FOURTH SEMESTER

1. **ANATOMY-IV (Neuro Anatomy)**
2. **BIOMECHANICS & ERGONOMICS-II**
3. **BEHAVIORAL SCIENCES (Psychiatry & Psychology)**
4. **BIOCHEMISTRY& GENETICS II**
5. **EXERCISE PHYSIOLOGY**
6. **MEDICAL PHYSICS**

ANATOMY - IV (Neuro Anatomy)

CREDIT HOURS: 3 (2-1)

COURSE DESCRIPTION:

The focus of this course is an in-depth study and analysis of the regional and systemic organization of the body. Emphasis is placed upon structure and function of human movement. A comprehensive study of human anatomy with emphasis on the nervous, skeletal, muscle, and circulatory systems is incorporated. Introduction to general anatomy lays the foundation of the course. Dissection and identification of structures in the cadaver supplemented with the study of charts, models, prosected materials and radiographs are utilized to identify anatomical landmarks and configurations of the region.

COURSE OUTLINE:

NEURO ANATOMY

- Central Nervous System: Disposition, Parts and Functions
- Brain stem (Pons, Medulla, and Mid Brain)
- Cerebrum
- Cerebellum
- Thalamus
- Hypothalamus
- Internal Capsule
- Blood Supply of Brain
- Stroke and its types
- Ventricles of Brain
- CSF circulation and Hydrocephalus
- Meninges of Brain
- Neural pathways (Neural Tracts)
- Pyramidal and Extra pyramidal System (Ascending and Descending tracts)
- Functional significance of Spinal cord level
- Cranial Nerves with special emphasis upon IV, V, VII, XI, XII (their course, distribution, and palsies).
- Autonomic nervous system, its components
- Nerve receptors.

SPINAL CORD

- Gross appearance
- Structure of spinal cord
- Grey and white matter (brief description)
- Meninges of spinal cord
- Blood supply of spinal cord
- Autonomic Nervous system

PRACTICAL:

During study of Gross Anatomy, emphasis should be given on applied aspect, radiological anatomy, surface anatomy and cross-sectional anatomy of the region covered in the respective semester/year.

RECOMMENDED TEXT BOOKS:

1. *Gray's Anatomy* by Prof. Susan Standring 39th Ed., Elsevier.
2. *Clinical Anatomy for Medical Students* by Richard S. Snell.
3. *Clinically Oriented Anatomy* by Keith Moore.
4. *Clinical Anatomy* by R.J. Last, Latest Ed.
5. *Cunningham's Manual of Practical Anatomy* by G.J. Romanes, 15th Ed., Vol-I, II and III.
6. *The Developing Human. Clinically Oriented Embryology* by Keith L. Moore, 6th Ed.
7. *Wheater's Functional Histology* by Young and Heath, Latest Ed.
8. *Medical Histology* by Prof. Laiq Hussain.

BIOMECHANICS AND ERGONOMICS - II

CREDIT HOURS: 3(2-1)

COURSE DESCRIPTION:

This course aims to develop appreciation of how mechanical principles can be applied to understand the underlying causes of human movement. It also examines selected anatomical, structural and functional properties of human connective, muscular, and nervous tissues, as well as skeletal structures. Emphasis is placed on the mechanical, neuroregulatory, and muscular events that influence normal and pathological motion.

This course will also help to gain an understanding of basic theoretical concepts, principles and techniques of ergonomics as well as an introduction to fundamental ergonomic measurement tools for assessment of physical workload, posture, occupational exposure, and stress.

COURSE OUTLINE:

BIOMECHANICS OF HUMAN SPINE

- Biomechanics of the Lumbar Spine
- Biomechanics of the Cervical Spine

- Factors influencing relative mobility and stability of different regions of Spine
- Biomechanical adaptations of spine during different functions
- Relationship between muscle location and nature and effectiveness of muscle action in the trunk
- Biomechanical contribution to common injuries of the spine.

APPLIED BIOMECHANICS

- Introduction to the Biomechanics of Fracture Fixation
- Biomechanics of Arthroplasty
- Engineering Approaches to Standing, Sitting, and Lying
- Biomechanics of Gait.

ANGULAR KINETICS OF HUMAN MOVEMENT

- Angular analogues of mass, force, momentum and impulse
- Angular analogues of Newton's laws of motion
- Centripetal and Centrifugal forces
- Angular acceleration.

ANGULAR KINEMATICS OF HUMAN MOVEMENT

- Measuring body angles
- Angular kinematics Relationships
- Relationship between Linear and Angular motion.

