Annexure - 'B'

REVISED SYLLABUS & CURRICULUM

w.e.f. 2022-2023 onwards

FOR

BS- ALLIED HEALTH SCIENCES (BS AHS)

(Four Year Degree Program)

A: BS AHS (Pathology Lab Sciences)
B: BS AHS (Surgery / OT Lab Sciences)
C: BS AHS (Radiology Lab Sciences)
D: BS AHS (Public Health Lab Sciences)

Department of Allied Health Sciences
Sargodha Medical College Campus
University of Sargodha
Sargodha

Forwarded for
o/a P/.
24/10/22.

Incharge
Department of Allied Health Sciences
Sargodha Medical College
University of Sargodha

Vetted

C: BS AHS (Radiology Lab Sciences)

Allied Health Professionals are the professionals who have the technical expertise in a wide variety of disciplines to help the Physicians and surgeons in the Diagnosis and treatment of various diseases. Radiology Lab Sciences is essential for diagnosing patients illness through radio-imaging and other imaging modalities.

GOALS OF THE PROGRAMME:

The purpose of BS radiology lab sciences (RLS) program is to prepare radiology technologists who will:

1. Be primary provider of radio-imaging diagnostic care
2. Keep pace with the advancements in the modern radioimaging studies.
3. Fulfill the health care system needs and should be well versed with the basic and advance methods of radio-diagnostics to improve the patient treatment.
4. Serve as responsible members in the professional community and are willing and able to assume leadership roles in the communities they serve.
5. Identify researchable problems, advocate and participate in research, and incorporate research findings into clinical practice.
6. Skillful, competitive and knowledgeable both practically and theoretically.
7. Cater the local and international needs for radiodiagnostics.
8. Have the capacity, knowledge and capability to undertake career in enhancing patient diagnosis to improve treatment in community and health care systems.
9. Correlate theory with practice and think creatively about, react to, adapt or shape new practice environments.

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OBJECTIVES OF THE PROGRAMME:

Graduates of the radiology lab sciences program will:

1. Be the primary member of the team involved in diagnosing the patients illness.
2. Serve as responsible members in the professional community and are willing and able to assume leadership roles in the communities they serve.
3. Advocate evidence based practice and participate in high quality research programs.
4. Practice respecting the social, economic and cultural issues of practice and effectively advocate for changes in policy.
5. Work in collaboration with members of an interdisciplinary team where appropriate
6. Integrate theoretical and practical knowledge and should be creative and adaptive to different working environments.
7. Participate in continuous education for communities, patients, peers, students and others.

BS RLS Curriculum/Syllabus

1st YEAR

Sr. No.	Subject Title	Theory Marks	Practical / Clinical & G. Viva Marks	Total Marks
1	ANATOMY I	100	100	200
2	PHYSIOLOGY I	100	100	200
3	BIOCHEMISTRY& GENETICS I	100	100	200
4	FUNDAMENTALS OF RADIOLOGY LAB SCIENCES	100	100	200
5	ENGLISH	100	Not Applicable	100
6	INTRODUCTION TO COMPUTER	100	Not Applicable	100
	TOTAL	**600**	**400**	**1000**

2nd YEAR

Sr. No.	Subject Title	Theory Marks	Practical / Clinical & G. Viva Marks	Total Marks
1	ANATOMY II	100	100	200
2	PHYSIOLOGY II	100	100	200
3	BIOCHEMISTRY & GENETICS II	100	100	200
4	MEDICAL INSTRUMENTATIONS	100	100	200
5	ISLAMIC STUDIES	100	Not applicable	100
6	PAKISTAN STUDIES	100	Not applicable	100
	TOTAL	**600**	**400**	**1000**

3rd YEAR

Sr. No.	Subject Title	Theory Marks	Practical / Clinical & G. Viva Marks	Total Marks
1	GENERAL PATHOLOGY AND MICROBIOLOGY	100	100	200
2	PHARMACOLOGY	100	100	200
3	RADIOLOGY AND NUCLEAR MEDICINE	100	100	200
	TOTAL	**300**	**300**	**600**

4th YEAR

Sr. No.	Subject Title	Theory Marks	Practical / Clinical & G.Viva Marks	Total Marks
1	SCIENTIFIC INQUIRY, BIOSTATISTICS, RESEARCH METHODOLOGY	100	Not applicable	100
2	CONVENTIONAL RADIOLOGICAL AND CLINICAL PRACTICES	100	100	200
3	RADIOLOGY LAB MANAGEMENT	100	100	200
	TOTAL	**300**	**200**	**500**
	RESEARCH REPORT WRITING	Qualifying		

Note:

1. There shall be 01Question Paper in each subject having an equal contribution from all sections.
2. 10% marks are reserved for internal assessment based upon 3-5 Class Tests average, Class attendance, and Overall performance.

CREDIT ACCUMULATION AND TRANSFER SYSTEM (CAT)

A Credit accumulation and transfer system is a systematic way of describing an educational program based upon its components. Credit hour or credit unit is basically the academic currency of the academic activities.

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Title	Recommended	Actual		
		Teaching	Clinical/Lab work	Total
1. Contact hours 1500-1800 hrs/year 2. 25-30 Contact hours = 01 credit point 3. Number of credit points in a year= 55-60	1500-1800 hours/year	1500+1500+1200+1300=5500	300+600=900	6400/4=1600 hours/year

DIVISION OF STUDY HOURS

1st YEAR

Sr	Subject Title	Theory	Practical
1	Anatomy I	200	100
2	Physiology I	200	100
3	Biochemistry & Genetics I	200	100
5	Fundamentals of Medical Lab Sciences	200	200
6	English	100	--
7	Introduction to Computers	100	--
	TOTAL	**1500**	

2nd YEAR

Sr	Subject Title	Theory	Practical
1	Anatomy II	200	100
2	Physiology II	200	100
3	Biochemistry & Genetics II	200	100
5	Medical Instrumentations	200	200
6	Islamic Studies	100	--
7	Pakistan Studies	100	--
	TOTAL	**1500**	

3rd YEAR

Sr	Subject Title	Theory	Practical
1	General Pathology and Microbiology	200	200
2	Pharmacology	200	200
3	Radiology and Nuclear Medicine	200	200

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	TOTAL	**1200**

4th YEAR

Sr	Subject Title	Theory	Practical
1	Scientific Inquiry, Biostatistics, Research Methodology	200	--
2	Conventional Radiological and Clinical Practices	200	200
3	Radiology Lab Management	200	200
4	Report Writing	300	
	Total	1300	

BREAK DOWN OF HOURS OF CLINICAL PRACTICE/LAB ROTATIONS

Year	Ward/Clinic	Hours	Period
3rd Year	Clinical Rotation	300	06 Months
4th Year	Clinical Rotation	600	06 Months
	TOTAL	**900**	

Grand Total

G. TOTAL (Theory + Practical + Report + Clinical)	**6400**

Note:

*2/3rd of the clinical training shall be provided in the morning whereas 1/3rd shall be provided in the evening. There shall be 02 months of summer vacations in an academic session.

1. PAPER PATTERNS & MARKS DISTRIBUTION OF UNIVERSITY EXAMINATIONS

PAPER PATTERN

I **TOTAL MARKS = 100** (having Theory Section only)

II **TOTAL MARKS = 200** (having Theory + Practical & G. Viva)

I- TOTAL MARKS = 100 *(having Theory only)*

THEORY (100 marks)			
Question	**No of Questions**	**Marks for each Stem**	**Total marks**
Question 01:MCQs (20 stems with 04 possible options only 01 correct)	01	01	01x20 = 20
Question 02 to 09: SEQs (Requiring short answer of all)	08	05	08x05 = 40
Question 10 to 12: LEQs (Requiring detailed answer of any 02 Qs)	02	15	02x15 = 30
Total Marks			**90**
INTERNAL ASSESSMENT (10 MARKS)			
Internal assessment Theory part			10
Total Marks			10
Grand Total Marks			**100**

II- TOTAL MARKS = 200 *(having both Theory and Practical & General Viva)*

WRITTEN /THEORY (100 marks)			
Question	**No of**	**Marks for each**	**Total marks**

	Questions	Stem	
Question 01:MCQs (20 stems with 04 possible options only 01 correct)	01	01	01x20 = 20
Question 02 to 09:SEQs (Requiring short answer of all)	08	05	08x05 = 40
Question 10 to 12:LEQs (Requiring detailed answer of any 02 Qs)	02	15	02x15 = 30
Total Marks			**90**
PRACTICAL (40 marks)			
Marks for Internal			20
Marks for External			20
Total Marks			**40**
G.VIVA (50 marks)			
Marks for Internal			25
Marks for External			25
Total Marks			**50**
INTERNAL ASSESSMENT (20 MARKS)			
Internal assessment Theory part			10
Internal assessment Practical part			10
Total Marks			**20**
Grand Total Marks			**200**

Note:
Passing marks in each paper will be at least 50% in theory and 50% in practical/viva voice (in the case of practical subjects).

DETAILED COURSE OUTLINE RLS

1st YEAR

1.	Anatomy I	200 Marks
2.	Physiology I	200 Marks
3.	Biochemistry & Genetics I	200 Marks
4.	Fundamentals of Radiology Lab Sciences	200 Marks
5.	English	100 Marks
6.	Introduction to Computer	100 Marks
	Total Marks	**1000 Marks**

ANATOMY I

COURSE DESCRIPTION

The main aim of this course is to train and teach the students of first year BS degree program in such a way that they can practically apply the concepts of this subject which forms the firm foundation for the art of healing (medicine). The curriculum equips the students with the clear and comprehensive study of human body structural organization. The knowledge sharing is done with the students as it is the science of macro/micro structure and forms of the human body. The topics

within the domain of anatomy include general anatomy, histology or microscopic anatomy, embryology or developmental anatomy, regional or gross anatomy which highlights the importance of the study of structural anatomy. Our teaching methodology involves group discussions, lectures and practical. At the end of the course study, the student will be able to understand the basic knowledge of upper limb, lower limb and thorax of the human body.

LEARNING OBJECTIVES

- Define basic technical terminology and language associated with anatomy
- Describe the structure, composition and functions of the organs in the human body
- Comprehend the concepts (& associated principles) for each general type of anatomical structures
- Demonstrate skills in the surface markings of clinically important structures, on normal living bodies and the correlation of structure with function
- Describe concepts of embryology and histology
- Identify histological slides of the human body
- Describe the interdependency and interactions of the structural and functional components of upper limb

COURSE CONTENTS

CELL BIOLOGY

GENERAL ANATOMY

Terms related to position and movements, the skin and subcutaneous tissues, Layers of skin, Integuments of skin, Glands associated with hair follicle, Microscopic picture of skin

BONES AND CARTILAGES

Osteology, Functions of Bones, Classification of bones, Parts of developing long bones, Blood supply of bones, Lymphatic vessels & nerve supply, Rule of direction of nutrient foramen, Gross structure of long bone, Surface markings, Cartilage, Development of bone and cartilage and Microscopic picture of cartilage and bone

THE MUSCLE

Introduction, Histological Classification, Functions of muscles in general, Type of skeletal muscles, Parts of skeletal muscle and their action and Nomenclature and Microscopic picture of muscle

STRUCTURES RELATED TO MUSCLES & BONES

Tendons, Aponeurosis, Fasciae, Synovial bursae, Tendon Synovial sheaths, Raphaes, Ligaments, Condyle, Epicongyle, Ridge, Tuberosity, Tubercle, Foramen, Canal, Groove, Process and Spur

THE JOINTS

Introduction, Functional classifications, Structural classification, Structures comprising a Synovial joint, Movements of joints, Blood supply of Synovial joints, their nerve supply and lymphatic drainage and Factors responsible for joint stability and Development of joints

CARDIOVASCULAR SYSTEM

Definition, Division of circulatory system into pulmonary & systemic, Classification of blood vessels and their microscopic picture and Heart and its histology and Function of the Heart and Anastomosis

NERVOUS SYSTEM

Definition, Outline of cellular architecture, Classification of nervous system, Parts of the central nervous system, Microscopic picture of cerebrum, cerebellum, spinal cord, Functional components

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of a nerve, Typical spinal nerve and Microscopic picture of nerve and Introduction of autonomic nervous system and Anatomy of neuromuscular junction

UPPER LIMB

OSTEOLOGY:

Detailed description of all bones of upper limb and shoulder girdle along their musculature and ligamentous attachments

MYOLOGY

Muscles connecting upper limb to the axial skeletal, Muscles around shoulder joint, Walls and contents of axilla, Muscles in brachial region, Muscles of forearm, Muscles of hand, Retinacula and Palmar apouenrosis and Flexor tendon dorsal digital expansion

NEUROLOGY

Course, distribution and functions of all nerves of upper limb and Brachial plexus

ANGIOLOGY (CIRCULATION).

