

1. Study of pulse rate and breathing rate with the change of postures.
2. Determination of diurnal variations of pulse rate, blood pressure, respiratory rate.
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
13. PFT and Pulse Oximeter

Course Outcome: In this practical unit the students will be able to learn the different techniques of assessing physiological parameters related to work and exercise. There is enough scope for the learners to develop skills for measuring different health related parameters of human.

PHY 105(Unit-10): Experimental Physiology **F.M 25, Credits 02**

1. 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.
2. Experiments on isolated uterus of rat: effects of drugs like Oxytocin.
3. Bioassay: Preparation of standard curves for acetylcholine through bioassay.
4. Estimation of nature and potency of unknown drug by using reference standard and blocker.
5. Bioassay of catecholamine.
6. Estimation of the potency of the unknown sample (Oxytocin) on rat uterus muscle by using reference standard.

Course Outcome: To demonstrate the students the kymographic record on skeletal and smooth muscles to explain their nature of functions and the effect of agonist and antagonist drugs and electrolytes and other physical parameters on skeletal muscles as well as on smooth muscles.

Paper: PHY 106

PHY 106 (Unit-11): Statistical Treatment of Biological Data F.M. 25, 02 Credits

1. Computation of percentile values from grouped data.
2. Computation and significance of product- moment r between two continuous measurement variables.
3. Computation and significance of Kendall's rank correlation coefficient between two ordinal 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 contingency coefficient between two qualitative variables having more two classes.
6. Testing the goodness of fit of a continuous frequency distribution with best –fitting normal distribution by Chi square test and G test.
7. Computation and significance of one- way model I analysis of variance and multiple comparison t- test and Scheffe,s F test.
8. Computation of Kruskal-Wallis test for one-way anova and multiple comparisons by Mann-Whitney U test.
9. Computation of models I linear regression equation of one variable on another.

Course Outcome: To train the students to employ bio-statistical methods to biological problems and draw proper interpretation for any given issue.

PHY 106(Unit-12): **Computer Application in Biological Problems F.M. 25, 02 Credits**

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.
   g. Operation of Ms Power point – making slide for any biological topic, editing, slide show.

3. Bioinformatics - study of structure of biomolecules – primary and secondary structure, tools for sequence analysis

Course Outcome: The learner will be able to get hands on training on operating system and standard software packages for solving problems in biology. The course will help the learners to acquire skill of computer programming to computer different biological data.

Semester II: (Theory: 200 + Practical: 100)

***Theory: (*Total Marks: 200, 16 Credits)**

PHY 201(UNIT-13): COMMUNITY HEALTH: EXERCISE PHYSIOLOGY AND MASS FITNESS
F.M. 25, 02 Credits

MODULE I: Ergonomics & human factor

- System Design: Concept of system design; Effect of Man, Machine and Environment in System Design; Failure of System – accident.
- Ergonomics and Safety: Application of Ergonomics for the development of safety; Analysis of accident; unsafe conditions; Mechanical (engineering) control/protective devices; Personal Protective Device (PPD). Occupational health.
- Anthropometry: Definition of Anthropometry; Static & Dynamic Anthropometry; Application of Anthropometry in design development.

MODULE II: sports physiology and sports medicine

- Hematological changes during graded muscular exercise, Oxygen consumption and O_2 pulse during graded muscular exercise. Heart rate, blood pressure, pulmonary ventilation, ventilation equivalent, VE Max, VO2Max; Alveolar ventilation at different state of breathing. Cardiorespiratory changes in sedentary and trained persons during exercise, Lactic acid concentration and O2 debt, Nutrition in sports and exercise, Concept of Physical fitness.
- Physiological effects of doping.
- Principles of safety in Physical Activity and sports – Role of conditioning, importance of correct coaching and teaching, the use of protective equipment, following the rules, availability of emergency care.
    - Management of Illness and Injury sustained in Exercise Activities – Prompt diagnosis, first –aid procedures, definitive medical care, rehabilitation procedures.
    - DRUG ABUSE IN SPORTS: Introduction: Brief history – economic and social causes of drug, Classification of Drugs and Mechanism of action. Dope Methods and Mechanism of action.

MODULE III: Occupational health hazards &it's physiological management

- Introduction to occupational health: Concept of Bernardino Ramazzini.
- Prevention of hazards: Personal Protective Devices: Respiratory protective equipments: Divisions and Uses, Industrial ventilation: Local Exhaust System as Engineering control.
    - Role of OSHA and NIOSH: Prevention and management of occupational health hazards
    - Work and health, Selection of human resources, Design of workstation, Occupational Impact on different systems Physiology for safety and productivity, Psycho-physiological aspects of work, Shift work, Physiological aspects in Regulation s and Recommendations.

MODULE IV: Occupational Stress physiology

- Defining stress, Stress-responses, Heat stress, Acclimatization to heat, Thermal distress: dehydration and heat cramps, heat exhaustion, heat stroke and prevention of thermal distress, Cold stress: Frost bites and Hypothermia.
- Oxidative stress, oxidative damage and mechanisms involved. Stress and Heat Shock Proteins, Stress-induced diseases and their possible remedy by anti-stress agents.

Course Outcome: This course addresses the concept of fitness with emphasis to physical training. It highlights the basic components of ergonomics and anthropometry. It also discusses various aspects of Occupational Health and safety with reference to occupational diseases. The students can acquire knowledge about therapeutic effects of practicing yoga.

PHY 201(UNIT-14): COMMUNITY HEALTH: HEALTH, DISEASE, NUTRITION AND LIFESTYLE MANAGEMENT **F.M. 25, 02 Credits**

Module I

- **Concept of community health and disease:** 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, epidemiological triad, web of causation, high - risk group, prevention of communicable diseases, prevention of non - communicable diseases, control of malaria, kala-azar, diarrhoeal disorders and endemic iodine deficiency disorders, physiologists as health counsellors.
- **Vulnerable sections in the society and their health care:** health and diseases in infant /children/girlchild/old persons, women in the reproductive age, rural/tribal population, health problems of old ages.