HUMAN MOVEMENT IN FLUID MEDIUM

- The nature of fluids
- Buoyancy and floatation of human body
- Drag and components of drag
- Lift Force
- Propulsion in a fluid medium.

ERGONOMICS II
SPECIAL CONSIDERATIONS

- Lifting Analysis
- Seating
- Computers and Assistive Technology.

APPLICATION PROCESS

- Ergonomics of Children and Youth.
- Ergonomics of Aging.
- Ergonomics in Injury Prevention and Disability Management.
- Ergonomics of Play and Leisure.

PRACTICAL TRAINING/LAB WORK:

- Biomechanical assessment of Upper extremity

- Biomechanical assessment of Lower Extremity
- Biomechanical assessment of Gait
- Reflective case assignment related to biomechanics of various regions of the body
- Measurement of angles of joints
- Biomechanical study of deformities.

RECOMMENDED TEXT BOOKS:

1. *Basic biomechanics of musculoskeletal system* By: Nordin & Frankel, 3rd edition.
2. *Basic Biomechanics*, By: Susan J. Hall 4th edition.
3. Additional study material as assigned by the tutor.
4. Ergonomics for the therapist by Karen Jacobs 3rd edition mosby and Elsevier publishers.

BEHAVIOURAL SCIENCES *(PSYCHIATRY & PSYCHOLOGY)*

CREDIT HOURS: 3 (3-0)

COURSE DESCRIPTION:

This course is designed to increase awareness of psychosocial issues faced by individuals and their significant reference groups at various points on the continuum of health and disability, including factors that influence values about health promotion, wellness, illness and disability. Personal and professional attitudes and values are discussed as they relate to developing therapeutic relationships. Communication skills are emphasized for effective interaction with clients, health-care professionals and others.

COURSE OUTLINE:

INTRODUICTION

- Behavioural Sciences and their importance in health
- Bio-Psycho-Social Model of Healthcare
- Desirable attitudes
- Correlation of brain, mind and Behavioural Sciences
- Roles of a doctor

UNDERSTANDING BEHAVIOUR

- Sensation, sense organs/special organs
- Perception and factors affecting it
- Attention and concentration
- Memory and its stages, types and methods to improve it
- Types and theories of thinking
- Cognition and levels of cognition
- Problem solving and decision making strategies

- Communication Its types, modes and factors affecting it Non-verbal cues
- Characteristics of a good communicator.

PERSONALITY AND INTELLIGENCE

- Stages and characteristics of psychological growth and development
- Personality and development theories of personality Factors affecting personality development
- Assessment of personality Influence of personality in determining reactions during health, disease, hospitalization, stress, etc
- Intelligence and its types Relevance of IQ and EQ Methods of enhancing EQ and effectively using IQ Factors affecting intelligence and their assessment.

STRESS MANAGEMENT

- Definition and classification of stress and stressors
- Relationship of stress and stressors with illness
- Stress and health
- Anxiety
- Coping skills
- Psychological defence mechanisms
- Conflict and frustration
- Adjustment and maladjustment
- Patient anxiety / stress
- Psychological theories of pain perception and patients' experience of pain Treatment adherence and compliance
- Psychological techniques including hypnosis.

DOCTOR – PATIENT RELATIONSHIP

- Concept of boundaries and psychological reactions in doctor – patient relationship (such as transference and counter transference).

PAIN, SLEEP AND CONSCIOUSNESS

- Concept of pain
- Physiology of pain, psychosocial assessment and management of chronic /intractable atypical facial pain
- Stages of sleep
- Physiology of consciousness
- Attend states of consciousness
- Psychological influence on sleep and consciousness
- Non-pharmacological methods of inducing sleep
- Changes in consciousness.

COMMUNICATION SKILLS

- Principles of effective communication
- Active listening

- Art of questioning
- Good and bad listener
- Counseling: steps, scope, indication and contraindications
- Dealing with real life crisis and conflict situations in health settings
- A practical method of communication between the doctor and patient about disease, drugs, prognosis etc.

INTERVIEWING

- Collecting data on psychosocial factors in Medicine / Surgery / Reproductive Health / Paediatrics and other general health conditions
- Types of interview
- Skills of interviewing.

HEALTH PSYCHOLOGY

- Importance of psychological consideration in clinical management of patients
- Psychological therapies
- Key concepts in child's social and cognitive development
- Psychological changes during adolescence and old age and their clinical management
- Impact of illness on a patient's psychological well being including the ability to cope and understand the association between psychological stress and physical well being
- Role of doctor in patient reassurance and allaying anxiety and fear.