Course and distribution of all arteries and veins of upper limb, Lymphatic drainage of the upper limb and Axillary lymph node and Cubital fossa

ARTHROLOGY

Acromioclavicular and sternoclavicular joints, Shoulder joint, Elbow joint, Wrist joint, Radioulnar joints. Inter carpal joints, Joints MCP and IP and Surface Anatomy of upper limb, and Surface marking of upper limb

DEMONSTARIONS:

Demonstration on Shoulder joint, attached muscles and articulating surfaces, Demonstration on Elbow joint, Demonstration on Wrist joint, Demonstration on Radioulnar joint, Demonstration on MCP and IP joints, Demonstration on acromioclavicular joint, Demonstration on sternoclavicular joint and Demonstration on Brachial plexus and Demonstration on Structure of bones

THORAX

STRUCTURES OF THE THORACIC WALL:

Dorsal spine (Vertebrae), Sternum, Costal Cartilages & Ribs, Intercostal Muscles, Intercostal Nerves, Diaphragm, Blood supply of thoracic wall and Lymphatic drainage of thoracic wall and Joints of thorax

THORACIC CAVITY:

Mediastinum, Pleura, Trachea, Lungs, Bronchopulmonary segments, Pericardium, Heart – Its blood supply, venous drainage & nerve supply, Large veins of thorax, superior and in-ferior vena cava., pulmonary veins brachiocephalic veins and Large Arteries – Aorta & its branches

LOWER LIMB

OSTEOLOGY

Detailed description of all bones of lower limb and pelvis along their musculature and ligamentous attachments.

MYOLOGY

Muscles of gluteal region, Muscles around hip joint, Muscles of thigh (anteriorly, posteriorly, laterally and medially) and Muscles of lower leg and foot

NEUROLOGY

Course, distribution, supply of all nerves of lower limb and gluteal region and Lumbosacral plexus.

ANGIOLOGY

Course and distribution of all arteries, veins and lymphatic drainage of lower limb

ARTHROLOGY

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Pelvis, Hip joint, Knee joint, Ankle joint, Joints of the foot, Surface Anatomy of lower limb and Surface marking of lower limb

GENERAL HISTOLOGY

Cell, Epithelium, Connective tissue, Bone, Muscles tissue, Nervous tissues, Blood vessels, Skin and appendages and Lymphatic organs

GENERAL EMBRYOLOGY:

Male and female reproductive organs, Cell division and Gametogenesis, Fertilization, cleavage, blastocyst formation and implantation of the embryo. Stages of early embryonic development in second and third week of intrauterine life, Foetal membrane (amniotic cavity, yolk sac, allantois, umbilical cord and Placenta) and Developmental defects

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 respective year.

RECOMMENDED BOOKS

1. *Gray's Anatomy* by Prof. Susan Standring 39th Ed.,
2. Elsevier, *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
6. *The Developing Human. Clinically Oriented Embryology* by Keith L. Moore, 6th Ed, *Wheater's Functional Histology* by Young and Heath,
7. Latest Ed, *Medical Histology* by Prof. Laiq Hussain, *Neuroanatomy*by Richard S.Snell.

PHYSIOLOGY I

COURSE DESCRIPTION:

Physiology is the integrative study of cellular and whole-body function and is the pivotal discipline linking other basic biomedical sciences on the one hand with the experimental and clinical medicine on the other. The course is designed to explain the physical and chemical mechanisms that are responsible for the origin, development, and progression of life. Two approaches are used to explain events that occur in the human body; one emphasizes the purpose of a body process and the other emphasizes the underlying mechanism by which this process occurs. Physiologists, however, explain how processes occur in the body in terms of cause and- effect sequences of physical and chemical processes. Emphasis in the course will be on normal structure and function of the human body and the approach will be to develop an understanding of the integrative nature of physiological systems to maintain the internal environment of the body within very narrow limits compatible with life.

LEARNING OBJECTIVES

- Define the terminology related to the structure and function of the human body systems
- Compare and contrast the structural and functional characteristics of the various human body cells
- Describe basic chemical concepts and principles as they apply to the structure and functioning of the blood and neuromuscular system

- Analyze the interrelationships of body organ systems, homeostasis, and the complementarity of structure and functioning of the blood and neuromuscular system
- Demonstrate advance techniques to investigate the body and interpret data to be used for diagnosis and treatment
- Define the principles behind medical instrumentation and their usage

COURSE CONTENTS

BASIC AND CELL PHYSIOLOGY

Functional organization of human body, Homeostasis, Control systems in the body, Cell membrane and its functions, Cell organelles and their functions and Genes: control and function

NERVE AND MUSCLE

Structure and function of neuron, Physiological properties of nerve fibers, Physiology of action potential, Conduction of nerve impulse, Nerve degeneration and regeneration. Synapses, Physiological structure of muscle, Skeletal muscle contraction, Skeletal, smooth and cardiac muscle contraction, Neuromuscular junction and transmission, Excitation contraction coupling, Structure and function of motor unit

Clinical Module

Perform nerve conduction studies and explain their clinical importance. Myopathies and neuropathies. Peripheral nerve injuries

CARDIOVASCULAR SYSTEM

Heart and circulation, Function of cardiac muscle, Cardiac pacemaker and cardiac muscle contraction, Cardiac cycle, ECG: recording and interpretation. Common arrhythmias and its mechanism of development, Types of blood vessels and their function, Haemodynamics of blood flow (local control systemic circulation its regulation and control). Peripheral resistance its regulation and effect on circulation, Arterial pulse, Blood pressure and its regulation, Cardiac output and its control, Heart sounds and murmurs Importance in circulation and control of venous return.. Coronary circulation, Splanchnic, pulmonary and cerebral circulation , Clinical Module

Clinical significance of cardiac cycle, correlation of ECG and heart sounds to cardiac cycle. Clinical significance of cardiac cycle, interpretation of ischemia and arrhythmias. Effects of hypertension. Clinical significance of heart sounds. Effects of ischemia. Shock

RESPIRATORY SYSTEM

Function of respiratory tract, Respiratory and non-respiratory function of the lungs, Mechanics of breathing, Production & function of surfactant and compliance of lungs, Protective reflexes, Lung volumes and capacities including dead space, Diffusion of gases across the alveolar membrane, Relationship between ventilation and perfusion. Mechanism of transport of oxygen and carbon dioxide in blood, Nervous and chemical regulation of respiration, Abnormal breathing, Hypoxia, its causes and effects, Cyanosis, its causes and effects

Clinical Module

Clinical importance of lung function tests. Causes of abnormal ventilation and perfusion. Effects on pneumothoax, pleural effusion, and pneumonia. Respiratory failure. Artificial respiration and uses & effects of O2 therapy. Clinical significance of hypoxia, cyanosis, and dyspnoea

BLOOD

Composition and general functions of blood, Plasma proteins their production and function, Erythropoiesis and red blood cell function, Structure, function, production and different types of haemoglobin, Iron absorption storage and metabolism, Blood indices, Function, production and type of white blood cells, Function and production of platelets, Clotting mechanism of blood, Blood groups and their role in blood transfusion, Complications of blood transfusion with reference to ABO & RH incompatibility, Components of reticuloendothelial systems, gross and microscopic structure including tonsil, lymph node and spleen, Development and function of reticuloendothelial system

Clinical Module

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Anemia and its different types. Blood indices in various disorders. Clotting disorders. Blood grouping and cross matching. Immunity
SKIN AND BODY TEMPERATURE REGULATION + SPORT PHYSIOLOGY

Practical

HEMATOLOGY
Use of the microscope. Determination of haemoglobin. Determination of erythrocyte sedimentation rate. Determining packed cell volume. Bleeding and clotting time tests. RBC count. Red cell indices. WBC count. Leukocyte count. Prothrombin and thrombin time
RESPIRATORY SYSTEM
Clinical examination of chest. Pulmonary volume, their capacities and clinical interpretation. Stethography
CARDIOVASCULAR SYSTEM
Cardiopulmonary resuscitation (to be coordinated with the department of medicine), Examination of arterial pulse, ECG recording and interpretation, Arterial blood pressure, Effects of exercise and posture on blood pressure, Apex beat and normal heart sounds

RECOMMENDED BOOKS

1. Textbook of Physiology by Guyton and Hall, Latest Ed.
2. Review of Medical Physiology by William F. Ganong, Latest Ed.
3. Physiology by Berne and Levy, Latest Ed.
4. Human Physiology: The Basis of Medicine by Gillian Pocock, Christopher D. Richards
5. Physiological Basis of Medical Practice by John B. West and Taylor, 12th Ed.

BIOCHEMISTRY & GENETICS I

COURSE DESCRIPTION

The knowledge and skills in fundamental and introductory biochemistry is provided that are essential for further studies. This course provides a basic understanding of life processes at the biochemical molecular level. It provides an understanding of the normal biochemical processes in the human body in which the function of the various organs and tissues are integrated. It covers introduction to the biomolecules i.e. amino acid, proteins carbohydrates, fats, enzymes and nucleic acids, and the nutritional biochemistry concludes the course. It also familiarizes the students with laboratory instruments / equipment used in biochemistry laboratory.

LEARNING OBJECTIVES

At the end of the course, the student should be able to demonstrate his knowledge and understanding on the subject with following learning objectives:

- Describe molecular and functional organization of a cell, and sub-cellular components in the context of chemistry and human biochemistry.
- Basic knowledge of structure, function and interrelationship of biomolecules and consequences of deviation from normal.
- Learning and understanding the properties, classification and functions of biomolecules with emphasis on amino acid, peptides, proteins, carbohydrates, lipids and nucleic acid.

- Having a clear understanding of the fundamental aspects of enzymology & its clinical applications.
- Explain importance of nutritional biochemistry with emphasis on minerals, trace elements, vitamins and balance diet.

COURSE CONTENTS

CELL
Introduction to Biochemistry, Cell: (Biochemical Aspects), Cell Membrane Structure, Membrane Proteins, Receptors & Signal Molecules
BODY FLUIDS
Structure and properties of Water, Weak Acids & Bases, Concept of pH &pK, Buffers& their mechanism of action, Body buffers
BIOMOLECULES
AMINO ACIDS, PEPTIDES & PROTEINS
Amino acids: Classification, Acid-Base Properties, Functions & Significance, Protein Structure, Primary, Secondary & Super secondary. &, Structural Motifs, Tertiary & Quaternary Structures of Proteins. Protein Domains, Classification of Proteins, Fibrous proteins, Globular proteins, Hemo-proteins and their clinical implications (such as jaundice etc)
ENZYMES
Introduction, Classification & Properties of Enzymes, Coenzymes, Isozymes & Proenzymes, Regulation & Inhibition of Enzyme activity & enzymes inhibitors, Clinical Diagnostic Enzymology
CARBOHYDRATES
Definitions, Classification, Biochemical Functions & Significance of Carbohydrates, Structure & Properties of Monosaccharides & Oligosaccharides, Structure & Properties of Polysaccharides, Bacterial cell Wall, Hetero-polysaccharides, Glycosaminoglycans(GAGs)
LIPIDS
Classification of Lipids, Fatty Acids: Chemistry, Classification occurrence & Functions, Structure & Properties of Triacylglycerols and Complex Lipids, Classification & Functions of Eicosanoids, Cholesterol: Chemistry, Functions & Clinical Significance, Bile acids/salts
NUCLEIC ACIDS
Structure, Functions & Biochemical Role of Nucleotides. Structure & Functions of DNA, Structure & Functions of RNA
MINERALS
Sources, RDA, Biochemical Functions & Clinical Significance of Calcium & Phosphorus. Sources, RDA, Biochemical Functions & Clinical Significance of Sodium, Potassium, Chloride.
Biochemical Functions & Clinical Significance of Iron, Copper, Zinc, Manganese, Magnesium, Selenium, Iodine and Fluoride
VITAMINS
Sources, RDA& Biochemical Functions & Clinical Significance of Fat-Soluble Vitamins, Sources, RDA& Biochemical Functions & Clinical Significance of Water-Soluble Vitamins
NUTRITION
Dietary Importance of Carbohydrates, Lipids & Proteins and other dietary Ingredients. Balanced Diet. Diet in specialized conditions

Practical

1. Working SOPs for a Biochemistry Practical Laboratory. Introduction to Laboratory Equipments and Techniques. Preparation of solution (Normal, Molar Equivalent solution etc).
2. Molisch's Test & Iodine Test. Benedict's Test &Barfoed's Test. Selivanoff's Test &Phenylhydrazine Test. Sucrose Hydrolysis. Starch Hydrolysis.

