CURRICULUM FOR BS RADIOLOGY

INSTITUTE OF PARAMEDICAL SCIENCES

KHYBER MEDICAL UNIVERSITY PESHAWAR

Prepared By: SHAIKH ATIF MEHMOOD

BS Medical Imaging Technology, MSc Ultrasound

Certificate in Health Profession Education (CHPE), Khyber Medical University Peshawar

Clinical Implementation of Ultrasound in Breast Imaging (CME Certificate)
Certificate in Radiation Terror (John Hopkins Bloomberg School of Public Health)
Certificate in Cone Beam CT better to guide Biopsies (University of Pennsylvania)
Certificate in Advanced Abdominal CT (Institute for Advanced Medical Education)
Certificate in 3D imaging Boosts Breast Cancer Detection (University of Pennsylvania)
Certificate in the Emerging Role of MRI in Prostate Imaging (Postgraduate Institute for Medicine Englewood)
Certificate in Cardiac CT best practices: Building and implementing injection Protocols (Institute for Advanced Medical Education)
Certificate in Extracellular and Hepatobiliary MRI Contrast Agents in the Evaluation of Liver Diseases (American Registry of Radiologic Technologist (ARRT)

LECTURER (RADIOLOGY) IPMS-KMU

CURRICULUM FOR BS RADIOLOGY

AIMS:

The aim of the 4 years degree program in Radiology is to equip the students with relevant professional knowledge, skills, techniques and ethical values to enable them to apply their acquired expertise at a level between the doctors and the patient for efferent health service delivery.

GENERAL LEARNING OUTCOMES

BS Radiology education and training should enable the student to:

- Develop accuracy and meticulousness to attain high levels of ethics and technical proficiency.
- Access the technical and non technical skills in a standardized and reproducible environment
- Strengthen the decision power and exercise appropriate judgment skills, to be applied especially and during crisis.
- Develop good leadership, problem solving and administrative skills.
- Develop and analyze innovative strategies for effective communication with the patient and the health care personnel.
- Demonstrate inter disciplinary team building strategies or effective co-ordination between various allied health disciplines.
- Demonstrate understanding of the basic concepts of professional behaviors and legal implementations of work environment.
- Demonstrate the knowledge of his/her role in health care delivery system.
- Establish and maintain continuing education as a faction of growth and maintenance of professional competence.

SPECIFIC LEARNING OUTCOMES

Following competencies will be expected from a student on completing four years degree course in Radiology. The student should be proficient to:

- Provide quality patient care in routine as well as advanced imaging procedures.
- Use digital imaging and information technology equipments competently, through application of the principal and theories of its operation.
- Evaluate performance characteristics of equipments
- Implement an effective radiation protection program.
- Apply the knowledge of sectional anatomy to relate clinical procedures.
- Demonstrate an understanding of the principles of exposure selection and image processing, and an ability to apply this knowledge
- Apply the principal of management, organization behavior, supervision, budgeting, human recourse management and labor relations in a medical imaging relation environment.
- Enhance human interaction and performance in a clinical environment by integrating liberal education principles

Skills to be Learnt during BS Radiology Course

- Demonstrate good knowledge of the detailed Human Anatomy and Physiology
- Ability to learn and master the operation of simple/advanced sophisticated imaging machinery
- Ability to identify trouble-shooting & problems related to the equipments used in Radiology
- Perform maintenance and corrective measures on imaging instruments, where required
- Demonstrate complete knowledge and technical skills regarding the diagnostic Radiology Technology including X-Rays, Medical Sonography, Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine, Fluoroscopes, and cardiovascular imaging etc
- Explaining the patient about the procedure, precautions and correct positioning
- Place the equipment in the proper position in relation to patients body and determine the proper machine settings
- Demonstrate knowledge and proper usage of the radiation protection equipments
- Manage small administrative issues of the department including purchase/ replacement of the related equipment
- Maintenance of work records, dye, and chemical storage, up to date methodology and miscellaneous duties
- Complete work in compliance with the quality assurance policies and procedures
- Maintenance of stock solutions, controls and equipments
- Ability to communicate effectively both verbally and in writing
- Basic computer skills and knowledge of the Microsoft office suite
- Knowledge of record keeping
- The ability to analyze and modify the imaging techniques according to the circumstances
- Attend continuing education programs as funding and work load permits
- Instruct and teach the junior staff and training technologists

FRAME WORK FOR BS RADIOLOGY

(4 YEAR PROGRAMME)

- Total number of Credit hours 130
- Duration 4 years
- Semester duration 16-18 weeks
- Semesters 8
- Course Load per Semester 15-18 Credit hours
- Number of courses per semester 4-6

Compulsory Requirements (the student has no choice)		**General Courses to be chosen from other departments**		**Discipline Foundation Courses**		**Discipline Specific Courses**	
08 courses		**1 course**		**12 courses**		**23 courses**	
Subject	**Cr. Hr**	**Subject**	**Cr. Hr**	**Subject**	**Cr. hr**	**Subject**	**Cr. Hr**
1. English I	2+0	1-Medical Sociology	2+0	1. Human Phy-I	3+1	**1**-Regional and Radiological Anatomy-I	2+1
2. English II	2+0			2. Human Phy-II	3+1		
3. Pakistan Studies	2+0			3. Biochemistry-I	3+1	**2**-Radiation Sciences and Technology	2+1
4. Islamic Studies / Bioethics	2+0			4. Biochemistry-II	3+1	3-General Radiology	2+1
5. Computer skills	1+1			5. Human Anatomy-I	3+1	4-Regional and Radiological Anatomy-II	2+1
6. Communication Skills	1+1			6. Human Anatomy-II	3+1	5-Conventional Radiological Procedures & Clinical Practice	2+2
7. Research Methodology	2+1			7-General Pharmacology	2+1	6-Radiological Positioning & Clinical Practice	2+2
8. Biostatistics	2+1			8-General Pathology	2+1	7-Radiobiology & Radiation Protection	1+1
				9-Clinical Medicine-I	1+1	8-Computed Tomography	2+2
				10-Clinical Medicine-II	1+1	9-Mammography & Special Radiological Techniques	2+1
				11- Surgery	1+1	10-Magnetic Resonance Imaging	2+2
				12-Patient care and management	2+0	11-Computed & Digital Radiography	1+1
						12-Radiological & Cross sectional Anatomy	2+1
						13-Computed Tomography Procedures & Clinical Practice	2+1
						14-Magnetic Resonance Imaging Procedures & Clinical Practice	2+1
						15-Therapeutic	

						Radiology 16-Clinical Sonography 17-Angiography and Cardiac Imaging 18-Nuclear Medicine 19-Echocardiography 20-Electrocardiography 21-Clinical Pathology & Radiological Presentation 22-Interventional Radiology 23. Research Project	2+1 2+2 2+2 2+1 1+1 1+1 1+1 1+1 0+6
	16		**02**		**38**		**74**

SCHEME OF STUDIES FOR 4 YEAR BS RADIOLOGY

Semester/Year	Name of Subject	CODE	Credits
First	Biochemistry-I	PMS-101	3+1
	Human Physiology-I	PMS-102	3+1
	Human Anatomy-I	PMS-103	3+1
	English-I	PMS-104	2+0
	Pak studies	PMS-105	2+0
	Computer skills	PMS-106	1+1
			18
Second	Biochemistry-II	PMS-107	3+1
	Human Physiology-II	PMS-108	3+1
	Human Anatomy-II	PMS-109	3+1
	English-II	PMS-110	2+0
	Islamic studies	PMS-111	2+0
			16
Third	Regional and Radiological Anatomy-I	PMS-210	2+1
	General Radiology	PMS-211	2+1
	Radiation Sciences and Technology	PMS-212	2+1
	General Pathology	PMS-201	2+1
	General Pharmacology	PMS-202	2+1
	Communication Skills	PMS-206	1+1
			17
Fourth	Clinical Medicine-I	PMS-234	1+1
	Regional and Radiological Anatomy-II	PMS-235	2+1
	Conventional Radiological Procedures & Clinical Practice	PMS-236	2+2
	Radiological Positioning	PMS-237	2+2

	& Clinical Practice		
	Computed & Digital Radiography (CR & DR)	PMS-238	1+1
	Radiobiology & Radiation Protection	PMS-239	1+1
			17
Fifth	Computed Tomography(CT)	PMS-313	2+2
	Mammography & Special Radiological Techniques	PMS-314	2+1
	Magnetic Resonance Imaging (MRI)	PMS-315	2+2
	General Surgery	PMS-316	1+1
	Interventional Radiology	PMS-317	1+1
	Clinical Medicine-II	PMS-318	1+1
			17
Sixth	Radiological & Cross sectional Anatomy	PMS-319	2+1
	Computed Tomography (CT) Procedures & Clinical Practice	PMS-320	2+1
	Magnetic Resonance Imaging(MRI)Procedures & Clinical Practice	PMS-321	2+1
	Therapeutic Radiology	PMS-322	2+1
	Biostatistics	PMS-308	2+1
	Research Methodology	PMS-310	2+1
			18
Seventh	Clinical Sonography	PMS-411	2+2
	Angiography and Cardiac Imaging	PMS-412	2+2
	Nuclear Medicine	PMS-413	2+1
	Echocardiography	PMS-414	1+1
	Electrocardiography(ECG)	PMS-415	1+1