SOCIAL AND COMMUNITY PERSPECTIVE

- Inequalities of healthcare and the relationship of social class
- Ethnicity, culture and racism, How disease pattern and medical care vary by culture and ethnicity?
- Gender and Healthcare
- Influence of health and illness on behaviour.

APPLICATION OF BEHAVIOURAL PRINCIPLES IN HEALTH AND DISEASE

- Mentally / emotionally handicapped
- Physically handicapped
- Chronically ill
- Homebound
- Medically compromised.

RECOMMENDED TEXT BOOKS:

1. *A Handbook of Behavioural Sciences for Medical and Dental Students* By: Mowadat H Rana, Sohail Ali and Mansoor Mustafa, University of Health Sciences, Lahore.
2. *Medicine in Society; Behavioural Sciences for Medical Students*, by: Christopher Dowrick, Arnold Publisher.

3. *Behavioural Sciences in Clinical Medicine* By: Wolf & Stewert.
4. *Developmental Psychology for Healthcare Professions* By: Katherine A Billingham.

BIOCHEMISTRYAND GENETICS - II

CREDIT HOURS: 2 (2-0)

COURSE DESCRIPTION:

This course provides the knowledge and skills in fundamental organic chemistry and introductory biochemistry that are essential for further studies It covers basic biochemical, cellular, biological and microbiological processes, basic chemical reactions in the prokaryotic and eukaryotic cells, the structure of biological molecules, introduction to the nutrients i.e. carbohydrates, fats, enzymes, nucleic acids and amino acids. The nutritional biochemistry concludes the course.

COURSE OUTLINE:

TISSUE BIOCHEMISTRY

- Extracellular Matrix
- Collagen
- Elastin and Extracellular Matrix Components
- Biochemistry of Proteoglycans
- Bone & Teeth
- Muscle & Cytoskeleton.

METABOLISM
BIOENERGETICS

- Introduction to Bioenergetics
- Biological Oxidations
- Electron Transport Chain and Oxidative Phosphorylation.

METABOLISM OF CARBOHYDRATES

- Digestion & Absorption of Carbohydrates
- Glycolysis & its Regulation
- Citric Acid Cycle
- Metabolism of Glycogen
- Gluconeogenesis and regulation of blood glucose
- Pentose Phosphate Pathway & its Significance.

METABOLISM OF LIPIDS

- Digestion & Absorption of Lipids
- Metabolism & Clinical Significance of Lipoproteins
- Fatty acid oxidation biosynthesis and metabolism of Triacylglycerols
- Metabolism & clinical Significance of Cholesterol

- Metabolism of Eicosanoids.

METABOLISM OF PROTEINS & AMINO ACIDS

- Digestion of Proteins & Absorption of Amino Acids
- Transamination & Deamination of Amino Acids and urea cycle
- Specialized products formed from Amino Acids.

MOLECULAR BIOLOGY

- Transcription in Prokaryotes
- Transcription in Eukaryotes
- Translation: (Genetic Code) Protein Synthesis in Prokaryotes
- Translation: (Genetic Code) Protein Synthesis in Eukaryotes
- Translation Inhibition by Antibiotics
- Regulation of Gene Expression
- Recombinant DNA Technology & Polymerase Chain Reaction.

HORMONES

- Classification & Mechanism of Action of Hormones
- Signal Transduction, Second Messengers and Receptors
- Steroid Hormones: Glucocorticoids and Mineralocorticoids
- Insulin & Glucagon.

RECOMMENDED TEXT BOOKS:

1. *Harper's Biochemistry* by Robbert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Latest Ed.
2. *Lippincott's Illustrated Review of Biochemistry* by Pamela C. Champe and Richard A. Harvey, Latest Ed.
3. *Practical Clinical Biochemistry* by Varley.
4. *Textbook of Biochemistry* by Devlin, 5th Ed.
5. *Textbook of Medical Biochemistry* Vol-I and II by M. A. Hashmi.
   Biochemistry by Stryer, Lubert, Latest Ed.

EXERCISE PHYSIOLOGY

CREDIT HOURS: 3 (3-0)

COURSE DESCRIPTION:

This course aims to develop a critical appreciation of exercise and applied physiology, enabling design of specialist injury prevention, rehabilitation and performance enhancement programmes and strategies

COURSE OUTLINE:

PHYSIOLOGY OF EXERCISE
CONTROL OF INTERNAL ENVIRONMENT

- Homeostasis

- Control systems of the body
- Nature of the control system
- Examples of homeostatic control
- Exercise : A test of homeostatic control.