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3. Biuret Test, Heat Coagulation Test & Salt Saturation Test. Ninhydrin Test, Xanthoproteic Test &Millon-Nasse's Test. Aldehyde Test, Sakaguchi's Test. Determination of Isoelectric pH of casein Protein.
4. Emulsification of natural fat & Solubility of soap, Test for Cholesterol, Iodine & Peroxide value calculation. Saponification value calculation
5. Sample Collection & Physical Evaluation of Urine. Analysis of Normal Urine. Analysis of Abnormal Urine

RECOMMENDED BOOKS

1. Harper's Biochemistry by Robbert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwel (Latest Edition).
2. Lippincott's Illustrated Review of Biochemistry by Pamela C. Champe and Richard A. Harvey (Latest Edition).
3. Practical Clinical Biochemistry by Varley (Latest Edition).
4. Textbook of Biochemistry by Devlin (Latest Edition).
5. Textbook of Medical Biochemistry by M.A. Hashmi (Latest Edition).
6. Biochemistry by Stryer (Latest Edition).

FUNDAMENTALS OF RADIOLOGY LAB SCIENCES

COURSE DESCRIPTION

Allied health professionals are considered the backbone of any healthcare work force and greatly influence the health care delivery system. This course is designed to give knowledge to the students about Radiology and Imaging Sciences and the role of Radiology Profession and the professionals in medical & healthcare field. General introduction, importance, infrastructure, problems and the solutions of the problems encountered in different laboratories related to various sub sections of Radiology Laboratory are the main focus of this course. This course aims at familiarizing the students with the basic radiological procedures, preparation of different types of contrast medias, and reagents used during radiological examinations.

LEARNING OBJECTIVES

At the end of this course, the students will be:

- Able to demonstrate the basics of Radiology Lab Sciences and its various sub-disciplines.
- Familiar with all the basic laboratory procedures and the principles for working in the clinical laboratories.
- Well aware of the responsibilities of Radiology Lab professionals
- Know about the proper use of PPEs
- Well aware about personal protection; hygiene and trouble shooting of laboratory procedures

COURSE CONTENTS

Introduction to Radiology, What is Radio-Imaging, Branches of Radiology; Diagnostic Radiology, Interventional Radiology, Therapeutic Radiology, Radiation Oncology, Brief introduction to various subspecialties of Radiology, Basic principles of Radiology, Planning and Organization of Radiology Lab/Department, Staffing in Radiology Lab/Department, Importance and role of Radiology department in health care, Medical Radiology profession and professionals, professionalism in medical personnel, Code of professional conduct for Radiology personnel, Qualities/characteristics of Radiology Technologists, Different sub-disciplines of Radiological Procedure/Techniques.

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Definition of atoms, structure of atom, model of atom, Atomic number, Mass Number, Isotopes and types of isotopes, Radio-Isotopes, Definition of Ionization energy,
Radioactivity and Radiations, radioactive materials and radioactive decay,
Types of radiations; Electromagnetic radiations, Ionizing and Non Ionizing radiations,
Radiation energy, Radioactive decay law, Units of Radioactivity
Interaction of radiation with matter, Radiation units, Absorption of Radiations
Biological effects of Radiations, Harmful tissue reactions, Sources of radiations; Natural vs Man Made Radiations, Use of Radio-Isotopes, Radioactive wastes,
Introduction to Medical Radiology and Radiobiology, Scope of modern radiology and health care.
Units of measurements and dosage calculations:
Brief discussion about benefits and adverse effects of radiology procedures
Different types of chemicals/contrast media, gels used in radiological procedures.
Contrast Agents
A. Types of compound: 1. Metallic salts, 2. Organic iodides: a. Ionic contrast agents, b. Nonionic contrast agents. 3. Gaseous, 4. Oils: Myelograms, sinouses, 5. Tablets: cholecystograms
B. Beam attenuation characteristics
1. Radiolucent (negative), 2. Radiopaque (positive), 3. Impact of atomic number
C. Composition and functions of contrast agents
1. Chemical composition, 2. Absorption characteristics
Characteristics of a good contrast medium, Solubility, Viscosity & Iodine Content, Systemic reactions to contrast medium, Precautions & contraindications of administering Contrast Media
Brief overview of radiological procedures: X rays, Ultrasound, Flouroscopy, CT Scan etc.
Dark Room
Dark Room Construction & Equipment, Theory of photographic process, Photographic process fundamentals, Construction of film, handling, Density Ratio, Constituents of dark room, Developer, Fixer. Automatic Processing, Difference between manual & automatic processing,
Film Artifacts & their Causes, Sensitometery, Densitometry & Optical density, Radiation Protection
Different types of radiation hazards encountered in radiology department
Infection control in radiology department

Practical

Use of PPEs, Preparation or use of various contrast media for radiological procedures, Contrast Materials (Market Availability, Method, Area of use), Measurements and calculation of radiations and radiation doses, Handling of various equipments, chemicals, reagents used in radiological procedures, Preparing patient for radiological examination.
Dark Room Construction & Equipment

RECOMMENDED BOOKS

1. Radiological science for technologists by Stewart C. Bushong 7th edition published by Mosby, Inc: A Harcout health company.
2. A guide to radiological procedures by Stephen Chapman & Richard Nikielny 3rd editionin by Bailliere tindall London
3. Merrill atlas of radiography positioning and radiologic procedure vol 3 by Philip W Ballinger.
4. Ultrasound teaching manual: The basics of Performing and Interpreting ultrasound Scans by Mathias Hofer.

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ENGLISH

COURSE DESCRIPTION

The course introduces the students to the underlying rules to acquire and use language in academic context. The course aims at developing grammatical competence of the learners to use grammatical structures in context in order to make the experience of learning English more meaningful enabling the students to meet their real life communication needs. The objectives of the course are to, reinforce the basics of grammar, understand the basic meaningful units of language, and introduce the functional aspects of grammatical categories and to comprehend language use by practically working on the grammatical aspects of language in academic settings. After studying the course, students would be able to use the language efficiently in academic and real life situations and integrate the basic language skills in speaking and writing. The students would be able to work in a competitive environment at higher education level to cater with the long term learners' needs.

LEARNING OBJECTIVES

Enable the students to meet their real life communication needs.

COURSE CONTENTS:

Comprehension; Answers to questions on a given text
Translation skills; Urdu to English
Paragraph writing; Topics to be chosen at the discretion of the teacher
Paragraph writing; Practice in writing a good, unified and coherent paragraph
Essay writing; Introduction
CV and job application; Translation skills, Urdu to English
Study skills; Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension
Academic skills; Letter/memo writing, minutes of meetings, use of library and internet
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency). Technical report writing, Progress Report writing

RECOMMENDED BOOKS

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41 45-53.
4. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
5. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

Vetted

Incharge
Department of Allied Health Sciences
Sargodha Medical College
University of Sargodha

6. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.

INTRODUCTION TO COMPUTER

COURSE DESCRIPTION

This is an introductory course on information and communication technologies. Topics include ICT terminologies, hardware and software components, the internet and World wide web, and ICT based applications. Students will get basic understanding of computer software, hardware, and associated technologies. This course is aimed to introduce computer and its basic numerical methods, data bases, networking, etc. World wide web and basic terms of databases, ICT on internet will also be discussed and taught to the students. Techniques of information search, objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace. The course is designed to equip and train students in basics of computers, internet resources, and several software required nowadays to complete the assignments, to design presentation. Course will also cover computer ethics and related social media norms and cyber laws.

LEARNING OBJECTIVES

After completing this course, a student will be able to:

- Understand different terms associated with computer and information technology.
- Identify various components of a computer system.
- Identify the various categories of software and their usage.
- Define the basic terms associated with communications and networking.
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools.
- The enabling/pervasive features of computer and information technology.

COURSE CONTENTS:

Basic Definitions & Concepts
Hardware: Computer Systems & Components
Storage Devices, Number Systems
Software: Operating Systems, Programming and Application Software
Introduction to Programming, Databases and Information Systems
Networks
Data Communication
The Internet, Browsers and Search Engines
The Internet: Email, Collaborative Computing and Social Networking
The Internet: E-Commerce
IT Security and other issues

RECOMMENDED BOOKS

1. Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)

2. Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition (McGraw HILL)
3. Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer
4. Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon press

2nd YEAR

1. Anatomy II	200 Marks
2. Physiology II	200 Marks
3. Biochemistry & Genetics II	200 Marks
4. Medical Instrumentations	200 Marks
5. Islamic Studies	100 Marks
6. Pakistan Studies	100 Marks
Total Marks	**1000 Marks**

ANATOMY II

COURSE DESCRIPTION

The main aim of this course is to train and teach the students of second year BS degree program in such a way that they can practically apply the concepts of this subject which forms the firm foundation for the art of healing (medicine). The curriculum equips the students with the clear and comprehensive knowledge of human body structural organization. The knowledge sharing is done with the students as it is the science of macro/micro structure and forms of the human body. The topics within the domain of Anatomy include Histology or Microscopic Anatomy, Embryology or Developmental Anatomy, Regional or Gross Anatomy and Neuroanatomy which highlight the importance of the structural Anatomy. Our teaching methodology involves group discussions, lectures and practical. At the end of the course study, the student will be able to understand the basic knowledge of structure, histology and development of the Abdomen, Pelvis, Head, Neck and Brain Regions.

LEARNING OBJECTIVES

- Describe gross anatomy of neuro-musculoskeletal and circulatory system of lower limb, abdominal wall and pelvis.
- Demonstrate anatomical landmarks and configuration of the lower limb, abdominal wall and pelvis through dissection/identification of structures in the manicans / smart board systems supplemented with the study of charts, models, prosected materials, and radiographs.
- Describe major stages of embryological development of the lower limb with development of the neurological and vascular supplies to the lower limb.

COURSE CONTENTS:

EMBRYOLOGY:

SPECIAL; Musculoskeletal system, cardiovascular system, CNS

THE HEAD AND NECK

THE NECK:

Muscles around the neck, Triangles of the neck, Main arteries of the neck, Main veins of the neck, Cervical part of sympathetic trunk, cervical plexus, cervical spine (Vertebrae), Joint of neck

THE FACE:

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Sensory nerves of the face, Bones of the face, Muscles of the face, Facial nerve, Muscles of mastication, Mandible, Hyoid bone, Temporomandibular joint, Brief description of orbit and nasal cavity

THE SKULL:

Bones of skull, Anterior cranial fossa, Middle cranial fossa, Posterior cranial fossa, Base of skull and Structures passing through foramina

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 and 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 and Autonomic Nervous system

ABDOME; ABDOMINAL WALL:

Structures of anterior abdominal wall: superficial and deep muscles, Structure of rectus sheath, Structures of Posterior abdominal wall, Lumbar spine (vertebrae), Brief description of viscera.

PELVIS

Brief description of anterior, posterior and lateral walls of the pelvis, Inferior pelvic wall or pelvic floor muscles, Sacrum, Brief description of perineum and Nerves of perineum.

Practical

During study, 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 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.
9. Neuroanatomyby Richard S.Snell

PHYSIOLOGY II

COURSE DESCRIPTION

Physiology is the integrative study of cellular and whole-body function and is the pivotal discipline linking other basic biomedical sciences on the one hand with the experimental and clinical medicine on the other. The course is designed to explain the physical and chemical mechanisms

that are responsible for the origin, development, and progression of life. Two approaches are used to explain events that occur in the human body; one emphasizes the purpose of a body process and the other emphasizes the underlying mechanism by which this process occurs. Physiologists, however, explain how processes occur in the body in terms of cause and- effect sequences of physical and chemical processes. Emphasis in the course will be on normal structure and function of the human body and the approach will be to develop an understanding of the integrative nature of physiological systems to maintain the internal environment of the body within very narrow limits compatible with life.