	Clinical Pathology & Radiological Presentation	PMS-416	1+1
			17
Eight	Patient care & Management	PMS-417	2+0
	Medical Sociology	PMS-409	2+0
	RESEARCH PROJECT	PMS-406	06
			10
	TOTAL CREDIT HOURS		**130**

Total credit hours= 130

HEC recommendation=124-136

LIST OF GENERAL COURSES

(9 Courses)

1. Clinical Medicine-I
2. General Pharmacology
3. General Pathology
4. Clinical Medicine-II
5. General Surgery
6. Medical Sociology
7. Patient care and management
8. Biostatistics
9. Research Methodology

Discipline Specific Courses

(23 Courses)

1-Regional and Radiological Anatomy-I

2-Radiation Sciences and Technology

3-General Radiology

4-Regional and Radiological Anatomy-II

5-Conventional Radiological Procedures & Clinical Practice

6-Radiological Positioning & Clinical Practice

7-Radiobiology & Radiation Protection

8-Computed Tomography (CT)

9-Mammography & Special Radiological Techniques

10-Magnetic Resonance Imaging (MRI)

11-Computed & Digital Radiography (CR & DR)

12-Radiological & Cross sectional Anatomy

13-Computed Tomography (CT) Procedures & Clinical Practice

14-Magnetic Resonance Imaging (MRI) Procedures & Clinical Practice

15-Therapeutic Radiology

16-Clinical Sonography

17-Angiography and Cardiac Imaging

18-Nuclear Medicine

19-Echocardiography

20-Electrocardiography (ECG)

21-Clinical Pathology & Radiological Presentation

22-Interventional Radiology

23-Research Project

1st SEMESTER COURSES

1. **MEDICAL BIOCHEMISTRY -I**
2. **HUMAN PHYSIOLOGY-I**
3. **HUMAN ANATOMY-I**
4. **ENGLISH-I**
5. **PAK STUDIES**
6. **COMPUTER SKILLS**

PMS-101 **MEDICAL BIOCHEMISTRY-I** **Credit Hours: 3+1**

Course objectives:

- To understand the chemical composition, biochemical role, digestion and absorption of macro and micro molecules of the cell.
- To understand different biochemical reactions in cell.
- To understand mechanism of action of hormones.

Course contents:

Biochemical composition and functions of the cell; Chemistry of signals and receptors; Structure and function of Carbohydrates, Proteins and lipids; biochemical functions of vitamins; biochemical function of Sodium, potassium, chloride, calcium, phosphorus, magnesium, sulfur, iodine and fluoride; Composition and function of saliva, gastric juice, gastric acid(HCL), pancreatic juice, bile and intestinal secretion; Digestion and absorption of proteins, carbohydrates, lipids, vitamins and minerals; Body buffers and their mechanism of action; Acid base regulation in human body; Biochemical mechanisms for control of water and electrolyte balance; Mechanism of action of hormones.

Practicals:

1. Good laboratory Practices
2. Preparation of Solutions
3. Principles of Biochemistry analyzers(spectrophotometer, flame photometer)
4. Determination of Cholesterol, Tg, HDL, LDL, sugar, calcium and phosphorus in blood
5. SOP of centrifuge, water bath and microscope

Recommended Books

- Harper's Biochemistry Robert K. Murray, Daryl K. Granner 28th edition 2009
- Medical Biochemistry Mushtaq Ahmad vol. I and II 8th edition 2013

PMS -102 **HUMAN PHYSIOLOGY-I** **Credit Hours: 3+1**

Course Objectives:

- To understand the basic concepts of physiology beginning from the cell organization to organ system function.
- To understand the organization of cell, tissue organ and system with respect to their functions.
- To Understand the physiology of Respiration, G.I.T, Urinary system and Endocrine system

Course contents:

Functional organization of human body, Mechanism of Homeostasis, Cell structure and its function, function of different Tissue, Functions of the skin, , Types and function of muscle, Neuromuscular junction, functions of the endocrine glands, Breathing Mechanism, Exchange of respiratory Gaseous, Transport of respiratory gases, Function of different part of Digestive system, Function of liver and pancreas, Digestion and Absorption in Gastrointestinal tract, Patho-Physiology of Gastrointestinal Disorders, Formation of Urine by the Kidney, Glomerular filtration, Renal and associated mechanism for controlling ECF, Regulation of Acid-Base Balance, Male Reproductive System (Male), Prostate gland, Spermatogenesis, Female Reproductive System, Menstrual Cycle and Pregnancy and parturition, Mammary Glands and Lactation and Fertility Control

Practicals:

1. Introduction to microscope
2. Bleeding time
3. Clotting time
4. WBCs count
5. RBCs count
6. Platelets count
7. Reticulocytes count

Recommended Books:

- Essentials of Medical Physiology K Sembulingam, Prema Sembulingam Sixth Edition 2013

- Concise Physiology Dr. Raja Shahzad 1st Edition 2012
- Guyton And Hall Textbook Of Medical Physiology John E. Hall, Arthur C. Guyton Professor and Chair 2006
- Ross and Wilson Anatomy and Physiology in Health And Illness 11th Edition Anne Waugh, Allison Grant 2010

PMS -103 **HUMAN ANATOMY-I** **Credit Hours: 3+1**

Course Objectives:

- To understand the basic concepts of anatomy beginning from the cell organization to organ system function
- To understand the basic concepts of general anatomy including skeleton and musculo skeleton.
- To Understand the anatomy of Thorax Abdomen and pelvis

Course contents: Musculo skeletal system(Axial and Appendicular),Axial Skeleton, Different bones of human body, Axial and Appendicular Skeleton, Classification on the basis of development, region and function, General concept of ossification of bones, parts young bone, Blood supply of long bones. Joints Structural Regional and functional classification of joints,Characteristics of synovial joints, Classification of synovial joints, Movements of synovial joints. Muscular System Parts of muscle Classification of muscles (skeletal, Cardiac, smooth) Thoracic wall: Muscles of thorax, Surface Anatomy, Trachea, lungs, pleura, mammary glands (breast), Heart and thoracic vessels. Thoracic cavity: Mediastinum, Lungs, bronchi, blood supply and lymphatic Abdominal wall: Skin, nerve and blood supply, Muscles of anterior abdominal wall. Abdominal cavity: General Arrangement of the Abdominal Viscera, Peritoneum, Omenta, mesenteries, Stomach, blood, nerve, lymphatic supply, Small intestine, blood, nervous and lymphatic supply, Large intestine: blood nerve and lymphatic supply. The pelvic wall: Anterior, posterior wall, diaphragm. Pelvic cavity: Ureters, urinary bladder Male genital organs, Female genital organs, Muscles of pelvic region, blood supply, nerve supply, Special Senses.

Practicals:

1. Study Axial and Appendicular skeleton on human skeletal model.
2. Study musculoskeletal system on human musculoskeletal model.
3. Study organs of special senses.
4. Study and understand anatomy of Thorax, Abdomen and Pelvis through:

5. Human Models
6. Video demonstration.

Recommended Books:

- Ross and Wilson Anatomy and Physiology in helth and illness 11th Edition Waugh Grant.
- Clinical Anatomy (By regions) 9th edition, Richard S. Snell.

Reference books:

- Netter Atlas of human anatomy 5th Edition Saunders.
- Gray's Anatomy for students 2nd Edition Drake Vogal Mitcell.

PMS -104 **ENGLISH –I** **Credit Hours: 2+0**

Course Objective:

- To enable the students to meet their real life communication needs
- To enhance language skills and develop critical thinking

Course Contents:

Vocabulary Building Skills: Antonyms, Synonyms, Homonyms, One word Substitute, Prefixes and suffixes, Idioms and phrasal verbs, Logical connectors, Check spellings, Practical Grammar & Writing Skill: Parts of Speech, Tenses, Paragraph writing: Practice in writing a good, unified and coherent paragraph, Précis writing and comprehension, Translation skills: Urdu to English, Reading skills: Skimming and scanning, intensive and extensive, and speed reading, summary and comprehension Paragraphs, Presentation skills: Developing, Oral Presentation skill, Personality development (emphasis on content, style and pronunciation)

Recommended books:

- Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.

PMS -105 **PAKISTAN STUDIES (Compulsory)** **Credit Hours: 2+0**

Course Objectives:

- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Contents:

Historical Perspective: Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah, Factors leading to Muslim separatism, People and Land, Indus Civilization, Muslim advent, Location and Geo-Physical features. Government and Politics in Pakistan, Political and constitutional phases:1947-58,1958-71,1971-77,1977-88,1988-99,1999 onward Contemporary Pakistan: Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan

Books Recommended:

- Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
- Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
- Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
- Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.