HORMONAL RESPONSES TO EXERCISE (BRIEF REVISION)

- Neuroendocrinology
- Hormones: Regulation and action
- Hormonal control of substrate mobilization during exercise.

MEASUREMENT OF WORK, POWER & ENERGY EXPENDITURE

- Units of measure
- Work and power defined
- Measurement of work and power
- Measurement of energy expenditure
- Estimation of energy expenditure
- Calculation of exercise efficiency.

CIRCULATORY RESPONSES TO EXERCISE (BRIEF REVISION):

- Organization of the circulatory system
- Heart: myocardium and cardiac cycle
- Cardiac output
- Hemodynamics
- Changes in oxygen delivery to muscle during exercise
- Circulatory responses to exercise
- Regulation of cardiovascular adjustments to exercise.

RESPIRATION DURING EXERCISE (BRIEF REVISION)

- Function of the lung
- Structure of respiratory system
- Mechanics of breathing
- Pulmonary ventilation
- Pulmonary volumes and capacities
- Diffusion of gases
- Blood flow to the lungs
- Ventilation-perfusion relationships
- O_2 and CO_2 transport in blood
- Ventilation and acid base balance
- Ventilatory and blood-gas responses to exercise
- Control of ventilation.

TEMPERATURE REGULATION

- Overview of heat balance during exercise
- Overview of heat production/heat loss
- Body’s thermostat-hypothalamus

- Thermal events during exercise
- Exercise in the heat
- Exercise in cold environment.

THE PHYSIOLOGY OF TRAINING: EFFECT ON VO2 MAX, PERFORMANCE, HOMEOSTASIS AND STRENGTH

- Principles of training
- Research designs to study training
- Endurance training and VO2 max
- VO2 max: cardiac output and arterio-venous oxygen difference
- Detraining and VO2 max
- Endurance training: effects on performance and homeostasis
- Endurance training: links between muscle and system physiology
- Physiological effects of strength training
- Physiological mechanisms causing increased strength.

PHYSIOLOGY OF HEALTH AND FITNESS
WORK TESTS TO EVALUATE CARDIO RESPIRATORY FITNESS

- Cardio respiratory fitness
- Testing procedures
- FIELD Tests for estimating CRF
- Graded exercise tests: measurements
- VO2 max
- Graded exercise tests : protocols.

EXERCISE PRESCRIPTION FOR HEALTH AND FITNESS

- Prescription of exercise
- General guidelines for improving
- Exercise prescription for CRF
- Sequence of physical activity
- Strength and flexibility training.

EXERCISE FOR SPECIAL POPULATIONS

- Diabetes
- Asthma
- Chronic obstructive pulmonary disease
- Hypertension
- Cardiac rehabilitation
- Exercise for older adults
- Exercise during pregnancy.

PHYSIOLOGY OF PERFORMANCE
FACTORS AFFECTING PERFORMANCE:

- Sites of fatigue
- Factors limiting All-out anaerobic performances

- Factors limiting All-out aerobic performances

LABORATORY ASSESSMENT OF HUMAN PERFORMANCE:

- Laboratory assessment of physical performance
- Direct testing of maximal aerobic power
- Laboratory tests to predict endurance performance
- Determination of anaerobic power
- Evaluation of muscular strength.

TRAINING OF PERFORMANCE

- Training principles
- Components of a training session: warm-up, workout and cool down
- Training to improve aerobic power
- Injuries and endurance training
- Training for improved anaerobic power
- Training to improve muscular strength
- Training for improved flexibility
- Year-round conditioning for athletes
- Common training mistakes.

TRAINING FOR THE FEMALE ATHLETE, CHILDREN AND SPECIAL POPULATION

- Factors important to women involved in vigorous training
- Sports conditioning for children
- Competitive training for diabetics
- Training for asthmatics
- Epilepsy and physical training.

RECOMMENDED TEXTBOOKS:

1. *Exercise Physiology- Theory and Application to Fitness and Performance* by: Scott K. Powers, Edward T. Howley.
2. *Exercise physiology, A thematic Approach By:* Tudor Hale, University College Chichester, UK.
3. *Additional study material as assigned by the tutor.*

MEDICAL PHYSICS

CREDIT HOURS: 3 (2-1)

COURSE DESCRIPTION:

This course will cover the basic principal of Physics which are applicable in medical equipment used in Physical therapy. Also help to understand the fundamentals of currents, sound waves, Heat & its effects, electromedical radiations and their effects as well as their application in physical therapy.

COURSE OUTLINE:

ELECTRICITY AND MAGNETISM

- Structure of an atom
- Electron Theory, Conductors & Insulations
- Conduction & Convection
- Displacement Current.