LEARNING OBJECTIVES

- Describe functions of gastrointestinal tract, endocrinology and cardiovascular system
- Describe physiology at the molecular, metabolic/cellular, tissue and systems levels
- Differentiate the physiological responses in normal function and disease stages

COURSE CONTENTS:

NERVOUS SYSTEM

General organization of the nervous system, Classification of nerve fibers, Properties of synaptic transmission, Function of neurotransmitters and neuropeptides, Type and function of sensory receptors, Function of the spinal cord and ascending tracts, Reflex action and reflexes, Muscle spindle and muscle tone, Mechanism of touch, temperature and pain., Functions of the cerebral cortex, Difference between the sensory and motor cortex and their functions, Motor pathways including pyramidal and extrapyramidal, Basal Ganglia and its functions, Cerebellum and its function, Control of posture and equilibrium, Physiology of sleep, Physiology of memory, Mechanism and control of speech, Function of the thalamus, Function of the hypothalamus and limbic system, Production of CSF.

Clinical Module

Significance of dermatomes. Injuries of the spinal cord. Hemiplegia and paraplegia. Parkinsonism. Effects of cerebellar dysfunction.

REPRODUCTION

Production and function of testosterone and Physiological changes during male puberty, Function of the female reproductive system, Production and function of oestrogen, and progesterone, Menstrual cycle, Physiological changes during female puberty and menopause.

Clinical Module

Male infertility. Female infertility. Basis for pregnancy tests.

GASTROINTESTINAL TRACT

General function of gastrointestinal tract, Enteric nervous system, control of gastrointestinal motility and secretion, Mastication, Swallowing: mechanism and control, Function, motility and secretions of stomach, Function, motility and secretions of small intestine, Function, motility and secretions of large intestine, Function of GIT hormones, Mechanism of vomiting and its control pathway, Defecation and its control pathway, Functions of liver, Functions of, gallbladder and bile in digestion and Endocrine & exocrine pancreas and functions of pancreas in digestion

Clinical Module

Dysphagia. Physiological basis of acid peptic disease. Causes of vomiting. Diarrhea and constipation in clinical settings. Jaundice and liver function tests in clinical settings

ENDOCRINOLOGY

Classification of endocrine glands, Mechanism of action, feedback and control of hormonal secretion, Functions of the hypothalamus, Hormones secreted by the anterior and posterior pituitary and their mechanism of action and function.. Function of the thyroid gland, Function of the parathyroid gland, Calcium metabolism and its regulation, Secretion and function of calcitonin, Hormones secreted by the adrenal cortex and medulla, and their function and mechanism of action,

Vetted MK

Endocrine functions of the pancreas, Control of blood sugar. Hormones secreted by the gastrointestinal system and their function, Function of the thymus and The endocrine functions of the kidney and Physiology of growth.

Clinical Module

Acromegaly, gigantism and dwarfism. Effects of panhypopitutiarism. Diabetes insipidus. Thyrotoxicosis and myxoedema. Pheochromocytoma. Cushing's disease. Adrenogenital syndrome. Diabetes mellitus and hypoglycemia.

BODY FLUIDS AND KIDNEY

Components and quantitative measurements of body fluids, Fluid compartments, tissue and lymph fluid, Structure of the kidney and nephron, General function of the kidney, GFR and its regulation, Formation of urine including filtration, re-absorption and secretion, Plasma clearance., Mechanism of concentration and dilution of urine, Water and electrolyte balance with reference to the kidney, Role of the kidney in blood pressure regulation, Hormonal functions of the kidney, Acidification of urine and its importance, Acid base balance with reference to the kidney and Micturition and its control.

Clinical Module

Renal function tests and their clinical importance. Fluid excess and depletion. Renal failure and dialysis. Metabolic acidosis and alkalosis. Abnormalities of micturition.

Practical

Nervous System

Examination of superficial and deep reflexes. Brief examination of the motor and sensory system. Examination of the cranial nerves.

RECOMMENDED BOOKS

1. Textbook of Physiology by Guyton and Hall, Latest Ed.
2. Review of Medical Physiology by William F. Ganong, Latest Ed.
3. Physiology by Berne and Levy, Latest Ed.
4. Human Physiology: The Basis of Medicine by Gillian Pocock, Christopher D. Richards
5. Physiological Basis of Medical Practice by John B. West and Taylor,12th Ed

BIOCHEMISTRY & GENETICS II

COURSE DESCRIPTION

The knowledge and skills in fundamental and introductory biochemistry is provided that are essential for further studies. This course provides a basic understanding of life processes at the biochemical molecular level. It provides an understanding of the normal biochemical processes in the function of the various organs and tissues with the principles of metabolic integration giving the genetic, biochemical and molecular understanding of the biochemical basis of various disease processes. It also familiarizes the students with laboratory instruments / equipment used in biochemistry laboratory with modem biochemical techniques and their uses in the diagnosis of diseases especially genetic diseases.

LEARNING OBJECTIVES

At the end of the course, the student should be able to demonstrate his knowledge and understanding on the subject with following learning objectives:

- To learn basic understanding with the homeostatic mechanisms through the concepts of inter-regulation of carbohydrates, lipids and protein metabolism and its relation to hormone

Vetted MW

actions in the human body.

- To learn and understand the basic biochemical processes taking place in the body, and understanding their relation with normal and abnormal human metabolism.
- To learn how large molecules are synthesized and used, and how energy is generated, stored, and retrieved (metabolism). And to have understanding and knowledge about how diseases are related to biochemical defects.
- To learn and describe respiration at cellular and molecular level and to explain the various biochemical pathways related to metabolism of carbohydrates, protein, lipids and nucleic acid.
- Applying basic knowledge of protein synthesis, post translational modification and targeting to its cellular destination.
- To learn and understand the molecular mechanisms of gene expression, the principles of genetic engineering & their applications in medicine.
- To learn and understand the basics of Molecular Medicine, Gene therapy and Stem Cell therapy in Physical Therapeutics.
- To have the basic principles and to make use of techniques/instruments to perform biochemical analysis relevant to clinical screening & diagnosis.

COURSE CONTENTS:

BIOENERGETICS

Introduction to Bioenergetics, Biological Oxidations and 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 and Pentose Phosphate Pathway & its Significance, Alcohol Metabolism

METABOLISM OF LIPIDS

Digestion & Absorption of Lipids, Metabolism & Clinical Significance of Lipoproteins, Fatty acid oxidation,fatty acid 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 and Specialized products formed from Amino Acids

Metabolism of Nucleic Acids

HORMONES

Classification & Mechanism of Action of Hormones, Signal Transduction, Second Messengers and Receptors, Hypothalamic & Pituitary Hormones, Steroid Hormones: Glucocorticoids and Mineralocorticoids, Insulin & Glucagon and brief introduction to the Diseases related to hormones abnormalities

MOLECULAR BIOLOGY

Structural Organization of Chromosome and Genes, Replication, Transcription and Translation (Protein synthesis)in Prokaryotes & Eukaryotes, Regulation of Gene Expression, Mutations and DNA repair mechanisms,Recombinant DNA Technology, Polymerase Chain Reaction, Blotting Techniques, Nucleic acid hybridization assays

Practical

1. Techniques of Instruments in Clinical Biochemistry with examples.
2. Visible Spectrophotometry. Flame photometry. UV & IR spectrophotometry. Atomic Absorption spectrophotometry. pH Metry. Chromatography and determination of Amino Acids in Urine by paper chromatography
3. Clinical quantitative analysis in Biochemistry

Incharge
Department of Allied Health Sciences
Sahiwal Medical College

Vetted

- Serum Glucose Estimation. Glucose tolerance Test (GTT). Serum Cholesterol estimation (Total, HDL and HDL cholesterol). Serum Bilirubin Estimation (Total, Direct and Indirect bilirubins). Serum Proteins Estimation (Total, Albumin & Globulin). Serum Total lipids Estimation. Serum calcium Estimation (total, ionized & unionized). Serum Uric acid Estimation. Serum Urea Estimation. Serum Creatinine Estimation. Enzymes Estimation in Serum: AST, ALT, ALP, Creatine Kinase (CK) and LDH.

RECOMMENDED BOOKS

1. Harper's Biochemistry by Robbert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwel (Latest Edition).
2. Lippincott's Illustrated Review of Biochemistry by Pamela C. Champe and Richard A. Harvey (Latest Edition).
3. Practical Clinical Biochemistry by Varley (Latest Edition).
4. Textbook of Biochemistry by Devlin (Latest Edition).
5. Biochemistry by Stryer (Latest Edition).by Stryer, Lubert, Latest Ed

MEDICAL INSTRUMENTATIONS

COURSE DESCRIPTION

This course is designed to provide general knowledge of basic instrumentations used for Radiological Examination to undergraduate students of Radiology Lab Sciences. Emphasis is placed on theoretical concepts of instruments, components, functions and their operations, calibration and troubleshooting of instruments. Getting the right diagnosis is a key aspect of health care which provides an explanation of patient's health problem and appraises subsequent health care decisions. This interactive course covers the various chemicals used in variety of radiological procedures to obtain the information about patients in diagnosis, treatment and prevention of diseases. By the end of this course, students will be familiar with the working principle, operation, quality control and assurance, and maintenance of sate of the art instruments used in radiology department to obtain the quality results.

LEARNING OBJECTIVES

Upon completion, students will possess the theoretical knowledge, skills, and abilities to:

- Understand the working principles, components and their functions of biomedical instruments & Chemicals used in the field of Allied Health Sciences for diagnostic and research.
- Operate and calibrate all these instruments mention in course content list efficiently.
- Understand importance of precaution to be taken while working with instruments & Chemicals.
- Detect errors and dealing with the accidents due to mishandling.
- Ask for routine instruments service in time.
- Selection and buying of medical instruments.
- Care and routine maintenance of these instruments.

COURSE CONTENTS:

Different relevant Techniques used in Medical fields. The names of instruments used, based upon different Techniques for working and evaluation of different parameters in Medical fields. Normal functioning of these instruments, parts of these instruments & individual functions of these parts. Their trouble shootings and routine manipulations to obtain correct results. Maintenance of

Sensitivity & Specificity of these instruments. The general study of following Medical Instruments available in Medical fields

X-Ray Machine: X-Ray tube, its structure, types and function. Portable and Mobile X-ray units: components, types and applications. Specialized X-Ray equipments: skull table, dental X-Ray equipments,

Mammography X-Ray Machine: Equipment and Technical Considerations, Mammography projections & Positioning, Composition and constituents of X-Ray film, methods of storage of films, Care and maintenance of X-Ray equipments, Significant mammographic findings & Related Pathology,

Contrast media, Purpose, Types a). Negative agents (Carbon dioxide, Air, Nitrous oxide), b) Positive agents (Barium sulfate, Iodinated).

Dosimetry: Definition and need of dosimetery, classification of dosimetery, Principle of dosimetery, its parts and functions.

Angiography and Cardiac Imaging: Basic principle of the procedure, types, Indications & Contraindications for the procedure, Patient positioning, Access method, Patient management during the exam, Contrast administration, Possible complications, Equipments, Exposure technique.

Fluoroscopy: types, image intensification, digital fluoroscopic equipments, C-arm fluoroscopic equipments. Visual Considerations, Instrumentation of Fluoroscopy, Practical Fluoroscopic Technique, Fluoroscopic Image Monitoring, Digital Fluoroscopy

Ultra Sound Machine: Principle, Components, Functions of each components, operation, advantages and disadvantages, Applications. Generation of ultrasound, Properties of ultrasound, Shape of the ultrasound beam, Spatial resolution, Echo Doppler effect, Ultrasound techniques i-e A-mode, B-mode, M-mode or TM-mode, B-scan, two-dimensional, Three- and four-dimensional techniques, B-flow.