PMS -106 **COMPUTER SKILLS** **Credit Course: 1+1**

Course objectives:

- To understand the basics of computer
- To utilize the MS office, internet and email

Course Contents:

Introduction to Computer and Window XP/7; MS Office 2007 (Word, Excel, PowerPoint); Internet access and different data bases available on the internet; Email.

Recommended Books:

- Computer science by Muhammad Ashraf, edition 1st 2010

2nd SEMERTER COURSES

1. **MEDICAL BIOCHEMISTRY-II**
2. **HUMAN PHYSIOLOGY-II**
3. **HUMAN ANATOMY-II**
4. **ENGLISH-II**
5. **ISLAMIC STUDIES**

PMS -107 **MEDICAL BIOCHEMISTRY-II** **Credit Hours: 3+1**

Course Objectives:

- To understand the metabolism of carbohydrates, lipids and proteins.
- To understand clinical role of enzymes in human being.
- To understand about the nutrition.

Course Contents:

Balance food, Major food groups, Nutritional status of Pakistani nation, Metabolic changes in starvation, Protein energy malnutrition, Regulation of food intake, Obesity; metabolism of carbohydrates (Citric Acid Cycle, Glycolysis, Pentose Phosphate Pathway), proteins (urea and corie cycle), nucleotides (uric acid formation) and lipids (beta oxidation); Respiratory chain and oxidative phosphorylation, components of respiratory chain, electron carriers, ATP synthesis coupled with electron flow, phosphorylation of ADP coupled to electron transfer; clinical diagnostic enzymology.

Practicals:

1. Determination of liver, cardiac, pancreatic enzymes
2. Determination of urea and uric acid

Recommended Books:

- Harper's Biochemistry Robert K. Murray, Daryl K. Granner 28th edition 2009
- Medical Biochemistry Mushtaq Ahmad vol. I and II 8th edition 2013

PMS -108 **PHYSIOLOGY-II** **Credit Hours: 3+1**

Course Objectives:

- To understand the basic concepts of physiology beginning from the organization of the systems to their role in the body.
- Understand the organization and function of various systems
- Understand the physiology of Blood, CVS, Nervous System and special senses
- Students will be able to understand immunity, its types and immune reactions

Course Contents:

Physiology of Nervous System, Function of various cranial nerves, Functions of somatic motor nervous system Functions of the autonomic nervous system, function of neurons, neuroglial cells and their components. Resting membrane potential and an action potential, function of a synapse and reflex arc, functions of the specialized sense organs: Eye, physiology of site, accommodation, optic nerve and optic chiasma, Ear, functions of the internal, middle and external ear Physiology of the hearing and balance, Smell, physiology of olfactory nerve. Taste, physiology of taste Location of the taste buds Physiology of speech, Blood: Composition and function of Blood , haematopoisis, Blood grouping, Coagulation mechanism, Physiology of Cardiovascular system The Physiology of Pulmonary Systemic Circulation: Arteries Veins Local Control of Blood Vessels Nervous Control of Blood Vessels Regulation of Arterial Pressure, The function of Lymphatic System, tonsils, lymph nodes, the spleen and the thymus, Classification and physiology of Immune system, Antigens and Antibodies, Primary and secondary responses to an antigen Antibody-mediated immunity and cell-mediated immunity Role of lymphocyte in immunity regulation.

Practicals

1. Spirometry
2. Electrocardiography
3. Blood Pressure Measurement
4. Normal and abnormal ECG interpretation
5. Pulse rate measurement
6. Heart sounds

Recommended Books

- Essentials of Medical Physiology K Sembulingam, Prema Sembulingam Sixth Edition 2013
- Guyton And Hall Textbook Of Medical Physiology John E. Hall, Arthur C. Guyton Professor and Chair 2006
- Ross and Wilson Anatomy and Physiology in Health And Illness 11th Edition Anne Waugh, Allison Grant 2010

PMS -109 **HUMAN ANATOMY-II** **Credit Hours: 3+1**

Course Objectives:

- To understand the basic concepts of anatomy beginning from the cell organization to organ system function
- To understand the anatomy of upper limb, lower limb and head and neck.
- To understand the knowledge about endocrine system

Course contents:

The upper limb Bones of shoulder girdle and Arm, Muscles, Axilla, Brachial plexus, Cubital fossa, the forearm, hand bones, muscles, Blood supply, Nerve supply, lymphatics, The lower limb Fascia, Bones, Muscles, Femoral triangle, Blood supply, Nerve supply, Lymphatic supply. Head and neck_Skull, Mandible, Cranial nerves, cranial cavity, Meninges, Brain, Orbit, Neck, Endocrine System Classification of endocrine glands, Pituitary glands, Thyroid Glands, Adrenal gland and differences between the cortex and medulla.

Practicals:

Study and understand the anatomy of Upper limb, Lower limb, Head and Neck through:

1. Human Models
2. Video demonstration
3. Study radiographs of upper and lower limb.

Recommended Books:

Essential books (text books)

- Ross and Wilson Anatomy and Physiology in health and illness 11th Edition Waugh Grant.
- Clinical Anatomy (By regions) 9th edition, Richard S. Snell.

Reference books

- Netter Atlas of human anatomy 5th Edition Saunders.
- Gray's Anatomy for students 2nd Edition Drake Vogal Mitcell.
- BD. Churasia Human Anatomy (All regions)

PMS -110 **ENGLISH –II** **Credit Hours: 2+0**

Course Objectives:

- To enhance students writing, reading and listening skills.
- To enhance language skills and develop critical thinking.

Course contents:

Writing Skill: CV and job application, Technical Report writing, Writing styles, Changing narration: Converting a dialogue into a report, Converting a story into a news report, Converting a graph or picture into a short report or story, Active and Passive voice, Letter / memo writing and minutes of the meeting, use of library and internet recourses, Essay writing, Phrases - Types and functions, Clauses - Types and functions, Punctuation: Tenses - Types, Structure, Function, Conversion into negative and interrogative. Speaking Skill: Group Discussion (Various topics given by the teacher), Presentation by the students (individually), Role Play Activities for improving Speaking. Listening Skill: Listening Various Documentaries, Movies, and online listening activities to improve the listening as well as pronunciation of the words.

Recommended Books:

- Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492.
- Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
- 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.
- Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

PMS -111 **ISLAMIC STUDIES** **Credit Hours: 2+0**

Course Objectives:

- To learn about Islam and its application in day to day life.
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life**.**

Course contents:

Fundamental beliefs of Islam, Belief of Tawheed, Belief in Prophet hood, Belief in the Day of Judgment, Worships, Salaat / Prayer, Zakat /Obligatory Charity, Saum / Fasting, Hajj / Pilgrimage, Jihad, Importance of Paramedics In Islam, Ethics, Religion and Ethics, Higher Intents / Objectives of Islamic Sharia and Human Health, Importance and Virtues of Medical Profession, Contribution and Achievements of Muslim Doctors, Knowledge of the Rights, Wisdom and Prudence, Sympathy /Empathy, Responsible Life, Patience, Humbleness, Self Respect, Forgiveness, Kindhearted, Beneficence, Self Confidence, Observing Promise, Equality, Relation among the Doctors, Jealousy, Backbiting, Envy, Etiquettes of Gathering, Relation between a Doctor and a Patient, Gentle Speaking, Mercy and Affection, Consoling the Patient, To inquire the health of Patient, Character building of the Patient, Responsibilities of a Doctor,

Recommended Books:

- Islamiyat (Compulsory) for Khyber Medical University, Medical Colleges and Allied Institutes

3rd Semester Courses

1- **Regional and Radiological Anatomy-I**

2- **General Radiology**

3- **Radiation Sciences and Technology**

4- **General Pharmacology**

5- **General Pathology**

6- **Communication Skills**

PMS -210 **Regional and Radiological Anatomy-I** **Credit Hours: 2+1**

Aims and Objectives:

- To Apply the knowledge of Regional & Radiological sectional anatomy to relate clinical procedures
- To provide quality patient care in routine as well as advanced imaging procedures.
- To Use digital imaging and information technology equipments competently, through application of the principal and theories of its operation.
- To implement an effective radiation protection program.