Module II

- **Nutrition in infancy, childhood and adolescence:** Nutritional requirement in adults, nutritional requirements of nutrients during infancy, breast feeding – nutritional and others factors, advantages, breast feeding human immunodeficiency virus transmission, infant milk substitute (IMS) act 1992, formula feeding, supplementary foods of milk, cow's milk, goat's milk, vegetarian beverages, fruit juice, nutritional requirement of pre- term babies.
- **Nutrients, gene and health:** Different food groups and nutrients, dietary fibres, food additives and artificial sweeteners, food processing, foodborne illnesss, food protection-thermal treatment, pasteurization, chemical methods, dehydration methods, vaccum and modified atmosphere packaging, irradiation technology; food toxicity and safety**,** classes of nutraceuticals, nutraceuticals to age, sex, physiological status (pregnancy), probiotics and prebiotics, functional foods and its prospects; transgenic foods and its importance; drug-nutrient interaction, nutritional epigenomics, nutrient sensing - role of sensing transcription factors and dietary signalling routes, genomics and transcriptomics.

Module III

Population biology

- Population problems: The 'law of diminishing returns', prospective
- People of India: Overview of the physical (anthropometric) and genetic diversities and affinities of the people of India. Molecular genetic markers in the study of human heritage:
- Genes and environment as determinants of health and disease: Isolation, migration, immigration, amalgamation and assimilation of populations.
- Molecular biology to community control of several burdensome diseases in India: A case example like Beta-Thalassemia in India.

Module IV.

- Health care and management about **COVID 19, SARS, H1N1, Swine flu, by WHO, ICMR etc.**
- **National health policy/programme, role of non-govt. and international organizations:** national health policy, role of WHO, UNICEF, UNDP, FAO, UNESCO, ILO, WORLD BANK, Red Cross, CARE, national health programmes, alternate health care planning.

Course Outcome: This unit highlights the concept, determinants and risk factors regarding community health and disease. It also emphasizes the role of National health policies and Non- Govt and International organizations in health promotion. It provides basic concept of population genetics and describes genetic predisposition of diseases. The concept of lifestyle modifications for effective treatment of metabolic disorder. It also addresses various aspects of lifestyle modification using dietary modifications, exercise and nutrition promotion in community for geriatric and general people.

Paper: PHY 202

PHY 202(UNIT-15): ADVANCE MICROBIAL STUDIES F.M. 25, 02Credits

Module I

Microbes& microbial pathology

General Microbiology: Different types of microbes, classifications; morphology, structure, classification, reproduction and physiology of bacteria. Microbial fermentation; antibiotics; organic acids and vitamins; microbes in decomposition and recycling processes; symbiotic and asymbiotic N2-fixation;

Microbiology of water, air, soil and sewage: microbes as pathological agents in man; general design and applications of biofermenter and biofertilizer.

Man-microbe interactions: Commensals, beneficials, parasites and pathogenic microbes.

Microbial Pathogenicity: Germ theory of disease, Infectious diseases and its control.

Microbial Flora: Normal microbial flora of humans on the skin, in the Gastro-intestinal tract, Respiratory tract, Urino-genital tract etc. and their role in health and disease

Module II

Growth and nutritional requirements of bacteria: growth curve, environmental influences on growth, nutritional requirements of bacteria, culture media, sterilization, 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, microorganisms in dairy products, microorganisms in food, industrial uses of microbial by-products, microorganisms 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, orthomyxoviruses, paramyxoviruses, picornaviruses; retroviruses: HIV and AIDS.

Study of some important groups of protozoa: general characteristics, the traditional groups of 'protozoa: sarwodina, ciliophora, mastigophora, sporozoa, some common protozoa mediated diseases: amoebiosis, giardiasis, trypanosomiasis, leishmaniasis, malaria.

Course Outcome: To develop advanced knowledge regarding microbial survival in nature under different environmental conditions, their interactions with hosts and their specific importance in several aspects on earth.

PHY 202(UNIT-16): ADVANCE STUDIES IN APPLIED BIOTECHNOLOGY& MOLECULAR PHARMACOLOGY F.M. 25, 02Credits

Module I

Applied biotechnology for human health

1. Concepts of Biotechnology: General & historical, aims, achievements and prospects.
2. Microbial technology: Fermentation technology, production of ethanol, penicillin and other antibiotics, microbial-insecticides, enzymes, amino acids etc. and application in industry. Use of microorganisms in pollution control.
3. Enzyme biotechnology: Immobilized enzymes and its application in industry.
4. Principles of protein engineering.

5. Biotechnology as applied to Immunology.

Module II

Principles of genetic engineering & recombinant DNA technology

1. Molecular Cloning: Vectors, Host, Restriction Enzymes, Transformation, Detection
2. PCR and Real Time PCR, site directed mutagenesis
3. Hybridisation, Immunoblotting DNA micro-array relevant Technique
4. DNA Sequencing, Classical and Modern, and relevant conventional techniques and their principles.
5. Regenerative Medicine, Gene Therapy

Module III

Cell& tissue culture techniques

1. Cell separation by different techniques. In vitro cell culture, properties of transformed cells.
2. Cell line, cell clone, cell fusion. Cell and Tissue culture media.
3. Gene transfer method in animal cells. Transgenic biology. Tissue culture: Principle and its practical application. Tissue transplantation technique Hybridoma technology.

Stem cell in modern biology

1. Gametogenesis, fertilization & early development, Morphogenesis & organogenesis, programmed cell death, ageing and senescence Definition AND types of stem cell
2. Genesis and differentiation of stem cells in different organs, Placenta as a source of stem cells and its importance in stem cell research
3. Stem cells: Applications and future in Modern Biology and Health Sciences.