Doppler techniques, Contrast agents, Artefacts, Adverse effects

CT Scan: Basic Principles of CT, Components, Functions of each components, operation, advantages and disadvantages, Applications. Data Acquisition, Image Reconstruction, Image Display, Methods of Data Acquisition, Image Quality, Quality Assurance, Post-Processing, Data Management

MRI: Principle, Components, Functions of each component, operation, advantages and disadvantages, Imaging weighting and contrast, Applications, MRI safety, Contrast agents in MRI, Advanced imaging techniques.

NMR: Principle, Components, Functions of each components, operation, advantages and disadvantages, Applications

Echo-Cardiography: Basic Principles of 2-D / M-Mode, Echocardiography Equipment, Construction, functions and applications, Principles of Doppler Echocardiography

Endoscopy Machine: Types, component parts, applications

Bone Densitometry: 1. Highlight different bone densitometry techniques. While focusing on Dual Energy X-Ray Absorptiometry (DEXA), also considers other densitometry methods for both axial and peripheral measurements. 2. Quality control issues and statistical interpretation of results relevant to DEXA.

Practical

Use of PPEs, Handling and maintenance of radiology instruments, Trouble shootings of radiology instruments, Handling, Operations and Maintenance of Radiological Tools, Units of measurements and radiation dose calculation.

RECOMMENDED BOOKS

1. Radiologic sciences for technologists by Stewart C. bushong.
2. A guide to radiologic procedure by Chapman.

Vetted

3. Merrill atlas of radiography positioning and radiologic procedure vol 3 by Philip W Ballinger.
4. Fluoroscopy Notes by TM series.
5. Ultrasound teaching manual: The basics of Performing and Interpreting ultrasound Scans by Mathias Hofer.
6. Colour atlas of ultrasound anatomy by Berthold Block, M.D
7. Echo made essay by Jaypee
8. Manual of cath lab Personnel invasive cardiology by Sanoy Watson .RN,BN,NFESC.
9. The cardiac catheterization Handbook by Mosby, Morton J.Kern.
10. Grossman cardiac catheterization, Angiography, Intervention by Donald s.Rain & William Grossman
11. Hand book of MRI Technique by Catherine Westbrook
12. Computed Tomography for Technologists A Comprehensive Text: by Lois Romans
13. Practical Gastrointestinal endoscopy by Colton PB and Williams CB in 1980 published by Oxford black well scientific
14. Text book of gastroteroentroloy by Bailliere tindall in London.

ISLAMIC STUDIES

COURSE DESCRIPTION

This course is aimed at to provide Basic information about Islamic Studies, enhance understanding of the students regarding Islamic civilization, improve student's skill to perform prayers and other worships, enhance the skill of the students for understanding of issues related to faith and religious life. Enhance the general knowledge of the students regarding the Muslim world and its current political, economic, social, and defence problems. Students will discuss different current issues being faced by the Muslim World and the importance of unity and cooperation among Muslim countries. In this regard, they will learn about different projects and cooperation among Muslim countries, the Islamic religious tradition within historical, social and cultural contexts; visual, performative and oral expressions of the heritage of Islam, including language, literature, art, and architecture; intra-Islamic differences and issues of inter-cultural diversity and integration within the Islamic world; the political systems of Muslim majority countries.

LEARNING OBJECTIVES

This course is aimed at:

1 To provide Basic information about Islamic Studies
2 To enhance understanding of the students regarding Islamic Civilization
3 To improve Students skill to perform prayers and other worships
4 To enhance the skill of the students for understanding of issues related to faith and religious life.

COURSE CONTENTS:

FUNDAMENTAL BELIEFS AND PRACTICES OF ISLAM.

Tauheed (Unity of Allah), Risalat (Finality of the Prophet-hood). Akhirat (Day of Judgement).,Salat, Soum, Zakat, Hajj and Jehad

NEED OF RELIGION AND ITS ROLE IN HUMAN LIFE.

MORALITY IN ISLAM.

Vetted

Concept of morality, Concept of morality and Faith., Islamic principles and methods of character building., Moral values in Islam.
RIGHTS OF THE INDIVIDUAL IN ISLAM.
QURAN AS A GUIDE FOR THE MODERN SOCIETY AND SCIENTIFIC DEVELOPMENT.
HOLY PROPHET (PEACE BE UPON HIM) AND HIS LIFE.
ISLAMIC CONCEPT OF STATE.
ISLAM AND SOCIETY.
Role of man and women in society, Rights of women children in Islam. Concept of woman's freedom in Islam., Hukook-ul-Ibad.
IMPORTANCE OF RIZK-E-HILAL.
CONTRIBUTION OF ISLAMIC SCHOLARS IN SCIENCE AND MEDICINE.

RECOMMENDED BOOKS

1. Introduction to Islam by Dr. Hamidullah.
2. Islam: Its meaning and message by Khurshid Ahmad
3. اسلام یک نظر میں مولانا صدر الدین اصلاحی
4. قرآن اور تعمیر سیرت ڈاکٹر میر ولی الدین

PAKISTAN STUDIES

COURSE DESCRIPTION

The course is designed to acquaint the students of BS Programs with the rationale of the creation of Pakistan. The students would be apprised of the emergence, growth and development of Muslim nationalism in South Asia and the struggle for freedom, which eventually led to the establishment of Pakistan. For this purpose, the foreign policy objectives and Pakistan's foreign relations with neighbouring and other countries are also included. This curriculum has been developed to help students analyse the socio-political problems of Pakistan while highlighting various phases of its history before and after the partition and to develop a vision in them to become knowledgeable citizens of their homeland.

LEARNING OBJECTIVES

- Develop vision of historical perspective, government, politics, Contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

COURSE CONTENTS:

IDEOLOGY OF PAKISTAN.
Definition and elucidation. Historical aspect. Ideology of Pakistan in the light of speeches and sayings of Allama Iqbal and Quaide-Azam.
PAKISTAN MOVEMENT
Basis for the creation of Pakistan. Historical developments: 1857-1947
POLITICAL DEVELOPMENTS IN PAKISTAN SINCE 1947
LAND AND PEOPLE OF PAKISTAN
Geography, Society, Culture, Natural resources, Health and education with reference to characteristics trends and problems.

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RECOMMENDED BOOKS

1. Ideological Orientations of Pakistan by Sharif Al Mujahid.
2. Struggle for Pakistan by I.H. Qureshi.
3. The Making of Pakistan by Richard Symond

3rd YEAR

1.	General Pathology and Microbiology	200 Marks
2.	Pharmacology	200 Marks
3.	Radiology and Nuclear Medicine	200 Marks
	Total Marks	**600 Marks**

GENERAL PATHOLOGY AND MICROBIOLOGY

COURSE DESCRIPTION

General pathology and microbiology courses are offered as vital subject matter at undergraduate level programs to students who are engaged in medical studies. This subject deals with the diagnosis of diseases which is ultimately back bone of healthcare system. A good diagnosis leads to excellent treatment and prognosis. In general pathology portion, students learn about the abnormal functions of the body and with the investigation of those pathological mechanisms which are common to all tissue cell pathology. Students will be able to describe and demonstrate the processes of cellular adaptation, inflammation, repair, immunology, cellular accumulation, and neoplasia. While, microbiology course is designed to teach students about microorganism like bacteria, viruses, fugus and parasites. In this course, students will gain knowledge about the interaction of human body with these organisms and how these organisms cause diseases in humans. Students will get familiar with different techniques of microbiology which includes the identification and quantification of microorganisms that cause human disease (qualitative and quantitative analysis) which will provide diagnostic information for therapeutic support in the clinical management of patients. At the end of this course, students will be able to collect samples and process this sample according to microbiological protocols to generate microbiology report.

LEARNING OBJECTIVES

After completing this course, a student will be able to:

- Recognize the structural and functional causes of human disease.
- Describe the aspects of a disease process that form the core of pathology
- Describe the cause of a disease (etiology)
- Describe the mechanisms of disease development (pathogenesis)
- Describe the structural, biochemical and molecular alterations induced in cells and tissues by the disease (morphologic ,molecular & biochemical changes)
- Describe the functional consequences of these changes (clinical significance)
- Describe the infectious diseases.

COURSE CONTENTS:

i. GEN. PATHOLOGY

Cell Injury and Death: Causes of cell injury, Necrosis, Apoptosis and Sub cellular responses. Cell Adaptations: Hyperplasia, Hypertrophy, Atrophy, Metaplasia and Intracellular accumulation. Inflammation: Acute inflammation. Vascular events, Cellular events and Chemical mediators.

Chronic Inflammation. General, Granulomatous and Morphologic patterns of acute and chronic inflammation. Healing and Repair:

Normal controls, Repair by connective tissue and Wound healing. Haemodynamic Disorders. Edema, Hyperemia / congestion, Hemorrhage, Thrombosis, Embolism, Infarction and Shock. Diseases of Immunity. General features, Hypersensitivity reactions, Immune deficiencies, Autoimmunity and Amyloidosis. Neoplasia: Nomenclature, Molecular basis, Carcinogenic agents and Clinical aspects

ii. MICROBIOLOGY

Basic Bacteriology

Bacteria Compared with Other Microorganisms, Structure of Bacterial Cells, Growth, Genetics, Classification of Medically Important Bacteria, Normal Flora, Pathogenesis,, Host Defenses, Laboratory Diagnosis, Antimicrobial Drugs: Mechanism of Action, Antimicrobial Drugs: Resistance, Bacterial Vaccines, Sterilization & Disinfection, Biosafety and bio risk management,

Clinical Bacteriology

Overview of the Major Pathogens & Introduction to Anaerobic Bacteria.

Gram-Positive Cocci; *Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus saprophyticus, Streptococcus pyogenes, Streptococcus agalactiae, Enterococcus faecalis,* Viridans streptococci, *Streptococcus bovi and S. pneumoniae*

Gram-Negative Cocci; *Neisseria meningitides* and *Neisseria gonorrhoeae.*

Gram-Positive Rods; *Bacillus anthracis, Bacillus cereus, Clostridium tetani, Clostridium botulinum, Clostridium perfringens, Clostridium difficile, Corynebacterium diphtheria* and *Listeria monocytogenes.*

Gram-Negative Rods Related to the Enteric Tract; *E. coli, Salmonella* species, *Shigella* species, *Vibrio cholerae, Vibrio parahaemolyticus, Vibrio vulnificus, Campylobacter jejuni, Helicobacter pylori, Klebsiella, Enterobacter, Serratia, Proteus, Providencia, Morganella, Pseudomonas spp., Bacteroides & Prevotella.*

Gram-Negative Rods Related to the Respiratory Tract; *Haemophilusinfluenzae, Bordetella pertussis*, and *Legionella pneumophila*

Gram-Negative Rods Related to Animal Sources (Zoonotic Organisms); *Brucella* species, *Francisella tularensis, Yersinia pestis*, and *Pasteurellamultocida*

Mycobacteria, Actinomycetes, Mycoplasmas, Spirochetes, Chlamydiae, Rickettsiae, Minor Bacterial Pathogens

Basic Virology

Structure, Replication, Genetics, Classification of Medically Important Viruses, Pathogenesis, Host Defenses, Laboratory Diagnosis, Viral Vaccines.

Clinical Virology

Herpes Viruses, Rabies Virus, Polio Virus, Hepatitis Viruses, Human Immunodeficiency Virus, Dengue Virus.

Mycology

Basic Mycology, Cutaneous & Subcutaneous Mycoses, Systemic Mycoses, Opportunistic Mycoses,

Parasitology

Intestinal & Urogenital Protozoa, Blood & Tissue Protozoa, Minor Protozoan Pathogens, Cestodes, Trematodes, Nematodes.

Sterilization

Laboratory Exercises:

Each lecture will be followed by two hour practical class where the student will apply their theoretical knowledge in the understanding of related microbiological investigations, which have been proved useful for the diagnosis of human diseases.

During the other laboratory sessions, the students will be engaged in the preparation of media, the sterilization of glass ware, Antigens, Antibodies, Vaccines – haemolysin, permanent slides,

laboratory reagents and also to assisting postgraduate students in the isolation of micro – organisms from clinical materials.