Course Contents:

Thoracic wall

Structure of the thoracic wall, Sternum, Costal Cartilages, Ribs, Intercostals Spaces, Intercostals Muscles, Intercostals Arteries & Veins, Intercostals Nerves, Suprapleural Membrane, Diaphragm, Internal Thoracic Artery, Internal Thoracic Vein, Levatores Costarum, Serratus Posterior Superior Muscle, Serratus Posterior Inferior Muscle, **Radiographic Anatomy,**

Thoracic cavity

Mediastinum, Superior Mediastinum, Inferior Mediastinum, Pleurae, Trachea, Principle Bronchi, Lungs, Bronchopulmonary Segments, Pericardium, Heart, Esophagus, Thymus, **Cross sectional Anatomy of the Thorax, Radiographic Anatomy**

Abdominal Wall

Introduction to structure of the abdominal walls, Inguinal Canal & its contents, Scrotum, Testes and epididymus, Vagina, Peritoneal Lining of the abdominal walls, **Radiographic Anatomy**

Abdominal Cavity

Liver, Gall Bladder, Esophagus, Stomach, Small intestine, Large Intestine, Pancreas, Spleen, Kidneys, Suprarenal Glands, Peritoneum, Jejunum and Ileum, Cecum, Ileocecal Valve, Appendix, Ascending Colon, Transverse colon, Descending Colon, Difference between the small & Large Intestine, Retroperitoneal Space, Ureter, Blood supply of abdominal organs, Portal Vein, Lymphatics on the posterior abdominal walls, Lymph Nodes, Lymph Vessels, Nerves on the posterior Abdominal Wall, Lumbar Plexus, Sympathetic Trunk (Abdominal Part), Aortic Plexus, **Cross-Sectional Anatomy of the Abdomen, Radiographic Anatomy**

Pelvic Wall Orientation of the Pelvis, False Pelvis, True Pelvis, Structure of the pelvic walls, Anterior Pelvic Wall, Posterior Pelvic Wall, Lateral Pelvic Wall, Inferior Pelvic wall or Pelvic Floor, Pelvic Diaphragm, Pelvic Fascia, Parietal Pelvic Fascia, **Radiographic Anatomy**

Pelvic Cavity Rectum, Ureters, Urinary Bladder ,Urethra ,Vas deferens, Seminal Vesicles ,Prostate, Cervix ,Ovary ,Uterine Tubes ,Uterus ,Vagina

Cross Sectional Anatomy of the Pelvis, Radiological Anatomy

Practicals:

- Identification of the Structures of different organs
- Radiological Presentation & Pathological Findings on Radiographs

Recommended Books:

- Clinical anatomy for medical student by Richard S Snell 5th edition by little brown Boston, New York, Toronto, London\
- Gray's Anatomy by Williams, Bannister 38 edition by Churchill living stone
- Atlas of radiological anatomy, Author: Weir Abrahams 2nd edition by Churchill living stone

PMS -211 **General Radiology** **Credit Hours: 2+1**

Aims and Objectives

- To provide quality patient care in routine as well as advanced imaging procedures.
- To Use digital imaging and information technology equipments competently, through application of the principal and theories of its operation.
- To Evaluate performance characteristics of equipments
- To implement an effective radiation protection program.
- To apply the knowledge of sectional anatomy to relate clinical procedures.
- To apply the principal of management, organization behavior, supervision, budgeting, human recourse management and labor relations in a medical imaging relation environment.

Course Contents

General Consideration of all imaging Modalities

Conventional and Digital Fluoroscopy Imaging System Image Capture, Image Display, Digital Subtraction Angiography (DSA)
Contrast Materials Definition of Radiolucent & Radiopaque, Definition & reasons for employing Contrast material, Types of contrast material Positive & Negative, Examples of types & areas of use, Oil, Liquids, Tablets, Powders, Airs or gases, Profile of Contrast for X. Rays, C.T, MRI, Characteristics of a good contrast medium, Solubility, Viscosity & Iodine Content, Systemic reactions to contrast medium, Precautions & contraindications of administering Contrast Media, Films demonstrating Anatomy, small and Large Intestine, Biliary tract routine, operative & t-tube, Urinary tract (Excretory, Retrograde)

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

Practicals:

- Fluoroscopic handling, Procedures, Performance
- Contrast Materials (Market Availability, Method, Area of use)
- Dark Room Construction & Equipment
- Films demonstrating Anatomy

Recommended Books:

- Radiological science for technologists by Stewart C. Bushong 7th edition published by Mosby, Inc: A Harcout health company
- A guide to radiological procedures by Stephen Chapman & Richard Nikielny 3rd editionin by Bailliere tindall London

PMS -212 **Radiation Sciences & Technology** **Credit Hours: 2+1**

Aims and Objectives

- To provide quality patient care in routine as well as advanced imaging procedures.
- To Use digital imaging and information technology equipments competently, through application of the principal and theories of its operation.
- To Evaluate performance characteristics of equipments
- To implement an effective radiation protection program.
- To apply the knowledge of sectional anatomy to relate clinical procedures.
- To Enhance human interaction and performance in a clinical environment by integrating liberal education principles

Course Contents

Radiologic Physics Concept of Radiation, Nature Of Surroundings, Sources Of Ionizing Radiation, Discovery of X-Rays, Development of Modern Radiology, Basic Radiation Protection Definition

Fundamentals of Physics Review of Mathematics, Units of Measurement

Mechanics Heat and Thermodynamics, Waves and Oscillation

The Atom Centuries of discovery, Combination of Atom, Magnitude of Matter, Atomic Structure, Atomic Nomenclature

Radioactivity Types of Ionizing Radiation, Electromagnetic Radiation, Photons Everywhere, Electromagnetic Spectrum, Radiologically Important Photons, Energy and Matter, Electromagnetism, Magnetism, Electricity and Magnetism, Energy Electrostatics, Electrodynamics, Electromagnetic Effects, Electromagnetic Induction, Electric Generators and Motors, The Transformer Rectification

Radiographic Imaging The X-Ray Machine, X-Ray Tube, X-Ray Production, X-Ray Emission Spectrum, X-Ray Emission, X-Ray Interaction with matter, Differential Absorption, Contrast Examinations, Exponential Attenuation, Operating Console, High Voltage Section X-Ray Tube, Rating Charts, Electron-Target Interaction, X-ray Quantity, X-ray Quality, Five Basic Interactions

Radiographic Film

Film Construction Formation of Latent Image, Handling and Storage Of Films, Processing the Latent Image, Evolution Of Film Processing, Processing Chemistry, Automatic Processing, Alternative Processing Methods

Intensifying Screens Screen Construction, Luminescence, Screen Characteristics, Screen-Film Combinations, Care Of Screens

Beam-Restricting Devices Production of Scatter Radiation, Control Of Scatter Radiation

The Grid Characteristics of Grid Construction, Measuring Grid Performance, Types of Grids, Use of Grids, Grid Selection

Radiographic Quality Film Factors, Subject Factors, Considerations for improved Radiographic Quality

Radiographic Exposure Kilovolts Peak, Milliamps, Exposure Time, Milliampere-Seconds, Distance

Radiographic Technique Patient Factors, Image Quality Factors, Radiographic Technique Charts, Automatic Exposure Techniques

Practicals:

- The X-Ray Machine (Handling, Operation, Image Production)
- Dark Room (Film Handling, Cassettes, Automatic & Manual film Processing, Chemicals)
- Grids
- Quality Control Procedures

Recommended Books:

- Radiological science for technologists by Stewart C. Bushong 7th edition published by Mosby, Inc: A Harcout health company
- Farr's Physics for Medical Imaging, 2nd Edition

PMS -201 **General Pathology** **Credit Hours: 2+1**

Aims and Objectives

- To describe cellular responses to stress and noxious stimuli and inflammation.
- To describe cell injury and cell death.
- To describe the mechanisms involved in wound healing.
- To Explain the pathology and pathogenesis of edema and shock
- To enumerate and describe the abnormalities of cell growth and differentiation

Course Contents

Cell Injury & adaptation Cell injury, Cellular adaptation

Inflammation Acute Inflammation, Chronic Inflammation

Cell Repair & Wound Healing Regeneration & Repair, Healing Factors affecting Healing

Hemodynamic Disorders Define & classify the terms, Edema, Hemorrhage, Thrombosis, Embolism, Infarction & Hyperemia, Shock, compensatory mechanism of shock, possible consequences of thrombosis & difference between arterial & venous emboli

Neoplasia Dysplasia& Neoplasia Difference between benign & malignant neoplasm, etiological factors for Neoplasia, different modes of metastasis

Practicals

- Practical Copy for General Pathology
- Specific Histopathological Slides

Recommended Books

- Robbins and Cotran Pathologic Basis of Disease, Professional Edition, 8th Edition

PMS -202 **General Pharmacology** **Credit Hours: 2+1**

Aims and Objectives

- To discuss the roles and responsibilities of the various members of the health care team in maintaining patient safety during drug therapy.
- To define common terms related to pharmacology and drug therapy.
- To discuss relevant historical, legal, and ethical issues related to pharmacology and drug therapy.
- To describe the process through which a drug must go as it is being developed and tested for safety.
- To describe basic facts about drugs such as names, sources, classification systems, preparations, and routes of administration

Course Contents:

Introduction to Pharmacology, Pharmacokinetics, Pharmacodynamics ,Adverse effects of drugs, Classification of drugs, Drugs affecting the Autonomic Nervous System, Opioids, Drugs Affecting CVS, Drugs Affecting Endocrine system, Gastrointestinal Drugs, Autacoids & Antagonists ,Anesthetics, Analgesics, Narcotics**,** Muscle Relaxants, Non-Narcotic Analgesics

RECOMMENDED BOOKS:

1. Lippincott's pharmacology (text book) by Mycek 2nd edition published by Lippincott Raven
2. Katzung textbook of pharmacology (Reference Book) by Bertram Katzung 8th Edition, Published by Appleton.