STATIC ELECTRICITY

- Charging by conduction and Induction
- Electrostatic Fields
- Gold leaf Electroscope
- Capacitors, types of capacitors, Construction, Units
- Arrangement of Capacitors in series and parallel
- Charging and discharging of capacitors
- Oscillating Discharge of Capacitors.

CURRENT ELECTRICITY

- Ohm's Law
- Electrical Components and their unit
- Resistance
- Types of Resistance, Units
- Chemical effects of a Current
- Types of Current
- Cell and Batteries
- Simple Voltage Cell
- Wet and dry Lachlanhe Cell
- Combination of Cells in series and parallel
- Thermal effects of current
- Electrolysis and Electrolytic burns
- Ionization of gases and Thermionic emission
- Electronic tubes
- Diodes and Triodes.

ELECTROMAGNETISM

- Molecular theory of magnetism
- Magnetic effect of an electric current
- Moving coil volt meter and Ammeter
- Moving iron type, hot wire type and Thermocouple type meter
- Measurement of high frequency and alternate current with meters
- Electromagnetic induction
- Faradays law and Lenses law
- Mutual and self Induction
- Eddy currents
- Transformer

- Construction and types
- Static and auto Transformer
- Dynamo, construction
- A.C & D.C Dynamo.

ELECTRO MECHANICS

- Current for treatment
- Rectification
- Rectification of A.C
- Half wave and full wave Rectification
- Valve rectification circuits and metal rectifier
- Surging of current
- Lewis surger and valve surger
- Reverser
- Metronome interrupter and Reverse Jones motor interrupter
- Vibrations and Multivibrators circuit.

CLASSIFICATION OF CURRENTS (OVERVIEW)
LOW FREQUENCY CURRENT

- Sinusoidal current
- Faradic current
- Galvanic current (constant and interrupted)
- Diadynamic current TENS
- Smart Bristow faradic coil
- Super imposed current and their graphical representation.

MEDIUM FREQUENCY CURRENT

- Interferential current
- Russian current.

HIGH FREQUENCY CURRENT (Produced by)

- Spark
- Valves
- Transistors
- Long waves, medium waves short waves micro waves.

SOUND WAVES

- Wave motion in sound
- Infrasonic
- Normal hearing band
- Characteristics of the sound waves and their velocities
- Ultrasonic
- Reflection and refraction of sound waves
- Characteristics of tone resonance and beats
- Interference of sound waves.

HEAT

- Scales of temp and its conversion to other scales
- Nature of heat energy
- Specific heat and three modes of heat energy transfer effect of impurities on melting and boiling points.

ELECTROMAGNETIC RADIATION

- Electromagnetic spectrum
- Relationship between frequency and wave length
- Laws of reflection, refraction and absorptions
- Total internal reflection
- Cosine law and inverse square law
- Concave and convex mirrors
- Lenses and prisms
- Reflectors
- Radio wave (long, medium, short, micro waves)
- Infra red rays
- Visible rays
- Ultra violet rays
- X-rays
- Nuclear waves (alpha beta and gamma).

SAFETY IN BIOMEDICAL INSTRUMENTS

- Electrical outlets, hot, neutral and ground connections
- House wiring
- Pervasiveness of electricity and of electric shocks
- Causes of electric shocks and precaution
- Effect of electric current on human body
- Techniques to reduce the effect of electric shock
- Earth shocks and precaution against earth shocks.

RADIATION PROTECTION

- Ionizing and non ionizing radiations
- Quantities and associated units of radiations
- Effect of ionizing and non ionizing radiation's
- Internal and external hazards
- Main principle to control external hazard
- Distance and shielding.

PRACTICAL:

- To verify the ohm's Law
- To find the specific resistance by using the potential divider
- To verify the joules law of electrical methods
- To calibrate a thermo couple and an unknown temperature
- To find the acceleration due to gravity by simple pendulum

- To verify the law of reflection of light
- To verify the law of refraction of light
- To verify the refraction index of glass using rectangular slab.

RECOMMENDED TEXT BOOKS:

1. *Clayton's Electrotherapy and actinotherapy* by: P. M Scott.
2. *Medical physics for physical therapists* by: A. D Moore.
3. Preliminary Electricity for Physiotherapists by B. Savage.
4. Basic Electronics by Grob.
5. Principles of Bio-instrumention by Richard A. Normann.
6. Hand book of Biomedical Instrumentation by R. S. Khanpur.
7. Basic Radiation Protection Technology by Gollnick.