Practical

- Acute Inflammation
- Chronic Inflammation
- Necrosis
- Gangrene
- Pigmentation
- Calcification
- Urine Examination
- Sterilization
- Culture Media
- Antibiotic Sensitivity testing
- Culturing bacterial pathogens
- Examination of different clinical specimens
- Blood Culture
- Anaerobic Culture
- Gram Staining
- ZN Staining
- Biochemical tests to identify bacteria (Conventional, API 20E, API 20NE, Automated systems)
- PCR
- KOH preparation for scraping
- Stool Examination
- ELISA

RECOMMENDED BOOKS

1. Basic Pathology by Robbins Latest Edition
2. Clinical Pathology Interpretations by A.H. Nagi
3. Pocket Companion to Robbins, Pathologic basis of disease Cotran, Kumar
4. Theory and Practice of Histological Techniques by John D Bancrof

PHARMACOLOGY

COURSE DESCRIPTION

Pharmacology is an essential component of the modern undergraduate curriculum. The course is designed to equip the students with the latest knowledge about drugs and related issues. To prescribe a drug safely and effectively, students need to know its pharmacological aspects including their common preparations. The students are made acquainted with the general principles of pharmacokinetics and pharmacodynamics of different drugs and their groups. The mechanism of action, pharmacological actions, indications, contraindications, drug interactions and adverse reactions of the various drugs acting on body systems are elaborated. It is important to emphasize to students that the presence of disease or organ pathology may influence the actions of a drug and

conditions such as age, pregnancy, concomitant administration of other drugs, and disease may alter the patient's response to a given drug. It is also highlighted that rational prescribing of drugs to a patient for selected disorders is the utmost aim of this course.

LEARNING OBJECTIVES

After completing this course, a student will be able to:

- Discuss prescription and/or over-the-counter medications used in the management of a variety of patient conditions encountered during radiological processes.
- Identify a range of drugs used in medicine and discuss their mechanisms of action.
- The student will be able to explain the mechanisms of action and pathology of abuse.

COURSE CONTENTS:

Introduction to Pharmacology, Pharmacokinetics, Pharmacodynamics, Adverse effects of drugs

The Evolution of Medical Drugs: U.S. Pharmacopeia, Drug Origins and Sources, The Food and Drug Administration (FDA), British Pharmacopeia

Drug Nomenclature: A. Chemical name, B. Generic name, C. Trade name

Methods of Drug Classification

A. Chemical group, B. Mechanism/site of action, C. Primary effect

General Pharmacologic Principles

A. Pharmacokinetics, B. Pharmacodynamics

Six Rights of Drug Safety

A. The right medication, B. The right dose, C. The right patient, D. The right time, E. The right location, F. The right documentation

Drug Categories of Relevance to Radiography (Uses and Impacts on Patient)

A. Analgesics, B. Anesthetic agents, C. Antiallergic and antihistamine drugs, D. Antianxiety drugs, E. Antiarrhythmic drugs, F. Antibacterial drugs, G. Anticoagulant and coagulant drugs, H. Antidepressants, I. Antiemetic drugs, J. Antihypertensive drugs, K. Anti-inflammatory drugs, L. Antiseptic and disinfectant agents, M. Bronchodilators, N. Cathartic and antidiarrheal drugs, O. Diuretics, P. Sedative and hypotonic drugs, Q. Vasodilators and vasoconstrictors

Contrast Agents

A. Types of compound:

1. Metallic salts, 2. Organic iodides; a. Ionic contrast agents, b. Nonionic contrast agents

3. Gaseous, 4. Oils: Myelograms, sinouses, 5. Tablets: cholecystograms

B. Beam attenuation characteristics

1. Radiolucent (negative), 2. Radiopaque (positive), 3. Impact of atomic number

C. Pharmacologic profile of contrast agents

1. Chemical composition, 2. Absorption characteristics, 3. Patient reactions

D. Dosage

E. Preparation

Routes of Drug Administration

A. Systemic: 1. Oral, 2. Rectal, 3. Tube/catheter, 4. Inhalation

B. Parenteral: 1. Intravenous, 2. Intra-arterial, 3. Intrathecal

Venipuncture

A. Methods: 1. Continuous infusion, 2. Intermittent infusion, 3. Direct injection: a. Hand injection, b. Mechanical pressure injector

B. Sites of administration: 1. Peripheral, 2. Central

C. Complications: 1. Infiltration, 2. Extravasation, 3. Phlebitis, 4. Air embolism, 5. Drug incompatibility, 6. Low fluid level in container

D. Venipuncture procedures: 1. Equipment, 2. Patient identification, assessment and instructions, 3. Informed consent, 4. Dosage, dose calculations and dose┐ response: a. Adults, b. Pediatric patients. 5. Patient preparation, 6. Application of standard precautions, 7. Procedure: a. Injection through an existing line, b. Venipuncture

8. Site observation

Introduction to Therapeutic Radiology, Applied Physics of Radiotherapy, Radiotherapy Equipments, simulation, treatment plan, Mechanism of action, Dose, Fractionation, Effect on different types of cancer, History of Radiation Therapy, Types, External beam radiation therapy, Conventional external beam radiation therapy, Stereotactic radiation, Systemic radiation therapy, Virtual simulation, 3-dimensional conformal radiation therapy, and intensity-modulated radiation therapy, Particle therapy, Brachytherapy, Radioisotope therapy (RIT), Side effects, Acute side effects. Late side effects, Radiation therapy accidents.

Practical

Replacement Fluids & dehydration (Normal saline, half normal saline, ringer solution, dextrose solution), ORS powder. Experiments designed to observe the action of drugs on animals and isolated tissue. Experiments on the actions of selected drugs to be demonstrated to the students.

Venipuncture

A. Methods: 1. Continuous infusion, 2. Intermittent infusion, 3. Direct injection: a. Hand injection, b. Mechanical pressure injector

B. Sites of administration: 1. Peripheral, 2. Central

C. Complications: 1. Infiltration, 2. Extravasation, 3. Phlebitis, 4. Air embolism, 5. Drug incompatibility, 6. Low fluid level in container

D. Venipuncture procedures: 1. Equipment, 2. Patient identification, assessment and instructions, 3. Informed consent, 4. Dosage, dose calculations and dose┐ response: a. Adults, b. Pediatric patients. 5. Patient preparation, 6. Application of standard precautions, 7. Procedure: a. Injection through an existing line, b. Venipuncture

8. Site observation

RECOMMENDED BOOKS

1. Katzung and Trevors Pharmacology Examination & Board review.
2. Lippincott illustrated Reviews of Pharmacology.
3. Chapman's Guide to Radiologic

RADIOLOGY AND NUCLEAR MEDICINE

COURSE DESCRIPTION

This course is designed with the aims to provide foundation knowledge about general radiology and radiation physics, physical principles of medical imaging, basic information about different imaging modalities and radiation hazards. This course also gives students an understanding of the effects of ionizing radiation on the human body. Typical radiation protection course is a part of this subject. By studying this course, the students will be able to discuss the basics of physics, atom, electricity & magnetism and solve numerical. Understand & describe the production of X-rays, and

the interaction of radiation with matter. The students can compare and contrast the radiographic quality & technique. The content of this course also provides the knowledge base necessary to perform standard radiographic procedures. The students are also able to explain the radiographic procedures to patients/ family members and modify directions to patients with various communications problems. Evaluate images for positioning, centering, appropriate anatomy and overall image quality. This course also focuses on the application of application of nuclear medicine on radio-imaging procedures and for the treatment of various disorders. The students will be able to apply general radiation safety and protection practices associated with radiography.

LEARNING OBJECTIVES

After completing this course, a student will be able to:

- Know basic physics of radiography processing system.
- Describe construction and working of film, intensifying screen, cassette, dark room, computed radiography, direct radiography and automatic processor.
- Explain radiographic film Processing chemistry.
- Discuss the factors affecting image quality in radiographic image and their application.
- Operate the workflow in x-ray imaging.
- Apply knowledge for the use of radiation factors.
- Demonstrate process the radiographic film in different systems
- Prepare care and maintenance of radiographic films, cassettes, intensifying screens, darkroom accessories and X-ray equipment.
- Define basic principle and physics of nuclear medicine.
- Apply preparation of patient for nuclear medicine examination.
- Apply precautions while handling radiopharmaceuticals.
- Recognizing the artefacts associated with nuclear medicine.
- Prepare and position the patients for nuclear medicine examination.
- Assess the knowledge of improving image quality in nuclear medicine.
- Systematize post processing for nuclear medicine data

COURSE CONTENTS:

i. RADIATION PHYSICS

Concepts of Radiation

Nature of our surroundings, Sources of Ionizing Radiation, Discovery of X-rays, Development of Modern Radiology, Basic Radiation Protection

Definitions

Fundamentals of Physics, Units of Measurement

Mechanics

Heat and Thermodynamics, Waves and Oscillation

The Atom

Centuries of Discovery, Combinations of Atoms, Magnitude of Matter, Atomic Structure, Atomic Nomenclature, Radioactivity

Types of Ionizing Radiation

Electromagnetic Radiation, Photons Everywhere, Electromagnetic Spectrum, Radiologically Important Photons, Energy and Matter

Electricity and Magnetism

Electric to Electromagnetic Energy, Electrostatics, Electrodynamics, Magnetism

Electromagnetism

Electromagnetic Effects, Electromagnetic Induction, Electric Generators and Motors, The Transformer, Rectification

RADIATION PROTECTION

Fundamental Principles of Radiobiology

From Molecules to Humans, Human Biology, Law of Bergonie and Tribondeau
Physical Factors Affecting Radiosensitivity
Biologic Factors Affecting Radiosensitivity
Radiation Dose-Response Relationships

Molecular and Cellular Radiobiology

Irradiation of Macromolecules, Radiolysis of Water, Direct and Indirect Effect, Celol Survival, Kinetics, LET, RBE, and OER

Early Effects of Radiation

Acute Radiation Lethality, Local Tissue Damage, Hematologic Effects, Cytogenetic Effects

Late Effects of Radiation

Local Tissue Effects, Life Span Shortening, Risk Estimates, Radiation-Induced Malignancy, Total Risk of Malignancy, Radiation and Pregnancy

Health Physics

Cardinal Principles of Radiation Protection, Maximum Permissible Dose, X-rays and Pregnancy

ii. General Radiology

Standard Terminology for Positioning and Projection

Standard terms: Radiographic position, Radiographic projection, Radiographic view
Positioning terminology: Recumbent, Supine, Prone, Trendelenburg, Decubitus, Erect/upright, Anterior position, Posterior position, Oblique position
General planes: Sagittal or midsagittal, Coronal or midcoronal, Transverse, Longitudinal
Skull lines: Glabellomeatal line, Interpupillary line, Orbitomeatal line, Infraorbitomeatal line, Acanthiomeatal line, Mentomeatal line
Skull landmarks: Auricular point, Gonion (angle), Mental point, Acanthion, Nasion, Glabella, Inner canthus, Outer canthus, Infraorbital margin, Occlusal plane, External auditory meatus, Mastoid tip
Terminology of movement and direction: Cephalad/caudad, Inferior/superior, Proximal/distal, Plantar/palmar, Pronate/supinate, Flexion/extension, Abduction/adduction, Inversion/eversion, Medial/lateral
Positioning aids: Sponges, Sandbags, Immobilization devices
Accessory equipment: Calipers, Lead strips, Lead shields or shadow shields, Lead markers, Image receptor holders

Positioning Considerations for Routine Radiographic Procedures

Patient instructions
Image analysis

1. Patient positioning, 2. Part placement, 3. Image receptor selection and Placement, 4. Beam-part-receptor alignment, 5. Beam restriction and shielding

Special considerations

1. Atypical conditions, 2. Trauma Radiography, 3. Pediatric Imaging, 4. Geriatric Radiography 5. Portable Radiography., 6. Tomography., 7. Introduction to Computed Radiography & Digital Radiography

Special needs patients

1. Trauma. 2. Obesity, 3. Cultural awareness, 4. Claustrophobia

Positioning for the following studies:

Skeletal system:

a. Upper extremity 1) Fingers, 2) Hand, 3) Wrist, 4) Forearm, 5) Elbow, 6) Humerus
b. Shoulder 1) Shoulder joint, 2) Scapula, 3) Clavicle, 4) Acromioclavicular articulations
c. Lower extremity: 1) Toes, 2) Foot, 3) Ankle, 4) Calcaneus, 5) Tibia/fibula, 6) Knee, 7) Patella, 8) Femur
d. Pelvic girdle: 1) Pelvis, 2) Hip

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Department of Allied Health Sciences

e. Vertebral column: 1) Cervical, 2) Thoracic, 3) Lumbar, 4) Sacrum, 5) Coccyx, 6) Sacroiliac articulations, 7) Scoliosis survey
f. Bony thorax: 1) Ribs, 2) Sternum, 3) Sternoclavicular articulations
g. Cranium: 1) Skull, 2) Facial bones, 3) Nasal bone, 4) Orbits/optic foramina, 5) Zygomatic arches, 6) Mandible, 7) Temporomandibular articulations, 8) Paranasal sinuses
h. Special studies: 1) Bone survey, 2) Long bone measurement, 3) Bone age, 4) Foreign body
Respiratory system: a. Upper airway, b. Chest
Abdominal viscera: a. Abdomen and GI, b. Urological studies

Practical

Radiation Protection Procedures
Occupational Exposure, Patient Dose, Reduction of Occupational Exposure, Reduction of Unnecessary Patient Dose
Practical's according to departmental schedule
DARK ROOM

- Need for good darkroom procedures and necessity for proper darkroom construction.
- Darkroom construction and equipment
- Theory of the photographic process, Safe light
- photographic process fundamentals;
- Construction of film; handling.
- Density Ratio,
- Constituents of Darkroom: Chemistry; Developer, Fixer
- Automatic processing: Differences between manual and automatic
- processing.
- Types and care of processing apparatus, film artifacts and their causes.
- Sensitometry, Densitometry and Optical Density.