Module IV

Molecular pharmacology: concepts & practice

1. Factors influencing drug absorption. Drug distribution - protein binding, tissue binding - blood brain barrier, placental barrier, Biotransformation of drugs - microsomal, non-microsomal metabolism, factors influencing, Pharmacogenetics. Cellular and molecular basis of drug action. Molecular models of Drug receptor interaction Stimulus response mechanisms
2. Agonism and Antagonisms, Drug induced signal transduction mechanisms, Receptor structure & biochemistry, Transporter structure and biochemistry
3. Intracellular communication, The cytoskeleton Cell surface biochemistry, Intracellular trafficking
4. State of the art molecular pharmacological assays measurement of intracellular Ca^{2+} levels by fluorescence Probes measurement of membrane potential by fluorescence probes.

Course Outcome: To develop in-depth knowledge about basic principles, tools and techniques employed in biotechnology. Also, the target is conceptual developments regarding major achievements in biotechnology.

Paper: PHY 203

PHY 203 (UNIT-17): NERVE MUSCLE AND SENSORY PHYSIOLOGY F.M. 25, 02Credits

Module I

Nerve muscle physiology

Nerve: Effects of various degree of nerve injury; Regeneration of nerve; Problem of regeneration of neurone within CNS; Acetylcholine – Structure-function relationship, Metabolism and Regulation; Drugs acting at NMJ; Acetylcholine esterases; Ganglion-Blocking Drugs; Neurotoxins at NMJ. Motor unit, MUAP, motor unit recruitment patterns, control of human movement. Muscle: Protein components and contraction mechanism, Excitation – contraction coupling, Role of fast and slow channels,

Ca++binding protein including calmodulin, Muscle fibre types.

Module II

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

Module III

Sensory system: From Receptor to Perception – Sensory modalities, Sensory receptors, Sensory circuits, and Sensory perception.

Chemical senses: Common chemical sense, internal chemoreceptors.
Taste system–Receptor organs–distribution, ultramicroscopic structures, innervation, - membrane mechanisms of transduction; Sensory processing; Taste pathways; Taste behaviour.

Module IV Sensory system

Olfactory system – Olfactory epithelium and receptors, turnover and regeneration of olfactory receptor cells; Central olfactory connections; Psychophysics – Anosmia and directional smelling; Olfaction and behaviour.

Visual Sense: Structures of retina and sensory transduction; Visual pathway, Visual cortex and cortical processing; Colour vision – retinal and neural mechanisms, binocular and stereoscopic perception;

Auditory Senses: Organ of corti- ultramicroscopic structure, cochlear mechanics, sensory transduction and processing; Functions of auditory system – Frequency analysis and its discrimination; pitch; Intensity processing – factors determining loudness, discrimination of loudness, loudness adaptation, masking, auditory fatigue; Processing of speech; Perception of sounds in space.

Course Outcome: The present unit enable the students to learn various aspects of nerve, muscle and the sensory organs.

PHY 203(UNIT-18): PHYSIOLOGY OF EXCITABLE CELLS AND HIGHER FUNCTIONS OF BRAIN
F.M. 25, 02 Credits

Module I

Spinal cord as a control system: Anatomical and histological organization of spinal cord, functions of spinal cord, feedback regulation of spinal motor functions. Segmental and inter segmental interactions: myotatic reflex, inverse myotatic reflex, flexor reflex, crossed extensor reflex, propio-spinal reflex, role of descending tracts in regulation of muscle tone, posture and spinal reflexes, γ – loop, autogenicinhibition.

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.

Regulatory functions of cerebellum: Cerebellar cortical neural circuitry, feed-back regulation of deep cerebellar nuclei, somato-topical 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.

Module II

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

Basal ganglia as a motor control system: Neural circuits and feedback loops of basal ganglia, functions and regulation of muscle tone and movements, control of eye movements, dysfunctions of basal ganglia**.**

Statokinetic control system: Vestibular apparatus, constant angular motion, transduction of vestibular hair cells, gravitational receptors, central processing of vestibular information, vestibule ocular and vestibule spinal reflexes, regulation of posture, nystagmus.

Module III

Behavioural physiology and cognitive functions

1. Approaches and methods in study of behaviour; proximate and ultimate causation; altruism and evolution-group selection, kin selection, reciprocal altruism;
2. neural basis of learning, memory, cognition, sleep and arousal; biological clocks; development of behavior; social communication; social dominance;
3. use of space and territoriality; mating systems, parental investment and reproductive success;
4. parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes

Module IV

Neuroendocrinolgy & Chronobiology

1. Neuroendocrinology: Hypothalamus as neuroendocrine organ, process of neurosecretions and neurosecretory materials, synthesis, transport, release, functions and control of neurosecretory materials.
2. Metabolic regulation of hypothalamic function and role of tanycytes; Neuroendocrine regulation of energy metabolism, Neuroendocrine disorders.
3. Chronobiology: Rhythms in Living Organism: Terminology and Methodology; Photoperiodisms, Influence of visible light radiation upon living organisms;
4. Clock and cellular mechanisms of clock: Zeitgebers, synchronizers, Jet Lag, shift-work, Seasonal Affective Disorder (SAD); Sleep mechanisms, Sleep disorders; Human Circadian Rhythm and its mechanism of control- cellular and molecular mechanisms; The SCN, photic and non-photic entrainment pathways, neurotransmitters; Recent advances : Extra retinal illumination experiments, immediate early genes (IEG) and further developments.

Course Outcome: This unit highlights the structural and functional properties of excitable cells This unit also emphasizes on the higher brain functions and understanding of the fascinating processes driving human thought, cognition and behavior and the disorders related to nervous system malfunction. The present unit provide knowledge about the mechanism of sensory coding, transduction and adaptation of olfaction and gustation. It will provide understanding about the role of basal ganglia and cerebellum in regulation of motor movements and regulation of posture and cellular and molecular mechanism of learning, conditioning and memory as well as the mechanism of sleep and the emotional processing by limbic systems.