PMS-206 **Communication Skills** **Credit hours: 1+1**

Aims and Objectives

By the end of the course students will be able to:

- Communicate effectively both verbally and non-verbally
- Apply the requisite academic communication skills in their essay writing and other forms of academic writing
- Use various computer-mediated communication platforms in their academic and professional work
- Relate to the interpersonal and organizational dynamics that affect effective communication in organizations.

1. **Introduction to Communication,** Meaning and definition of Communication,The process of communication,Models of communication
2. **Effective Communications in Business,** Importance and Benefits of effective communication,Components of Communication.,Communication barriers, Non verbal communication
3. **Principles of effective communication,** Seven Cs.
4. **Communication for academic purposes,** Introduction to academic writing, Summarizing, paraphrasing and argumentation skills, Textual cohesion
5. **Communication in Organizations,** Formal communication networks in organizations, Informal communication networks, Computer-mediated communication (videoconferencing, internet, e-mail, skype, groupware, etc)
6. **Business Writing** , Memos , Letters, Reports , Proposals , Circulars, etc
7. **Public Speaking and Presentation skills,** Effective public presentation skills, Audience analysis, Effective argumentation skills, Interview skills

Recommended books:

- Interpersonal Communication Paperback by Kory Floyd
- Reading into Writing 1: English for Academic Purposes: A Handbook-Workbook for College Freshman English (Mass Market Paperback) by Concepcion D. Dadufalza
- Lecture Notes/Presentations

4th Semester Courses

1- Clinical Medicine-I

2- Regional and Radiological Anatomy-II

3- Conventional Radiological Procedures & Clinical Practice

4- Radiological Positioning & Clinical Practice

5- Radiobiology & Radiation Protection

6- Computed & Digital Radiography (CR & DR)

PMS -234 **Clinical Medicine-I** **Credit Hours: 1+1**

Aims and Objectives

- To obtain from a patient an accurate focused or complete medical history based on the presenting complaint and appropriate to the clinical setting.
- To perform an accurate focused or complete physical examination appropriate to the clinical setting.
- To prioritize patients' problems, formulate appropriate differential diagnoses, and develop plans for diagnosis and management.
- To Prepare and maintain in an accepted format the medical record of the evaluation and care of inpatients and outpatients, including written or electronic entry of a complete history and physical examination, progress notes, procedure notes, clinic visit notes, physician's orders, and prescriptions for medications.

Course Contents

Diseases of Cardiovascular System Investigations of the cardiovascular disease, ECG, Heart Failure, Cardiac Arrest, Myocardial Ischemia & Infarction, Mitral, Aortic, Pulmonary & Tricuspid Valve disease, Persistent Ductus arteriosus, Coarctation of aorta, Arterial & Ventricular Septal defect, Tetralogy of fallot, Cardiac Tumors

Diseases of Respiratory System Investigations of the respiratory disease, the solitary radiographic pulmonary Lesion, Tuberculosis, X-Ray findings of common disease caused by organic & in organic dusts, Primary & Secondary tumors of the lungs, Tumors of Mediastinum, Diseases of the pleura, Deformities of the chest Wall

Diseases of the Kidneys & Urinary System Investigation of the renal disease, Cystic kidney Disease, Obstruction of the urinary tract, Urinary tract calculi & nephrocalcinosis, Tumors of the renal pelvis, Kidney, ureter & bladder, Prostatic disease, Testicular tumors

Endocrine Diseases Imaging investigation of endocrine disease, Hypothyroidism & Hyperthyroidism, Simple Goiter, Solitary thyroid nodule, malignant tumors

Practicals:

- Checking up patients
- Systematic Examination
- Radiological and Physical Investigations
- First Aid and
- Concept of Holistic Health

Recommended Books

- Davidson's Principles and Practice of Medicine, 21st edition
- Kumar and Clark's Clinical Medicine (Kumar, Kumar and Clark's Clinical Medicine), 8th edition
- Clinical Medicine by Parveen Kumar, Michalclark in by ELBS

PMS -235 **Regional and Radiological Anatomy-II** **Credit Hours: 2+1**

Aims and Objectives

- To Apply the knowledge of Regional & Radiological sectional anatomy to relate clinical procedures
- To provide quality patient care in routine as well as advanced imaging procedures.
- To Use digital imaging and information technology equipments competently, through application of the principal and theories of its operation.
- To implement an effective radiation protection program

Course Contents

The Upper Limb The Pectoral Region and Axilla, The Breasts, Bones of the Shoulder Girdle and arm, The Axilla, The Superficial Part of the Back and the Scapular Region**,** Bones of the Back**,** Muscles**,** Rotator Cuff**,** Nerves**,** Shoulder Joint**,** Sternoclavicular Joint**,** Acromioclavicular Joint**,** The Upper Arm**,** Bones Of the forearm**,** Bones Of the Hand**,** The Forearm**,** The region of the wrist**,** The Palm of the hand**,** Small Muscle of the hands**,** Blood, Nerve Supply of the Palm**,** The Dorsum of the hand
Joints of the Upper Limb, **Radiographic Appearance of the upper Limb**

The Lower Limb Basic Anatomy, Organization of the lower limb, The Gluteal region, The Front and medial Aspect of the Thigh, Fascial Compartments of the thigh, The Back of the thigh, Hip Joint Bones of the Leg Bones Of the foot, Popliteal fossa, Arteries, Nerves, The front of the Leg, The Back of the Leg, The Region of the Ankle, The Foot, Joints of the Lower Limb, Knee Joint, Ankle Join, tarsal Joint, Interphalegeal joint, **Radiographic Anatomy, Radiographic appearance of the Lower Limb**

Head and Neck Bones of the Skull, External Views of the Skull, Parts of the Brain, The Cranial Nerves in the Cranial Cavity, The Orbital Region, The Orbit, The eye, The Ear, The Mandible, The Scalp, The Face, The Neck, Veins of the Head and Neck, Cranial Nerves, The Salivary Glands, The Pharynx, The Esophagus, **Radiographic Anatomy**, **Radiographic Appearance of the Head and Neck**

The Back The Vertebral Column, Composition and Joints Of the Vertebral Column, Muscles of the Back, Deep Fascia of the Back, Spinal Cord, Cerebrospinal Fluid, **Radiographic Anatomy, Radiographic Appearance of Vertebral Column**

Practicals:

- Identification of the Structures of different organs on Radiographs
- Radiological Presentation & Pathological Findings on Radiographs

Recommended Books:

- Clinical anatomy for medical student by Richard S. Snell 5th edition by little brown Boston, New York, Toronto, London\
- Gray's Anatomy by Williams, Bannister 38 edition by Churchill living stone
- Atlas of radiological anatomy, Author: Weir Abrahams 2nd edition by Churchill living stone

PMS-236 **Conventional Radiological Procedures & Clinical Practice** **Credit Hours: 2+2**

Aims and Objectives:

- To describe the basics of the Radiological procedures and techniques.
- To describe its capabilities and limitations.
- To describe and explain what is required from the patient.
- To familiar with the indications for and complications of the examination/procedure.
- To describe the basic approach to interpret the results.
- To Understand key concepts including what produces density differences on radiographic images, radiographic Nomenclature for particular exams

Course Contents:

Techniques/Procedures 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

Practicals:

- Understanding, Performance and technical competencies of all the conventional radiological Procedures during clinical internship/attachment
- Radiation Protection Procedures

Recommended Books:

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

PMS -237 **Radiological Positioning & Clinical Practice** **Credit Hours: 2+2**

Aims and Objectives

- To demonstrate the principles of transferring, positioning and immobilizing patients.
- To select technical factors to produce quality diagnostic images with the lowest radiation Exposure possible
- To demonstrate competency in the principles of radiation protection standards
- To Critique images for appropriate anatomy, image quality and patient identification
- To Determine corrective measures to improve inadequate images

Course Detail:

Radiographic Positioning Techniques

Terminology, Nomenclature of Anatomy & Terms, Plans & positions, The Skull, The Para nasal Sinuses, The Upper Limb, The Lower Limb, The Shoulder, The Pelvis & Hip Joints, The Vertebral Column, Bones of Thorax, Skeletal System Survey, The Respiratory system & Heart, The Abdomen & Pelvic Cavity, Foreign Bodies, Bed Site Radiography, Soft tissue Radiography, Tomography, Macro radiology