There will be an overview of the common instruments used in the above sub disciplines.

NUCLEAR MEDICINE
Introduction to Nuclear Physics:
Atomic and nuclear structure, Artificial and natural radioactivity, Modes of radioactive decay, Exponential decay and; Half-life and mean life of radionuclides, Radioactive decay series and equilibrium, Interaction of high energy radiation with matter
Basic physical principles of nuclear medicine imaging and instrumentation
Isotopes (including physical and chemical properties) that are used routinely in the compounding of radiopharmaceuticals for nuclear radiology procedures
Indications for isotopes used for therapeutic purposes
Normal and abnormal findings on all imaging and functional studies
Nuclear studies, including indications, pathologies, protocols, correlative studies, radiopharmaceuticals used for each study, and various parameters that might interfere with the results of the procedure
Radiopharmaceuticals used in cardiac nuclear studies, including the methods of red cell labeling, patient dosages, and physical properties of the isotopes.
Patient conditions and patient monitoring requirements, particularly in relation to exercise and drug stress studies
Range of invasive and noninvasive tests, test characteristics, and the prognostic value of tests used
Radiopharmaceuticals used in Nuclear Radiology studies:
Production of isotopes , Physical properties of isotopes, Generation elution and quality control, Compounding of radiopharmaceuticals, Radiochemical quality control, Biodistribution and mechanisms of localization, Calculation of patient doses, using information related to decay factors, volume, concentration, and patient parameters

Quality control and quality assurance of radiopharmaceuticals, Hot laboratory and dispensing operations, Chemical toxicity of radionuclides.
Procedures and rationale for instrument quality control in nuclear medicine
Rules and regulations that apply to the practice of nuclear radiology

Radiation Detection and Instrumentation

Basic principles of radiation detectors and their common properties, Gas-filled detectors and their application, Scintillation detectors, Rectilinear scanners, Non imaging probes, Scintillation counters, Dose calibrator, Scintillation camera, Multicrystal devices, Tomographic imaging technique, SPECT and PET, Image production & display, Image quality in nuclear medicine, Quality assurance procedures in Nuclear Medicine instrumentation, Use of computers in Nuclear Medicine-principles & applications to NM data
acquisition, processing & display.

Radiation protection: Radiation quantities and units, Radioactive waste disposal, Radiation shielding and transportation of radioactive materials, Health physics instrumentation, Methods of safe Handling of Radionuclides and Pertaining Rules and Regulations

Clinical nuclear medicine imaging: Systemic Nuclear Medicine teaching including application of radiopharmaceuticals for imaging of different organs, Indications of nuclear medicine diagnostic and therapeutic procedures, Techniques of performing scintigraphy and common therapy procedures, Acquisition protocols, image processing and quantitation on images

Practical

The techniques and methods of major nuclear medicine diagnostic and therapeutic applications

- Elution of Mo-Tc generator system
- Calculation of dose and preparation of radiopharmaceuticals.
- Quality control of radiopharmaceuticals
- Estimation of bound and free fraction.
- Thyroid uptake studies.
- Quality control tests for gamma camera.
- Routine operational tests for SPECT.
- Dynamic studies with patient.
- Static and SPECT studies

RECOMMENDED BOOKS

1. Wolbarst, A. B. (1999). Looking within: how X-ray, CT, MRI, ultrasound, and other medical images are created, and how they help physicians save lives. Univ of California Press.
2. Clinical sonography a practical guide by Roger C Saunders / Tom Winter
3. Hertzberg, B. S., & Middleton, W. D. (2015). Ultrasound: the requisites. Elsevier Health Sciences.
4. Murray, J. R., Holmes, E. J., & Misra, R. R. (2008). AZ of musculoskeletal and trauma radiology. Cambridge University Press.
5. Mettler, F. A. (1996). Essentials of Radiology. Saunders.
6. Chandra, R., & Rahmim, A. (2017). Nuclear medicine physics: the basics. Lippincott Williams & Wilkins.
7. Bernier, D. R., Christia, P., & Longan, J. (1997). Nuclear Medicine Technology and Techniques, Mosby, St.
8. Mistry, R. (2013). Manual of Nuclear Medicine Procedures. Springer.
9. Radiologic sciences for technologists by Stewart C. bushong .
10. The essential physics of Medical imaging by Bushberg.
11. Quality assurance work for radiographers and radiologic Technologist by Peter J Lioyd.
12. Instruction Manual for Bushong bt TM. Series

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13. Radiographic Positioning by Eisenberg.
14. Merrill atlas of radiography positioning and radiologic procedure vol 1, 2, 3 by Philip W Ballinger.
15. Clarke positioning in radiography by Clarke.
16. book of atlas of diagnostic imaging by Professor Dr. Mohammad Tariq.

4th YEAR

1.	Scientific Inquiry, Biostatistics, Research Methodology	100 Marks
2.	Conventional Radiological and Clinical Practices	200 Marks
3.	Radiology Lab Management	200 Marks
	Report Writing	Qualifying
	Total Marks	**500 Marks**

SCIENTIFIC INQUIRY, BIOSTATISTICS, RESEARCH METHODOLOGY

COURSE DESCRIPTION

This course includes discussion on basic quantitative methods and designs, including concepts of reliability and validity, interpretation of inferential statistics related to research designs, co relational statistic & designs, interclass correlation coefficients, and critical appraisal of the literature. It involves selection of appropriate statistical techniques to address questions of medical relevance; select and apply appropriate statistical techniques for managing common types of medical data; use various software packages for statistical analysis and data management; interpret the results of statistical analyses and critically evaluate the use of statistics in the medical literature; communicate effectively with statisticians and the wider medical community, in writing and orally through presentation of results of statistical analyses; explore current and anticipated developments in medical statistics

LEARNING OBJECTIVE

- Identify the basic concepts of research and scientific inquiry and its methodologies
- Identify appropriate research topics
- Define appropriate research problem and parameters
- Construct a project proposal to undertake a research project.
- Discuss scientific Inquiry, its principle and application in medical research.
- Describe Search techniques for literature review
- Differentiate between different levels of evidence, appraisal and different studies with respect to their effectiveness in literature.
- Discuss necessary concepts of statistics to enable them to realize a research project in the field of Physiotherapy
- Explain Fundamentals of reading and understanding research methods, design, and statistics

COURSE CONTENTS

i. SCIENTIFIC INQUIRY

- Describe scientific inquiry, Evidence based approach to scientific inquiry, Principles of scientific inquiry, the application of scientific inquiry to physical therapy.

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• Access digital libraries and different research databases, Effective searching and reviewing literature material.
• Interpret Critical appraisal of published research in the areas of Examination and Evaluation, Diagnosis, Prognosis, Intervention
• Interpret Critical evaluation of Randomized Control Trial (RCT), Systemic review, Diagnosis and screening tests, Case reports
• Discuss how to conduct clinical research and hierarchy of evidences in clinical researches

ii. BIOSTATISTICS

• Define Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

PRESENTATION OF DATA

• Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Historigram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

MEASURES OF CENTRAL TENDENCY

• Explain Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

MEASURES OF DISPERSION

• Describe Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation. The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

PROBABILITY AND PROBABILITY DISTRIBUTIONS

• Define Discrete And Continuous Distributions: Binomial, Poisson And Normal Distribution. Exercises.

SAMPLING AND SAMPLING DISTRIBUTIONS

• Describe sample design and sampling frame, bias, sampling and non-sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

iii. Research Methodology

Research Fundamentals; Research, Theory in Research, Research Ethics

Research Design; Research Problems, Questions, and Hypotheses, Research Paradigms, Design Overview and Research Validity

Experimental Designs; Group Designs and Single-System Design

Non Experimental Research; Overview of Non experimental Research, Clinical Case Reports, Qualitative Research, Epidemiology, Outcomes Research and Survey Research.

Measurement; Measurement Theory and Methodological Research.

Data Analysis; Statistical Reasoning, Statistical Analysis of Differences; The basics, Statistical Analysis of Differences; Advanced and special Techniques, Statistical Analysis of Relationships; The basics and Statistical Analysis of Relationships; Advanced and special Techniques

Implementing Research; Implementing a Research Project and Publishing and Presenting Research

RECOMMENDED BOOKS

1. Essentials of clinical research By Stephan P. Glasser.
2. Rehabilitation Research (Principles and Applications) 3rd Edition By Elizabeth Domholdt.
3. Walpole RE. Students study guide: introduction to statistics. 3rd ed. 1982.

Vetted

4. Muhammad F. Statistical methods and data analysis. Faisalabad: KitabMarkaz; 2000
5. R. L Ott, Micheal T longnecker. An introduction to statistical methods and data analysis, 7th ed.
6. Brooks/Cole, Cengage Learning 2015

CONVENTIONAL RADIOLOGICAL AND CLINICAL PRACTICES

COURSE DESCRIPTION

The main aim of this course to provide necessary knowledge and to develop cognitive skills underlying the performance of the tasks typically required for entry level radiology/imaging technologists in this specialized area. The core of this course is clinical skills to acquire images by using patient required technology, knowledge of safe practice, understanding of image about normal and abnormal conditions, and professional attitude in accordance with the scope of profession. This course also focuses on the manifestations of surgical conditions, indications and role of medical imaging procedures and general overview of a verity of surgical conditions. The students will be able to define terminologies used in the study of surgery and to describe the general principles and mechanisms of surgical conditions. This course also describes indications of imaging procedures in selective surgical conditions.

LEARNING OBJECTIVES

After completing this course, a student will be able to:

- Understand the basic patient positioning during radiographic investigation.
- Apply special positioning skills for different pathological and physical conditions.
- Application of equipments while working in radiology departments.
- Choose proper position during radiography.
- Explain relative positions of x-ray tube and patient relevant exposure factors during radiography.
- Explain the anatomic and physiological basis of the procedure to be undertaken.
- Explain the radiographic appearances of both normal and common abnormal conditions.
- Know basic physics of radiography processing system.
- Describe construction and working of film, intensifying screen, cassette, dark room, computed radiography, direct radiography and automatic processor.
- Explain radiographic film Processing chemistry.
- Discuss the factors affecting image quality in radiographic image and their application.
- Operate the workflow in x-ray imaging.
- Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for different radiological procedures.
- Understand the patient preparations needed before any radiological examination.
- Generalize knowledge of post procedural care.
- Do precautions and care required in interventional suits.

COURSE CONTENTS:

Radiation management and treatment planning of following malignancies;
Brain, Pituitary, Eye, Nasopharynx, Parotid gland, Oral cavity, Hypopharynx, Larynx, Thyroid, Lung, Esophagus, Breast, Stomach, Pancreas, Colon and Rectum, Bladder, Prostate, Testis, Male and Female Urethra, Uterine cervix, Endometrium, Vagina and Vulva, Ovary, Bone, Soft tissue sarcoma, Childhood tumors, Radiation treatment of benign disease, Palliation: Brain, Spinal cord, Pain management etc.