Paper: PHY 204 (CBCS) Taken by other PG Courses

UNIT 01: LIFESTYLE AND HEALTH **F.M. 25, 02Credits**

Module I

1. **Concept of lifestyle:** Definition, components of lifestyle, factors influencing, importance of lifestyle on health, lifestyle and environment.
2. **Concept of health and disease**: definition of health (WHO), dimension and determinants of health, physical health, mental health, psycho-social health. **Disease** - definition, causal factors.

Module II

3. **Nutrition and health:** Concept of food, nutrition, nutrients, diet, nutrition as a lifestyle factor; concept of malnutrition and deficiency disorders.
4. **Health concepts of physical education:** Concept of physical education, need and importance of physical education, physical activity and health benefits, types of physical activity, recreational physical activity and its importance. Role of physical education programme on community health promotion.

Module III

5. **Lifestyle and diseases:** general concept, concept of risk, risk factors, risk groups; lifestyle components related to development of diseases and underlying mechanisms; socio-cultural events - lifestyle and diseases.
6. **Non-communicable diseases:** definition, its relation to lifestyle, risk factors, mortality, impact on community health, common non-communicable diseases – Coronary Heart Disease (CHD), cancer, diabetes mellitus, obesity, hypertension, osteoporosis, back pain, hypokinetic diseases. Drug: abuse and addiction.

Module IV

7. **Communicable diseases:** definition, mortality, causative agents, transmission vehicles, transmission modes, its relation with lifestyle; concept of infection and infectious agents; virulence & virulence factors; concept of vectors - common vector borne diseases; sexually transmitted diseases; lifestyle, personal hygiene and communicable diseases; antibiotics and drug resistance. Some common communicable diseases in India: diarrhoea, AIDS, malaria, kala-azar, influenza, hepatitis, tuberculosis, typhoid, skin infections.
8. **Food toxicity** - general concept, common causes, food handling.

Course Outcome: This unit highlights the relationship of lifestyle and health and its associated problems. Provide understanding on concepts of physical activity and fitness, healthy habits and fitness related nutrition as well as about communicable and non-communicable diseases and food toxicity in the community.

UNIT 02: IMPORTANCE OF HEALTH EDUCATION AND ITS PROMOTION F.M. 25, 02Credits

Module I

1. **Safety education in health promotion:** Health and safety in daily life, health and safety at work and their management, principles of accident prevention, first aid and emergency care.
2. **Repetitive motion injury**: Definition, causes, and prevention.

Module II

3. **Physical fitness and health promotion:** Physical fitness components, activities for developing physical fitness components, types and components of fitness, cosmetic fitness, assessment of physical fitness physiological effects of exercise. Cardio-respiratory endurance, muscular strength and endurance, body composition and weight control: body mass index and skin fold measurement, body types and posture, anthropometry and it types of measurement. Blood pressure, Heart rate and pulse rate: Definition and measurement.
4. **Sports, lifestyle and recreation:** yoga, meditation and relaxation, sports and mechanics, sports and socialization, yoga and stress management.

Module III

5. **Nutritional management in health promotion:** concept of balanced diet, meal, meal planning, energy

intake, therapeutic diet; food fortification–mass fortification, targeted fortification, nutritional policies for mass health promotion.

6. **Occupational health hazards** and lifestyle management, postural modification and health promotion.

Module IV

7. **Lifestyle modification** and management of non-communicable and communicable diseases like coronary heart disease, obesity, hypertension, cancer, diarrhoea, malaria, tuberculosis, AIDS.
8. **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.

Course Outcome: This unit will give idea about the different aspects of health education, especially in the workplace. The learner can acquire knowledge about the safety in daily life as well as work place. The relationship between physical fitness and life style and health promotion can be known. The effect of life style modification on health can be well understood.

Practical (Total Marks: 100, 08 Credits)

PHY 205 (UNIT-19): ANTHROPOMETRY AND ASSESSMENT OF COMMUNITY HEALTH STATUS

F.M. 25, 02Credits

1. Anthropometric measurements of different body compositions and anthropometric indices such as BMI, Body surface area, ponderal index, Dugdel nutritional index, Waist- Hip ratio, obesity index.
2. Nutritional status assessment by standard growth curve and determination of stage of malnutrition in different age groups.
3. **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.

Course Outcome: To provide training to the students for anthropometric measurements, their importance and applications. Field based training will also be offered on health, diseases through community-based health survey to make them understand the actual forms of physiological problems in population in various socio-demographic backgrounds beyond classroom teaching

PHY 205(UNIT-20): ERGONOMIC, EXERCISE PHYSIOLOGY AND MASS FITNESS

F.M. 25, 02Credits

1. Determination of Physical Fitness Index with step test.
2. Determination of Physical Fitness Index with Astride Jump Test.
3. Determination of VO_2 max with Queen College Step Test / Astrand-AstrandNomogram by Bicycle ergometry / MargariaNomogram by Step Test.
4. Determination of Cardio-respiratory fitness with Pointslope Method by Step Test.
5. Determination of static and dynamic lung functions.
6. Determination of steady state heart rate at different work load on a bicycle ergometer.
7. Evaluation of lung function – estimation of FVC, VT, IRV, ERV, IC as well as FEV_1, MSC (MVV).
8. Electrocardiographic study in human in resting and stress condition.
9. Electromyographic study in human in different stages f sleep and wakefulness.
10. Evoked potential study in human: brain stem evoked potential and auditory evoked potential in human.

11. Neurobehavior study: Locomotor movement in open field, Lordosis behavior, Pentobarbital induced sleeping time, exploratory behavior in hole board apparatus.