Practicals:

- All standard views of Head & neck, Upper limb, Lower Limb, Abdomen, Pelvis and Patient Positioning
- Cassette and Bucky settings
- KVp, MAs (X-ray tube Settings)
- Radiation Protection (Aprons, Gloves, Methods to Reduce Occupational and Patient exposure)

Recommended Books:-

- CLARK'S Positioning in Radiography By Clark,12th edition
- Merrill's Atlas of Radiographic Positioning and Procedures,12th edition
- Positioning in Radiography by Eisenburg
- Textbook of Radiographic Positioning and Related Anatomy by Kenneth L.Bontrager

PMS-238 **Computed & Digital Radiography (CR&DR)** **Credit Hours: 1+1**

Aims and Objectives

- To describe several advantages of computed radiography over screen-film radiography
- To explain the operating characteristics of a computed radiography apparatus
- To identify five digital radiographic modes in addition to computed Radiography
- To explain the operating characteristics of a Digital radiography apparatus

Course contents

Computed Radiography Anatomy of a Computer, hardware, Processing Methods, Software, Computer Languages, The CR image receptor, Photostimulable Luminescence, Imaging Plate, Light Stimulation- Emission, The Computed Radiography reader, Optical Features, computer Control ,Imaging Characteristics, Image Receptor Response Functions, Image noise, Patient Characteristics, Radiation Dose, workload

Digital Radiography Scanned Projection Radiography, Charge-Coupled Device, Cesium Iodide/Charge Coupled Device, Cesium Iodide/Amorphous Silicon, Amorphous Selenium, Digital Mammography

Digital Fluoroscopy Digital Fluoroscopy Imaging System, Image Capture, Image Display,

The Digital Image Spatial Resolution, Contrast Resolution, Contrast Detail Curve, Patient Dose Considerations

Viewing the Digital Image Photometric Quantities, Hard copy, Soft copy, Active Matrix Liquid Crystal Display, Preprocessing the Digital Image, Post processing the Digital image

Digital Display Quality Control Performance Assessment Standards, Luminance Meter, digital Display Device Quality Control, Quality Control by the technologist, **Digital Image Artifacts**

Practicals:

- operating characteristics of a computed radiography (CR) apparatus (Uses of computers, Processing Methods)
- Radiation Protection
- operating characteristics of a Digital radiography (DR) apparatus ((Uses of computers, Processing Methods)

Recommended Books:

- Radiological science for technologists by Stewart C. Bushong 7th edition published by Mosby, Inc: A Harcourt health company
- Computed Digital Radiography in Clinical Practice by Reginald E. Greene, Jörg Wilhelm Oestmann

PMS -239 **Radiobiology and Radiation Protection** **Credit Hours: 1+1**

Aims and Objectives

- To minimize the health effects due to radiation
- To decrease in the personnel exposure rate
- To eliminate the conditions that can lead to accidents, or construction of more effective shielding systems
- To decrease public and occupational radiation exposure and knowledge about radiation hazard

Course Contents

Fundamental Principles of Radiobiology From Molecules to Humans, Human Biology, Law of Bergonie and Tribondeau ,Physical Factors Affecting Radio sensitivity, Biologic Factors Affecting Radio sensitivity, Radiation Dose-Response Relationships, Molecular and Cellular Radiobiology, Irradiation Of Macromolecules, Radiolysis of Water, Direct and Indirect Effect, Celol Survival Kinetics, LET, RBE, 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-Rays and Pregnancy, Design of Radiologic Imaging Facilities, Design Team, Departmental Activity, Location Of X-Ray Department, Plan Layout, Construction Consideration, Designing for Radiation Protection, Design of X-ray Apparatus, Design of Protective Barriers, Radiation Detection and Measurement, Radiation Protection Procedures, Occupational Exposure, Patient Dose, Reduction of Occupational exposure, Reduction of Unnecessary Patient Dose

Practicals:

- Restriction of exposure through the use of personal protective Equipment
- Proper use of personal protective equipment System
- Aprons, gloves and other shields against penetrating radiations
- Guide for choosing protective suits

Recommended books:-

- Radiologic Science for Technologists(Physics, Biology ,and Protection) by Stewart C. Bushong 10th edition
- Farr's Physics for Medical Imaging, 2nd Edition
- Radiation Protection and Dosimetry - An Introduction to Health Physics by Michael Stabin

5th Semester Courses

1. Computed Tomography (CT)
2. Mammography & Special Radiological Techniques
3. Magnetic Resonance Imaging (MRI)
4. General Surgery
5. Interventional Radiology
6. Clinical Medicine-II

PMS -313 **Computed Tomography (CT)** **Credit Hours: 2+2**

Aims and Objectives:

- To describe and understand the principles of operation of CT
- To relate the CT system components to their functions
- To describe the technique selection in CT
- To discuss the image quality as it relates to spatial resolution, contrast resolution, noise ,linearity, uniformity and patient dose

Course Contents:

Axial anatomy to understand CT images, Principles & Instruments of CT, Generations of CT, Principles of Operation, System Components, Image Characteristics & Reconstruction, Image Quality, Patient Care & Preparation, Whole body CT imaging (Axial), Multislice spiral CT imaging Principles, Assessment & Monitoring, IV Procedures, Contrast Agents, Radiation Safety, Clinical Application of CT, Artifacts, Bone Densitometry, Highlight different bone densitometry techniques, DEXA, Quality Control issues & Statistical Interpretation of results relevant to DEXA

Practicals:

- Principles of Operation (Software, image reconstruction, image quality , Film Processing, Hardware) of CT
- Correct Positioning of the Patient
- Contrast Method and Use (I.V & Oral)
- Operation at CT Console and Workstation

Recommended Books:

- Radiological science for technologists by Stewart C. Bushong 7th edition published by Mosby, Inc: A Harcourt health company
- Computed Tomography: Principles, Design, Artifacts, and Recent Advances, Second Edition (SPIE Press Monograph Vol. PM188) by Jiang Hsieh
- Computed Tomography by Willi A. Kalender

PMS -314 **Mammography & Special Radiological Techniques** **Credit Hours: 2+1**

Aims and Objectives

- To discuss the difference between soft tissue radiography and conventional radiography
- To describe the unique features of a mammographic imaging system
- To explain the differences between diagnostic and screening mammography
- To understand the knowledge of others special radiological techniques

Course Contents

Soft tissue radiography, Anatomy of the Breast, Basic Principles & Instruments of mammography, X-ray Apparatus, Image Receptors, Xeroradiographic Process, Positioning & Techniques, Special X-ray Imaging, Select plane film procedures, Screening and Diagnostic Mammography, Tomography, Steroradiography, Magnification radiography, Fluoroscopy, Visual Considerations, Practical Fluoroscopic Techniques, Image Intensification, Fluoroscopic Image Monitoring, Digital Imaging, Digital Fluoroscopy, PACS, Quality Control, Radiographic Systems, Special X-ray Systems, Photographic Procedures, Artifacts

Practicals:

- Handling with instruments of Mammographic Apparatus (X-Ray tube, Image Receptors)
- Exposure settings (KVp, MAs)
- Dark room (Film Processing, Loading, Unloading of Cassettes)
- Quality Control Procedures

Recommended books:

- Radiological science for technologists by Stewart C. Bushong 7th edition published by Mosby, Inc: A Harcourt health company
- Teaching Atlas of Mammography by Laszlo Tabar

PMS -315 **Magnetic Resonance Imaging (MRI)** **Credit Hours: 2+2**

Aims and Objectives

- To understand the basic knowledge of MRI, its operation and technical competencies required for a MR Technologist
- To evaluate the role of magnetic resonance imaging (MRI) as a non-invasive diagnostic tool
- To upgrade significantly improved MRI image quality and also enables faster scans to be performed, greatly reducing the procedure time for most patients
- To determine an individual's safety for MRI, a thorough safety screening process is performed on all patients prior to entering the MRI room
- To provide knowledge, understanding and training in routine and state-of-the-art MRI procedures applied to all organ systems

Course Contents

Fundamentals Overview, Electricity & magnetism, Nuclear Magnetism Equilibrium, Radio frequency ,pulse sequence, MRI parameters, How to measure Relaxation time,T1 and T2 Weighted images, Fourier Transformation, Imaging System , MRI Hard ware, Primary & Secondary MRI Magnets, Image Formation, Digital Imaging, Walk through Spatial Frequency Domain, MRI images, Spin Echo Imaging, Chemical Shift & Magnetization Transfer, Gradient Echo Imaging, Faster Imaging Techniques Applications, MR Contrast Media, Sequences & Artifacts

Practicals:

- Whole Body MR Scan Protocol (Uses of computer, MR Film Processing)
- Correct Positioning of the Patient
- Contrast Method and Use
- MR Safety
- Principles of Interpretation of Neuroimaging, Body Imaging (Anatomy, Pathological Findings)