Special Investigations, Orthography, Barium Studies of GIT, Contrast studies of Genito Urinary System, Contrast studies of Hepato Biliary System, Myelography, Sinograms, Sialuography , Venography , Catheterization, Lymphography, Arteriography, Radiological
Pathology, Clinical Management Practice

Interventional Radiology

History, Milestones Pioneered by Interventional Radiologists, Introduction of Interventional Radiology

Imaging Modalities: Fluoroscopy, Computed tomography (CT), Ultrasound (US), and Magnetic resonance imaging (MRI) including plane Radiograph

Disorders: Vascular, Oncologic, Neurologic, Spine, Hepatobiliary, Kidney

Procedures: Angiography, Balloon angioplasty/stent, Drain insertions, Endovascular aneurysm repair. Embolization, Thrombolysis:, Biopsy, Radiofrequency ablation (RF/RFA, Cryoablation:, IVC filters, Vertebroplasty, Radiologically inserted gastrostomy, TIPS, Biliary intervention, Dialysis. Endovenous laser treatment,

Tools: Diagnostic angiographic catheters, Micro catheters, Drainage catheters, Balloon catheters, Central venous catheters

Practical

Understanding, Performance and technical competencies of all the conventional radiological Procedures during clinical internship/attachment
Radiation Protection Procedures
Practical application of procedure elements: prepare the system and patient, process 3D reconstructions, select optimal working positions for interventions
Complete operating (scan) plan of imaging modalities used in different interventions
Best practices for reducing operator and patient exposure

RECOMMENDED BOOKS

1. A guide to radiological procedure by Stephen Chapman & Richard Nakielny 3rd edition
2. Atlas of radiological anatomy, Author: Weir Abrahams 2nd edition by Churchill living ston

RADIOLOGY LAB MANAGEMENT

COURSE DESCRIPTION

The purpose of this subject is to train graduates of Radiology Sciences for the supervision and operation of Radiology Department, to perform Radio-Imaging procedures to get scanned images of human body parts for diagnostic purposes and also for patient treatment through radiotherapy. In the era of modern technology, radio diagnostic in conjunction with a patient history and physical examination confirm the diagnosis and provide valuable information about a patient health status and response to therapy. In addition to these, radiological findings are also essential for epidemiological surveillance and research purposes. In this course, students will gain theoretical and practical knowledge about radio-imaging techniques to furnish and evaluate th scanned images of the body parts.

LEARNING OBJECTIVES

After completing this course, a student will be able to:

- Explain and apply the major principles and practices of laboratory administration, supervision of various lab disciplines and budgeting.
- Use leadership skills, help his/her team and organization make progress and act in the right way.

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- Use quality assurance principles and practices to ensure the accuracy and reliability of radiological tests.
- Interpret and evaluate patient results and suggest appropriate additional confirmatory tests.
- Understand lab investigations and form an accurate differential diagnosis.
- Implement standard operating procedures (SOPs) & influence the other staff to adhere with safety measures.
- Explain the working principles, methodologies and clinical significance of laboratory procedures in diagnosis and treatment of disease.
- Use educational methods to present information and develop instructional materials.
- Communicate effectively with laboratory personnel, other health care professionals, patients and the public.

COURSE CONTENTS:

LEADERSHIP AND MANAGEMENT; Operation management, Human Resource Management, Financial Management, Marketing Management, Quality Systems Management.

Introduction to Health Facility, Management & Standards of Radiology Practices, Infrastructure & Resources in Radiology Department, Quality Radio-Imaging Management Systems, Radiation Safety, Radiology Department Management of Information Systems, Systemic approach to Radiological Procedures, Support Supervision, Effective administration of Radiology Services, Defining Standards of performance, Budget Processing, Document control through complaints Control of Records, Internal Audits & Management Review

STRATEGIC PLANNING

DESIGN AND SERVICE MODELS FOR RADIOLOGY SETUP; Assessment, Physical Design, Identify Space for offices, Personal Facilities, Storage, Conference/Library area, Students Area, Furniture, Functional area, Ancillary and auxiliary areas, Construction of Dark Room and related areas.

REGULATIONS, ACCREDITATION AND LEGISLATION; Prospective Payment System, Deficit Reduction Act, Ergonomic Safety and Health Program Management Guidelines, Occupational Exposure to Hazardous Radiations, Hazardous Material Regulations, Radiology-Related Governmental Agencies, Safety, Biological Hazard, Chemical Hazard, Ergonomic Hazard, Waste Disposal.

RESOURCES; Management, Personnel, Facilities: buildings and equipment

Design, layout and shielding in a diagnostic and interventional radiology department

- Radiation protection of staff
- Working environment, Personal safety and monitoring
- Radiation protection of patients, Safe design criteria for equipment
- Risks of diagnostic and interventional radiology treatment for the patient (side effects)
- Techniques to reduce dose
- Diagnostic reference levels (Guidance levels)
- Persons supporting the patient
- Reporting of incidents and accidents
- Radiation protection of the public
- Review of facility design, Designation of areas
- Documentation of procedures and record keeping
- ISO and IEC Standards
- Treatment documentation and log books
- Accidents and incidents, Potential exposures in the different stages of the installation, acceptance and operation

Incharge
Department of Allied Health Sciences

- Quality management, Quality assurance and quality control
- Concepts of QA and its application to radiation protection in diagnostic and interventional radiology
- Patient related QA
- Equipment selection, installation, commissioning and maintenance
- Organization and administration – the responsibility of the user
- The role of different professions

QUALITY ASSURANCE: Protocol (or study plan) review, SOP review, Planning (master schedule, inspection plan), Audits and inspections, Quality assurance statement, QA inspections of suppliers and contractors, Issuing and archiving of QA files and reports.

Practical

Recruitment of Staff, Documentation
Equipments
Methods of Radiological Examinations
Radiology Report design/ Certificates
Design of Radiology Setup
Building requirement
Design and construction of Dark Room
Specified areas in Radiology setup
Safety. Hygiene, Disposal of Waste

RECOMMENDED BOOKS

1. Wolbarst, A. B. (1999). Looking within: how X-ray, CT, MRI, ultrasound, and other medical images are created, and how they help physicians save lives. Univ of California Press.
2. Clinical sonography a practical guide by Roger C Saunders / Tom Winter
3. Hertzberg, B. S., & Middleton, W. D. (2015). Ultrasound: the requisites. Elsevier Health Sciences.
4. Murray, J. R., Holmes, E. J., & Misra, R. R. (2008). AZ of musculoskeletal and trauma radiology. Cambridge University Press.
5. Mettler, F. A. (1996). Essentials of Radiology. Saunders.
6. Chandra, R., & Rahmim, A. (2017). Nuclear medicine physics: the basics. Lippincott Williams & Wilkins.

RESEARCH Report Writing

In the final year, a project will be allocated to a single or group of students, depending on available facilities. The In-charge / chairperson of the concerned department/institute shall allot a supervisor. This report shall be evaluated by a panel of examiners notified by the office of the controller examination from an approved panel comprising external and internal examiners. Every student shall be evaluated keeping in view their contribution, thorough understanding of work done and comprehensive presentation. If the student cannot defend his/her work in 1st annual examination, they shall reappear in the 2nd annual/supplementary examination. The details of the report are given below

- Title page
- Names of students
- Students I.D number
- Supervisor's name
- Program name
- Name of the department

- Project title
- Abstract

Abstract

A maximum of one page (200 words) on the work performed and your main conclusions. Abstract should be single line spacing, should not contain any figures, contain a maximum of 2 references, and written in Arial / New Times Roman font size II. The title of the project should be on the first line (Arial / New Times Roman size 11, bold). The name of the student and their supervisor should appear on the next line (Arial / New Times Roman size 11, italic).The abstract should be then be included as a single paragraph. References (if required) should be included at the end (Arial / New Times Roman, size 9).

Points into account while writing Abstract

Explain the purpose of your study/paper. This should optimally be only one sentence long. State the primary objectives and scope of the study or the reasons why the document was written (unless these things are already clear from the title of the document or can be derived from the rest of the abstract). Also state the rationale for your research. Why did you do the research? Is the topic you are researching an ignored or newly discovered one? In terms of Methodology (research methods), clearly states the techniques or approaches used in your study. If you want to introduce new methods or approaches in your abstract, keep in mind the need for clarity.

Describe your results (the findings of your experimentation), the data collected, and effects observed as informatively and concisely as possible. These results of course may be experimental or theoretical, but remember the difference between conjecture and fact and note them in your abstract. Give special priority in your abstract to new and verified events and findings that contradict previous theories. Mention any limits to the accuracy or reliability of your findings.

By stating your conclusions, you are in essence describing the implications of the results: why are the results of your study important to your field and how do they relate to the purpose of your Investigation? Often conclusions are associated with recommendations, suggestions and both rejected and accepted hypotheses. You may wish to include information that is incidental to the main purpose of your paper, but is valuable to those outside your area of study. If you choose to include such information, be careful not to exaggerate its relative importance to the abstracted document

Declaration of Originality

Place on a separate page;

"We hereby declare that this project is entirely our own work other than the counsel of our supervisor and that it has not been submitted for any academic award, or part thereof, at this or any other Educational Institution"

Signed: Authors

Counter signed: Supervisor

Acknowledgements (Optional)

To include those individuals or groups of individuals you would like to thank in relation to the support you received.

Table of Contents

You should list all of the sections and sub-sections, together with their corresponding page numbers

List of Tables

List of Figures

List of Appendices

Suggested Chapter Structure

The following outlines a chapter structure suitable to a project, which involved a distinct component of data collection. The structure of the main body is flexible and you should discuss an appropriate structure with your supervisor. The content and importance of each section will depend on the type of project you are undertaking and again should be discussed with your supervisor before submission.

Vetted

MUS

Chapter 1. Introduction

i) Introduction (Very brief review of literature and indicate significance of study)
ii) Statement of Problem (Should include clear purpose of study)
iii) Questions/Hypothesis
iv) Outline Methodology
v) Definition of Terms

The introduction should 'set the scene' for the examiners and enable them to appreciate the relevance of your work in a particular research area.

Chapter 2. Literature Review

A literature review is an extended essay, which is based on source material. In simple terms, the merit of your literature review is proportional to the comprehensive nature and originality of your sources. Your writing should be confined to the questions/hypothesis being examined. A literature review is more than a listing of references. You should attempt to synthesize a new understanding of your topic, and provide a critique of what other commentators have had to say on the subject.

Chapter 3. Methodology

i) Participant Selection (Including ethical considerations)
ii) Experimental Design
iii) Measurement Procedures

- Data collection procedures
- Rationale for selecting these procedures/questions

iv) Analysis of Data

The methodology should describe the characteristics of the subjects, award of ethical approval, and where appropriate the apparatus, calibration procedures, reliability of the methods used, experimental protocols and the statistical treatments of the data. Diagrams and photographs may be appropriate to illustrate procedures.

Chapter 4. Analysis of Results

Your results should consist of tables of your findings, illustrated with graphs where appropriate. The results section should contain text, which takes the reader through your graphs and tables, pointing out the salient features. Tables should wherever possible summarize the data from several subjects in the form of means and standard deviations. You do not need to give tables of every piece of original data. If you feel it is essential to include these put them in an appendix.

Chapter 5. Discussion of Results

It is good practice to begin with a summary of your findings. This is your opportunity to interpret your data in the context of what is already known from existing literature. However, make every effort to explain your findings first, justifying the arguments by reference to previously published work. NOT the other way around. The discussion is the place for explanations and opinions. Link your findings with the purpose/questions/hypothesis of your project. Include critical appraisal of your own work and that of others. Address what you would do differently with hindsight?

Chapter 6. Conclusion

- Summary of main findings
- Recommendations (Impact of findings and future research)
- Conclusion

This section should summarize main findings, highlight areas where more work is needed and suggest avenues for future development of this work. An overall conclusion from the study should be included to complete the project.

References: A list of references must be included at the end of the project document and appropriately referenced within the text according to a recognized standard of the University.

Appendices: In this section, if required, include any raw data, interview transcript, computer program listings, and questionnaires etc., which were not in the results section, but which may need to be consulted.

Vetted