Course Outcome: In this practical unit the students will be able to learn the different techniques of assessing physiological parameters related to work and exercise. There is enough scope for the learners to develop skills for measuring different health related parameters of human.

Paper: PHY 206

PHY 206 (UNIT-21): APPLIED MOLECULAR BIOTECHNOLOGY TECHNIQUES

F.M. 25, 02Credits

- Isolation of plasmid DNA from bacterial cells.
- Separation, visualization and determination of molecular sizes of isolated DNAs by agarose gel electrophoresis.
- Endonuclease digestion of nuclei and analysis of DNA by Agarose Gel Electrophoresis, thermal melting of DNA.
- Isolation of genomic DNA from animal tissue Isolation and agarose gel electrophoresis of a plasmid DNA from antibiotic resistant bacteria.
- Preparation of primary cell cultures(CEC).
- Peripheral blood lymphocytes culture, demonstration of other tissue culture experiments.
- Microinjection or electroporation of ES cells with foreign DNA and transplantation to foster mother.
- Reverse transcription (RT) of total RNA isolated from animal tissue to cDNA, Primer designing for PCR, PCR of a transcript (mRNA) with suitable primer, agarose gel electrophoresis of PCR product.
- Techniques of DNA and RNA isolation, Western blot.

PHY 206(UNIT-22): APPLIED MICROBIOLOGICAL TECHNIQUES F.M. 25, 02Credits

- Preparation of media and cultivation of bacteria, molds, yeasts and their isolation from natural sources.
- Microbial morphology – Gram staining, acid fast staining, spore staining, staining of molds, yeast, determination of microbial dimensions.
- Isolation of pure culture from mixes bacterial culture by streaking, spread plate, pourplate.
- Fermentation of carbohydrates by bacteria: glucose, fructose, lactose, sucrose.
- Production of acetyl-methyl carbinol by bacteria.
- Production of indole by bacteria.
- Determination of amylase activity of the supplied bacteria by hydrolysis ofstarch.
- Determination amylase activity of the supplied bacteria by hydrolysis of starch.
- Determination of catalase activity of the supplied bacteria.
- Determination of urease activity of the supplied bacteria.
- Determination of the protein hydrolysing ability of the supplied bacteria by preparing case in plate.
- Determination of minimum inhibitory concentration (MIC) of an antibiotic for pathogenic bacteria.
- Determination of antibiotic resistance profile by disc agar diffusion (DAD) technique.

Semester III: (Theory: 200 + Practical: 100)

PAPER: PHY 301(UNIT23): CELLULAR & MOLECULAR PHYSIOLOGY

F.M. 25, 02Credits

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.

Genetic Element and its evolution: Fundamental aspects: law of DNA constancy, Eukaryotic Chromosome Organization,

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.

DNA in Molecular Flux: Replication, Repair, Transpositions, Recombination

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, polyadenylation, different forms of RNA in gene expression, regulation of gene expression in prokaryotic and eukaryoticsystem.
RNA: coding and non-coding RNA: RNA in Molecular Flux: The Catalytic RNA, Post Transcriptional Modification

Module IV

Genetic code, protein synthesis and their processing: genetic code, codon and anticodon 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.

Course Outcome: The objective of this unit is to enable the students to learn regarding molecular nature and way of functioning of key structural elements of cell and genetic materials and thus to develop gross understandings towards molecular explanation of physiological interplays.

PAPER: PHY 301(UNIT 24): HUMAN GENETICS **F.M. 25, 02Credits**

Module I

Organisation of human chromosomes: Normal chromosomal constitution, Autosomal & Sex chromosome, cytogenetic mapping, Karyotype, Karyogram, Ideogram, Chromosomal abnormalities, Polyploidy, Anueploidy, Euploidy, dosage compensation and mechanism of sex determination, etc**.**

Module II

Classical genetics: Mendelian principles: dominance, segregation, independent assortment; allele, multiple alleles, pseudo-allele, complementation tests

Inheritance: Laws of inheritance, Autosomal dominant and autosomal recessive inheritance, X-linked inheritance, traits, alleles, linkage and related disorders. Genes in the Kinderds and in the individuals: Genetic variations, genetic factors in diseases, Pedigree analysis**.**

Module III

Immunogenetics: Blood Groups, Histocompatibility and Organ Transplantations.

Genetics disorders: Sickle cell anemia, hemophilia, thalassemia, cystic fibrosis, Huntington disease, Colourblindness,Phenylketonuria. Cancer Genetics

Module IV

Population Genetics: Hardy-Weinberg equilibrium, mutation, selection, drift, gene flow, inbreeding, genetic diversity, races.

Xenobiotics and its management

- Types and pathways of metabolic reactions; Involvement of cytochrome P.450-its isoforms and inhibitors xenobiotic metabolising enzymes. Fate of xenobiotic metabolites Factors influencing xenobiotic metabolism;
- Pharmacologic, toxic, immunologic and carcinogenic effects
- Clinical correlations and biomedical importance

Course Outcome: To develop detailed knowledge regarding cell structures, subcellular organelles and their functions, cellular interactions, life cycle, signaling and coordination. Moreover, in-depth understandings to be developed on pathological conditions and cell-based technology.

PAPER: PHY 302(UNIT 25): ENDOCRINOLOGY & REPRODUCTIVE PHYSIOLOGY

F.M.25,02Credits

Module I

Principles of endocrinology: Functions of hormones, interaction of hormones, etc.

Chemistry of Hormones: Chemical nature, synthesis, storage, release, transport and degradation of steroids, amines and peptide hormones. Cytokines and growth factors.

Mechanism of hormone actions: Membrane bound and intercellular receptors; steroid hormone-receptor interactions;membrane bound hormone-receptor interactions; secondmessenger in hormone action/signal transduction; recycling of receptors.

Module II

Hormones in immune responses: Autoimmune endocrine disorders. Non-Conventional Endocrine Molecules in Health & Disease.