Recommended books

- MRI Made Easy (for Beginners) by Govind B. Chavhan, Published by Jaypee Brothers Medical Publishers, New Delhi
- Handbook of MRI Technique by Catherine Westbrook
- Rad Tech's Guide to MRI: Basic Physics, Instrumentation, and Quality Control by William H. Faulkner Jr. (Author)

PMS-316 **General Surgery** **Credit Hours: 1+1**

Aims and Objectives

- To become familiar with the recognition, natural history, and general and specific treatment of those adult general surgical conditions
- To familiarize oneself with the pathophysiology of common general surgical conditions
- To take a relevant history and perform a physical exam concentrating on the relevant areas
- To arrive at an appropriate differential diagnosis and then to correlate with radiological investigations

Course Contents

Introduction to Surgery Importance of imaging in surgical conditions, Interventional Radiology,
Surgical Process Diagnostic Process,
Arterial Disorders Arterial Stenosis or Occlusion, Acute Arterial Occlusion, Arterial Dilatation, Aortic Aneurysm
Venous Disorders Venous Incompetence, Varicose Veins, Venous Thrombosis,
Musculoskeletal Disorders, Fractures of the Bones, Dislocation of Joints, Simple & Compound Fracture, Describing a dislocation or fracture, Complications of dislocation or fracture
The Cranium Head & Brain Injury, Hydrocephalus, Intracranial Tumors, SAH & Aneurysms,
The Breast Investigations, Benign breast disease, malignant tumors of the breast,
Diseases of Bones & Joints Acute Osteom yelitis, Tuberculosis arthritis & tenosynovitis, Tumors of the Bones & Joints, Spinal Deformity, Congenital Disorders
Diseases of the GIT Congenital abnormalities of the Esophagus, Foreign bodies in the Esophagus, Corrosive injury of esophagus, Rupture of Spleen, Aneurysm & Infarction, Splenomegaly & Splenectomy, Stones &Stricture in Bile duct, Malformations & Functional abnormalities of Small & Large Intestine, Vermiform Appendix, Anorectal Disorders,
Diseases of the Genito Urinary System Imaging investigations of the Genital tract, Congenital abnormalities of Kidneys & renal tract, Hydronephrosis, Renal & Ureteric & Bladder Calculi, Rupture of the Bladder, Urethral Stricture, Varicocele & Hydrocele, Neoplasm of the Genito Urinary System

Practicals:

- To become familiar with sterile techniques, tools, Equipments, preparing the patients and monitoring of Vital Signs
- Checking up patients, Systematic Examination, Radiological and Physical Investigations, First Aid

Recommended books

- Principles and practice of surgery: a surgical supplement to Davidson's Principles and practice of medicine A. P. M. Forrest, David Craig Carter
- Schwartz's Principles of Surgery, by Seymour I. Schwartz, Eighth Edition

PMS -317 **Interventional Radiology** **Credit Hours: 1+1**

Aims and Objectives

- To become familiar with the signs and symptoms of disorders amenable to diagnosis and/or treatment by percutaneous methods guided by radiologic imaging.
- To become familiar with the medical and surgical therapeutic alternatives of these disorders.
- To become familiar with the indications and contraindications for vascular and interventional radiologic procedures.
- To gain experience in performing preprocedural clinical evaluation of patients and providing post procedural follow-up care.
- To gain experience in performing and interpreting the spectrum of vascular and non-vascular interventional procedures.
- To gain exposure to new and evolving interventional procedures.
- To gain experience interpreting non-invasive evaluations of vascular diseases of the arterial and venous systems.

Course Contents

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

Practicals:

- 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:

- Advanced Radiographic and Angiographic Procedures: With an Introduction to Specialized Imaging. Patrick A. Apfel, Marianne Rita Tortorici. F A Davis Co., 2010
- Abrams' Angiography: Vascular and Interventional Radiology. Herbert L. Abrams (Editor), Stanley Baum (Editor) and Michael J. Pentecost (Editor) Little Brown and Co., 2005.

PMS -318 **Clinical Medicine-II** **Credit Hours: 1+1**

Aims and Objectives

- To obtain from a patient an accurate focused or complete medical history based on the presenting complaint and appropriate to the clinical setting.
- To perform an accurate focused or complete physical examination appropriate to the clinical setting.
- To prioritize patients' problems, formulate appropriate differential diagnoses, and develop plans for diagnosis and management.
- To Prepare and maintain in an accepted format the medical record of the evaluation and care of inpatients and outpatients, including written or electronic entry of a complete history and physical examination, progress notes, procedure notes, clinic visit notes, physician's orders, and prescriptions for medications.
- To communicate orally with other members of the health care team regarding the evaluation and care of a patient. This includes giving case presentations to ward teams, attending physicians, and consultants, and verbal instructions to ancillary health care personnel.

Course Contents

Diseases of the Alimentary Tract Investigation of gastrointestinal diseases, Dysphagia, Dyspepsia, Vomiting, GERD, Tumors & Perforation of the Esophagus, Peptic ulcer disease, Tumors of the Stomach, Pancreas & Small intestine

Diseases of the Liver & Biliary System Investigations, Portal Hypertension, Ascites, Hepatomegaly, Splenomegaly, Tumors of the Liver, Gall bladder & Bile duct, Liver Abscess, Hepatic Nodules, Gall Stones & Cholecystitis

Diseases Of the Joints & Bones Investigations, Low back pain, Neck pain, Joint pain, Osteoarthritis, Rheumatoid & Juvenile Idiopathic arthritis, Infective arthritis, Osteoporosis, Osteogenesis imperfect, Osteomalacia & Rickets, Paget's disease, Cancer associated bone disease

Diseases of the Nervous System Investigations, Disturbance of the visual system ,CVA Disorders of the spine & spinal cord, Meningitis, Intracranial neoplasm, Para neoplastic neurological disease, Hydrocephalus

Practicals:

1.Checking up patients
2.Systematic Examination
3.Radiological and Physical Investigations
4.First Aid and Concept of Holistic Health

Recommended books:

- Kumar and Clark's Clinical Medicine (Kumar, Kumar and Clark's Clinical Medicine), 8th edition
- Davidson's Principles and Practice of Medicine, 21st edition

6Th Semester courses

1. **Radiological & Cross sectional Anatomy**
2. **Computed Tomography (CT) Procedures & Clinical Practice**
3. **Magnetic Resonance Imaging (MRI) Procedures & Clinical Practice**
4. **Therapeutic Radiology**
5. **Biostatistics**
6. **Research Methodology**

PMS-319 **Radiological & Cross sectional Anatomy** **Credit Hours: 2+1**

Aims and Objectives

- To build upon students' knowledge of gross anatomy in order to enhance understanding of radiologic imaging, particularly radiographs and cross sectional imaging
- To understand the normal and abnormal findings on Computed Tomographic (CT) and M.R images while doing a scan and film processing
- To help students correlate anatomical structures encountered in the gross anatomy lab with their radiographic appearance
- To develop an appreciation for how the 3-D body is represented on a 2-D plain film image

Course Contents

Cranial CT (Computed Tomography) Axial, Coronal **Cranial MRI (Magnetic Resonance Imaging)** Axial, Sagittal, Coronal
Cranial MR Angiography Arterial, Venous
Neck Axial, Sagittal, Coronal
CT of the Thorax Axial
MRI of the Thorax Sagittal, coronal**, CT of the Heart, MRI of the Heart**
MR Angiography Aorta, Pulmonary Vessels
MR Mammography Axial
CT of the Abdomen Axia**l**
MRI of the Abdomen Sagittal, Coronal
MR Angiography Renal Artery, Portal Vein, MR Cholangiopancreatography
MR of the Male, Female Pelvis Axial, Sagittal, Coronal
MR Angiography of the Lower Extremity
Upper Extremity Arm (Axial), Shoulder (Coronal, Sagittal), Elbow (Coronal, Sagittal), Hand (Coronal, Sagittal)
Lower Extremity Leg (Axial), Hip (Coronal, Sagittal), knee (Coronal, Sagittal), Foot (Coronal, Sagittal)
Spine (Sagittal), **Cervical Spine (**Axial, Sagittal, Coronal), **Thoracic Spine** (Axial, Sagittal), **Lumbar Spine** (Axial, Coronal)

Practicals:

- cross sectional anatomy and anatomy pertaining to contrast studies on CT and M.R films
- integration to teaching about basic interpretation of CT and M.R examinations
- Audio/Video understandings

Recommended Books:

- Pocket Atlas of Sectional Anatomy (Computed Tomography and Magnetic Resonance Imaging) by T.B Moeller, E.Rief Volume I,II,II 3rd Edition
- Atlas of radiological anatomy, Author: Weir Abrahams 2nd edition by Churchill living stone

PMS-320 Computed Tomography (CT) Procedures & Clinical Practice Credit Hours: 2+1