Hormonal regulation of metabolism: Carbohydrate, protein, lipid, water, minerals/electrolyte etc. Metabolic and lifestyle disorders.

Module III

Embryology of the gonads and the genital ducts: Origin of primordial germ cells, differentiation of testis and ovary, germ cells and interstitial tissue. Function of mammalian testis: Spermatogenesis; Sertoli cells – germ cells – Leydig cells interaction; functions of sertoli cells and Leydig cells. Structure of Sperm: Histology, Biochemistry and capacitation of spermatozoa.

Functions of mammalian ovary: Folliculogenesis, Ovogenesis, Ovulation, Luteinization and Luteolysis. Biological action of gonadotropins on gonads. Feed-back control of gametogenesis andendocrine functions of gonads. Photoperiods and grade (nerve Pathway of light to pineal gland, synthesis of melatonin and its influence on gonads).

Module IV

Fertilization: Molecular mechanism of fertilization; acrosomal reaction; chemical, mechanical and immunological method of controlling fertility; in vitro fertilization, preservation of gamates and embryotransfer.

Onset of Puberty: Reproductive cycles and its hormonal regulation. **Implantation:** Decidualization, function of placenta and foeto- placental unit, placental hormone (synthesis, control, role in foetal life and bioassay of HCG).

Parturition and Lactation: Regulation of parturition and lactation.

Course Outcome: The unit will help to develop an understanding of the structure-function relationship as well as mechanism of the endocrine system in maintaining body homeostasis and health. The student will be better able to learn the integrative workings of endocrine signaling system and endocrine pathologies.

PAPER: PHY 302 (UNIT 26): HUMAN IMMUNE SYSTEM F.M. 25, 02Credits

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, and IgM, biological properties of immunoglobulin; triggering of the immune response, humoral immunity, adaptive immunity; cell cooperation for triggering T and B cells; immunosuppression, 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, immunofluorescence, monoclonal antibody.

DSE (Special Paper): Any one special paper will be taken by the same PG student

Special Paper: Microbiology and Immunology

PAPER: PHY 303 (UNIT 27): ADVANCED STUDIES IN MICROBIOLOGY

F.M. 25, 02Credits

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

Course Outcome: To develop advanced knowledge regarding basic features of genetic constitutions observed in microbes. In addition to learn the different models of gene expressions, diverse factors in gene expression and their basic mechanisms of action, prospective applications in technology.

PAPER: PHY 303 (UNIT 28): CELLULAR AND MOLECULAR IMMUNOLOGY F.M. 25, 02Credits

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 moleculesCD4 & 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.

Course Outcome: To develop advanced knowledge in relation to immunological mechanisms in relation to infection and several immunological techniques having clinical and analytical significances.

PHY 304 (CBCS): Taken by other PG students

UNIT 01: ENVIRONMENT AND HEALTH F.M. 25, 02Credits

Module I

Environment and health: history and definition of environmental health, perspective on individual health: nutritional, socio-cultural and developmental aspects, Human developmental indices for public health.

Climate change and effects on public health: global warming and its consequences. green house effects, ozone depletion, manifestations of climate change on public health- changing disease pattern and different environmental diseases.

Module II

Environmental pollutants and toxicological hazards: sources, adverse effects of environmental pollutants and contaminants (air, water, soil, radionuclide, pesticides, microbes) on human health (both acute and chronic) and methods of protection and control, food contamination, effects of toxicants on mammalianorganisms;xenobiotic-induced oxidative stress, hepatotoxicity, reproductive toxicity, nephrotoxicity, neurotoxicity, genotoxiciy, immunotoxicity, endocrine disruption.

Module III

Perspectives and interventions in public health: epidemiological perspectives of environmental health - disease burden and surveillance, alternative systems of medicine, universal immunization programme (uip), occupational health hazards; occupational diseases - prevention and control; assessment of health risks associated with exposures to environmental hazards.

Module IV

Environmental management policies and practices: municipal solid waste management, solid waste management system in urban and rural areas, policies and practices with respect to environmental protection act, forest conservation act, wildlife protection act, water and air act, industrial, biomedical and e waste disposal rules, wet land management.
Global environmental health issues in developing countries, ethical issues of environmental health- environmental injustice and racial inequality in environmental rule-making and environmental management.

Course Outcome: This unit will help to acquire knowledge in the area of environmental health, including climate change and effects, different environmental pollutants and their toxicity, epidemiological perspectives of environmental health and environmental management policies.

UNIT 02: HUMAN REPRODUCTIVE HEALTH AND RELATED ISSUES F.M. 25, 02Credits

Module I
Male and female reproductive physiology: concept of reproductive health, reproductive anatomy and physiology of male and female, sex differentiation, disorder of sex differentiation, physiological basis of male and female puberty, adolescence and adulthood, pregnancy, endocrinology of childbirth, physiology of lactation and physiological importance, contraception, ectopic pregnancy, endometriosis, effects of nutrition, stress and exercise on reproductive functions in vitro fertilization.

Module II
Adolescent health: physical and psychological changes in adolescent, adolescent sexuality, problems of adolescents, adolescent and reproductive health, guidance and counseling for adolescents.
Maternal health and mortality: meaning and concept of maternal health, maternal mortality & morbidity, MCH care, safe motherhood: pre-natal, anti-natal and post-natal care; problems and precautions during pregnancy; abortion, maternal health issues- nutrition, health education, vaccination, PNDT Act, medical termination of pregnancy act, MCH Services in India, MCH & nutrition.

Module III
Infertility -definition, Epidemiology, primary and secondary infertility, psychological and social impact of infertility, causes of infertility, diagnosis and treatment; in vitro fertilization – test tube babies.
STIs/RTIs and HIV/AIDS - diagnosis, treatment, prevention: Concept of RTI, STI, causes and precautions in RTI and STI, Impact of RTI & STI on women; problems of RTI and STI suffering women,HIV/AIDS,transmission of HIV/AIDS, HIV/AIDS counselling, HIV/AIDS suffering adolescent, role of national and international organizations, role of governmental and non-governmental organizations.

Module IV:
Menopause and beyond - definition, premenopause, perimenopause, postmenopause, signs and symptoms, health complications, psychological and long-term effects, management - hormone replacement therapy (HRT), selective estrogen receptor modulators, other medication, other therapies.
Health inequalities - concepts and measurement of equity and inequity in health concepts and principles of health impact assessment, changing paradigms of health and health care, making health and health care universally accessible.

Course Outcome: This unit will enlighten the idea about male and female reproductive physiology including adolescent and maternal health and different related disorders.

Semester III: Practical **(Total Marks: 100, 08 Credits)**

PHY 305(UNIT-29): HISTOCHEMICAL AND HISTOMETRIC TECHNIQUES F.M. 25, 02 Credits

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 ofATPase.
    c. Detection ofcholinesterase.
6. **Histometry (demonstration):**
    a. Measurement of testicular Leydig cells.
    b. Measurement of livercells
    c. Measurement of thyroid follicular cells etc.
7. **Histopathology:**
    Effect of toxicity on the different organ histology
8. **Immunohistochemistry(demonstration)**

Course Outcome: This unit will demonstrates to learn essentials of histochemical techniques used for the visualization of biological structures for the identification and distribution of various chemical components of tissues through the use of stains, indicators and microscopy as well as through enzymatic, immunohistochical techniques with special emphasis on histometry and histopathology.

PHY 305 (UNIT-30): EXPERIMENTAL IMMUNOLOGY F.M. 25, 02Credits

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, polymorphonuclearcells
2. Isolation and culture of peritoneal cells from experimentalanimal
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-scaleisolation.
7. Glassware decontamination, washing-sterilization, packing and sterile handling for animal cell tissueculture.
8. Media and reagent preparation, sterility checks, CO_2incubator.
9. Maintenance of cellcultures.

10. Preparation of primary cell cultures (CEC).
11. Peripheral blood lymphocytes culture, demonstration of other tissue cultureexperiments.
12. Chick embryo fibroblast primary cell cultures and mouse choronicvilluscells.
13. Induced ovulation in mouse, collection of oviducal eggs and in-vitro fertilization, culture in-vitro of mouse embryos to the blastocyststate.
14. Transferring foreign gene (e.g. chicken globin gene) into mouse fertilized eggs and transplantation to foster mother.
15. Microinjection or electroporation of ES cells with foreign DNA and transplantation

Course Outcome: To get training in basic immunological and cellular techniques important to express body defense mechanisms.

Paper: PHY 306(Unit-30 & 31): (Special Papers)

Special Paper A: Microbiology and Immunology

PAPER: PHY 306(UNIT 31): **MICROBIOLOGICAL TECHNIQUES** **F.M. 25, 02Credits**

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.

Course Outcome: To get hand-on trainings on microbial growth, cultivation and experiments on several metabolic activities of microbes used as important markers for identification and analysis of microbial agents.

PAPER: PHY 306(UNIT 32): EXPERIMENTAL IMMUNOLOGY **F.M. 25, 02Credits**

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, Bcells, 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, CO2 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

Course Outcome: To get training in specialized immunological and cellular techniques important to express body defense mechanisms.

Semester IV: (Theory: 150 + Practical: 150)

PAPER 401 (UNIT-33) YOGA AND STRESS PHYSIOLOGY F.M. 25, 02 Credits

Module I

Stress physiology & its management: Defining stress response in different environmental conditions and effect of stress-inducing and anti-stress agents on the activities of catalase, peroxidases, superoxide dismutases, dehydrogenases. Cardio-respiratory Responses during high altitude acclimatization.

Module II

Antioxidant Defense: Classical and non-classical antioxidants, reaction mechanisms, Antioxidant enzymes and mechanisms of catalysis. Importance of antioxidants in prevention / amelioration of stress-related diseases. How cells respond to stress. Role of hypothalamo-hypophyseal-adrenal axis. Stress responsive elements and molecular pathways.

Module III

Atmospheric requirements of Man in space: Pressure, O_2, CO_2, Temperature and Relative humidity, Micro-contaminant level, energy requirements, water. Waste removal and/or storage. Human tolerances to stresses in space including space flight: Acceleration, Deceleration, Weightlessness, Thermal Extreme, High 'g', Ionizing Radiation, Meteorites. The Cabin Atmosphere (Space Craft): Nutritional problems, Isolation & Sensory Deprivation. General Medical Emergencies.

Module IV

Perspective of Yoga: different types of yoga with their physiological importance. Role of yoga in cognitive functions, immunological response, cell signaling.

Course Outcome: This course focuses upon a global, interdisciplinary, cross-cultural and contextual view on stress and coping. Our collective inquiry will afford students the opportunity to apply thinking across a variety of professional roles in psychology, health care, social work, education and leadership.

PAPER 401 (UNIT-34) MODERN TECHNIQUES IN PHYSIOLOGY F.M. 25, 02 Credits

Module I

Techniques and Instrumentation: Principles and applications of gel filtration, ion-exchange and affinity chromatography, HPLC. Basic Principles of Electrophoresis, agarose gel electrophoresis, SDS-PAGE, Western Blotting, PCR and its application in gene expression studies.Flow Cytometry, FISH, FTIR techniques.

Module II

Nanotechnology & its applications in physiology: Definition, Principles of Nanotechnology Nanoparticles - Biophysical and Biochemical Characteristics. An idea of nanotechnological solutions to problems in tissue engineering, molecular imaging, Biosensors and diagnostics. Concept of "Nanoproducts" that will aid in early detection, real- time assessment of drug efficacy, symptom management and the knowledge of the discovery of new targets for anticancer therapy.

Module III

Concept of nanofabrication: An overview of scanned probe microscopy and analysis including scanning tunneling microscopy (STM), atomic force microscopy (AFM), and scanning transmission electron microscopy (STEM). Basic idea about the devices to study the molecular interactions that drive the release of chemical messengers.

Concept of red-emitting quantum dots and quantum dot-tagged cancer cells.

Concept of surface polymerization to generate patterned arrays for binding of biomolecules

Module IV

Concepts of omics: applications and analysis: Concept of OME and Omics, Genomics, Proteomics, Metabolomics; Techniques applied for OMICS study; Software's and Anaysis; Application of "Omics" in human analysis

Course Outcome: This course will teach the students the various instrumentations that are used in the analytical laboratories. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules. At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

PAPER 402(UNIT-35): RESEARCH METHODOLOGIES IN APPLIED PHYSIOLOGY

F.M. 25, 02 Credits

Module I: Basic concept of Research

Definition, objectives, criteria and significance of research, types of research.

Principles and Code of Animal Ethics as per CPCSEA and ICMR,Code of human ethics in research.

Module II: Research Methods

Induction and deduction, quantitative qualitative and mixed, experimental, descriptive, historical, quasi experiments.

Module III: Research design and sampling

Meaning, need of research design, components and types of research design, issue in design construction. Research sampling concept, key differences in two approaches, sampling methods and sample size and sampling error, selecting participants and contexts to examine social phenomenon.

Module IV: Research Cycle

Systematic literature review and referencing, formulation of research problem, plagiarism detection, research article, dissertation and thesis writing style and format.

Research report: types of contents, style and steps in drafting. Significance of impact factor, citation index, science citation index, IST, SCOPUS etc.

Course Outcome: This unit will encompass the methodology and theory of statistics as applied to problems in the field of life sciences. The course will provide students with basic understanding and application of statistics as a tool for testing hypothesis and experimental design for research studies. This course would enable them to carry out purposeful research on their own by keeping the research ethics in mind.

PAPER 402(UNIT-36) INDUSTRIAL AND WORKING ENVIRONMENTAL PHYSIOLOGY

F.M. 25, 02 Credits

Module I

Basic concepts of industry, types and their working environment.The physical basis of man's perception on industrial environment.The human body and its metabolic regulation in industrial environmental condition.

Module II

Practical ergonomics and design factors, Layout of equipment, design of seating, design of instrumental displays, computability, design characteristics of controls.

Module III

Industrial environmental factors, environmental temperature and humidity, noise, the visual environment, vibration.

Module IV

Methods of investigating work, the organization of work, inspection, shift of work,age
Related factors

Course Outcome: This unit will cover the quantitative estimation of different environmental pollutants and it also emphasizes the assessment of lethality of toxicants and parameters of oxidative stress. This course encompasses different factors for environment and its pollution.

DSE (Special Paper): Any one special paper will be taken by the same PG student

Paper: PHY 403(Unit-36 and Unit-37)

Special Paper A: Microbiology and Immunology

PAPER 403(UNIT-37) MICROBIAL GENETICS: ADVANCED STUDIES F.M. 25, 02 Credits

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.

Course Outcome: To develop advanced knowledge regarding basic features of genetic constitutions observed in microbes. In addition to learn the different models of gene expressions, diverse factors in gene expression and their basic mechanisms of action, prospective applications in technology.

PAPER 403(UNIT-38) CLINICAL IMMUNOLOGY F.M. 25, 02 Credits

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

Course Outcome: To develop advanced knowledge in relation to immunological mechanisms in relation to infection and several immunological techniques having clinical and analytical significances.

Semester IV

***Practical* (Total Marks: 150, 12 Credits)**

PAPER 404 (UNIT-39) MODERN TECHNIQUES IN PHYSIOLOGY I F.M. 25, 02 Credits

1. EEG recording of normal human subject in different status by multichannel recorder
2. Determination of Vo2 max by Queen's college test.
3. Determination of hearing threshold by audiometer.
4. Determination of critical fusion frequency
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.

Course Outcome: The students will get hands on advanced training on different parameters of electrophysiology, physical efficiency and neuro-physiological parameters

PAPER 404 (UNIT-40) MODERN TECHNIQUES IN PHYSIOLOGY II F.M. 25, 02 Credits

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
10. Estimation of physiological active substance by HPLC.

Course Outcome: Students from different specializations will get hand-on trainings on certain specialized advanced techniques in Microbiology, Immunology, Biochemistry and Endocrinology.

Paper: PHY 405(Unit-40 & 41): (Special Papers)

Special Paper A: Microbiology and Immunology

PAPER: PHY 405(UNIT 41) ADVANCED TECHNIQUES IN MICROBIOLOGY F.M. 25, 02Credits

1. Determination of sensitivity of bacteria to different antibiotics
2. Determination of minimum inhibitory concentration (MlC) 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)

Course Outcome: To get in-depth practical training on microbial infection related diagnostic techniques, and several methods related to microbial genetics.

PAPER: PHY 405(UNIT 42) CLINICAL IMMUNOLOGY F.M. 25, 02Credits

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.

Course Outcome: Intensive practical trainings to be developed on immunological and related cytological techniques with clinical significance.

PAPER 406 (UNIT-43) F.M. 25, 02 Credits

One month Internship report (Any Industry / health Center/ Research Laboratory or Center/ Health Informatics Center/ Public Health Base NGO's).

OR

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.

PAPER 406 (UNIT-44) PROJECT PREPARATION & PRESENTATION F.M. 25, 02 Credits

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

Course Outcome: This practical paper will help students to execute a research project under the guidance of a teacher (laboratory based or field based) for a period of 6 months which can specialise in a more advanced area as part of their community heath and infection, specific disease, pharmacology or industry related research project.