Aims and Objectives

- To Develop and demonstrate knowledge and understanding of modified CT technique, anatomy and image interpretation and evaluation
- To Demonstrate an understanding of the principles of exposure selection and image processing, and an ability to apply this knowledge
- To Demonstrate knowledge of the use of contrast media (oral and intravenous)
- To Demonstrate knowledge and experience of the range of procedures undertaken in CT

Course Contents

All the Procedures consist of the following CT scan Protocol (Patient Preparation, Patient Position, Scan Parameters, and Slice Thickness, Slice incrementation, Field of View, I.V Contrast, Oral Contrast, and Window Settings)

Abdomen,Adrenals,Ankles,Aorta,Bladder,Brachial.Plexus,Brain,Chest,Contrast,GallBladder,Hips,Kidneys,Knees,Larynx,Limbs,Liver,Neck,Oesophagus,Orbits,Pancreas,Parathyroids,Pelvis,Pituitary,Shoulders,Spine,**CT Angiography, Pre and Post Contrast Scans**

Practicals:

- Understanding, Performance and technical competencies of all the Computed Tomographic (CT) Procedures during clinical internship/attachment
- Radiation Protection Procedures

Recommended Books:

- A guide to radiological procedure by Stephen Chapman & Richard Nakielny 3rd edition
- Rad Tech's Guide to CT: Imaging Procedures, Patient Care and Safety (Rad Tech Series) Deborah L. Durham

PMS-321 **Magnetic Resonance Imaging (MRI) Procedures & Clinical Practice** **Credit Hours: 2+1**

Aims and Objectives

- To get trained and experience in all aspects of MRI, including brain, neck, spine, cardiovascular, body, musculoskeletal and breast imaging
- To develop, under supervision, progressively independent skills in the performance and interpretation of magnetic resonance imaging studies
- To Demonstrate knowledge of the use of contrast media and range of procedures undertaken in MRI
- To Develop and demonstrate knowledge and understanding of modified MRI technique, anatomy and image interpretation and evaluation

Course Contents

MR Angiography, Perfusion Imaging, Diffusion Imaging, Cardiac MRI, Safety, Contrast Agents, Biological Effects, Managing MRI System, Theoretical & Practical Concepts, Parameters, Gated Respiratory/ Cardiac Compensatory Technique, Quality Control ,MRI Examination By Anatomical Regions, Head & Neck, Spine, Thorax including HEART, Abdomen, Pelvis, Upper Limb, Lower Limb, Joints ,Pediatric Imaging, Selective Radiological Pathology of Brain & Spine

Practicals:

- Understanding, Performance, technical competencies ,and Scan Protocol of all the MRI Procedures during clinical internship/attachment
- MR Safety

Recommended Books:

- MRI Made Easy (for Beginners) by Govind B. Chavhan, Published by Jaypee Brothers Medical Publishers, New Delhi
- Handbook of MRI Technique by Catherine Westbrook
- Rad Tech's Guide to MRI: Basic Physics, Instrumentation, and Quality Control by William H. Faulkner Jr. (Author)

PMS-322 **Therapeutic Radiology** **Credit Hours: 2+1**

Aims and Objectives

- To identify radiological anatomy and discuss optimal imaging for radiotherapy, from diagnosis to on-treatment verification.
- To Understand the principles of contouring and become proficient in contouring for radiotherapy
- To understand the manifestation of treatment-related side effects and their management.
- To understand the management processes and their application in oncology.

Course Contents

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,

Practicals:

- Accurate visual observations
- Laboratory studies, medication administration, and patient care activities
- Perform or assist with procedures, treatments, administration of medication, management and operation of diagnostic and therapeutic medical equipments

Recommended Books:

- Technical Basis of Radiation Therapy: Practical Clinical Applications (Medical Radiology / Radiation Oncology) Seymour H. Levitt, James A. Purdy
- Therapeutic radiology By Carl M. Mansfield Medical Examination Pub. Co., 1983

PMS-308 **Biostatistics** **Credit Hours: 2+1**

Aims and Objectives

The objectives of the group are to conduct: independent basic research, collaborative research, statistical consultations, statistical training to health professionals, serving on Hospital and research Centre committees that are responsible for evaluating research proposal, and reviewing the statistical quality of medical and scientific papers. Our areas of interest include, but are not limited to, survival analysis, design and analysis of clinical trials, group sequential clinical trials, multilevel modeling, statistical evaluation of medical screening tests, and application of statistical methods as well as development of novel methods for the analysis of microarray data.

Course Detail

Introduction of Statistics Statistical data, condensation of Data, Presentation of Data by Graphs, Health Related Data, Presentation of quantitative data

Sampling The concept of sampling, types and methods of sample, sample distribution, error of sampling, standard error, Chi square, T-Test, Z-Test

Selection of a sample Sample and population, Basic considerations in sampling, random sampling, stratified random sampling, cluster sampling, systematic sampling, determination of sample size, elimination of sampling bias

Central Tendency Concept, Mean, Median, Mode and their value in health, Percentiles, measure of dispersion, Coefficient of variation and skewness, normal distribution, range, standard deviation and relative deviation

Hypothesis Concepts of hypothesis testing, null and alternative hypothesis, two types of errors, acceptance and rejection Regions, Tow sided and one sided tests, general steps in hypothesis testing, test about means, confidence interval for mean

Instrumentation and Data Collection Types of tests and scales, validity and reliability of an instrument scales, assessment, development of tests/scales

Data Analysis and Interpretation Preparing data analysis, types of measurement scales, descriptive statistics, inferential statistics, using computer for data analysis

Introduction to research Quantitative vs. qualitative research, application of scientific method, positivistic vs. naturalistic paradigm

Classification of research Basic vs. applied research, evaluation research, research & development (R&D), action research

Preparation of a research report Steps/sequence, methods involved while preparing a research report

Recommended Books:

- A quide to research methodology, biostatistics and medical writing by college of physicians and surgeons Pakistan by WHO collaboration center
- Reading understanding multivanant statistics giimm LG Yard AD PR, publisher American Psychological association
- Ilyas Ansari's community medicine (Text Book) by Ilyas and Ansari 2003 published by Medical division Urdu Bazzar Karachi

PMS-310 **Research Methodology** **Credit hours: 2+1**

Aims and Objectives:

To introduce the significance of research methodology foundation, concept of measurement, design clinical research and health system research to the students.

Course contents:

Introduction to research (in simple term and a scientific term), concept of research, why do need research, advantage of research, identification of research need and its qualities, component of research, ethical and legal aspect of research and objective of research (definition, purpose, structure) Relevance, Avoidance of duplication, Physibility, Political acceptability, Applicability, Cost efficiencies, work plan, budget required for research work, literature searching, statistical help, material, type of manuscript, printing of manuscript for submission and postage, Principles and reliability of measurement, errors and sources of measurement, types of measurement, measure of disease frequency and screening (introduction, validity and screening test) Studies design (introduction, selection of design), research questionnaire, validity and reliability of research finding, confounding factors, strategies to deal with threats to validity, hypothesis testing, sampling, collect data, data collection procedure, step and data collection survey questionnaire, starting questionnaire

Recommended Books:

1. Foundation of Clinical Research by Portney LG Walkais MP in 1993, Publisher by Appleton and lauge USA
2. A guide to Research Methodology, Biostatistics and Medical writing by college of physicians and surgeons Pakistan by WHO collaboration center
3. Health system research project by Corlien M Varkerisser, Indra Pathmanathan, Ann Brownlee in 1993 by International Development Research Center in New Dehli, Singapore.

7^{Th} Semester Courses

1. Clinical Sonography
2. Angiography and Cardiac Imaging
3. Nuclear Medicine
4. Echocardiography
5. Electrocardiography(ECG)
6. Clinical Pathology & Radiological Presentation

PMS-411 **Clinical Sonography** **Credit Hours: 2+2**

Aims and Objectives

- To develop competent and professional ultrasonographers, who are proficient to enter the field of diagnostic medical ultrasound
- To provide students with intensive training in both the theoretical basis of medical ultrasound
- To provide basic understanding of ultrasound physics and technology, and the rudiments of cross-sectional anatomy, and is designed to help that background towards the practical business of working an ultrasound machine
- To provide students with the clinical understanding and knowledge of disease required to used these skills optimally in their future careers

Course Contents

Basic Physics for successful Scanning Sound wave propagation, The Pulse Echo Principle, Beam Angle to Interface, Tissue Acoustic Impedance, Absorption and Scatter, Transducer Frequency, Beam profile, Transducer Focal Zone

Instrumentation Types of Ultrasound Display (A-Mode, B-Mode, M-Mode, B-Scan, Real Time, B-Scan), Real Time Imaging, Transducers, Gel, Specialized Ultrasound Systems

Knobology Use of Knobs, Gain, Depth Gain Compensation (DGC), Log Compression, Preprocessing, Persistence, Post processing, Zoom, Write Zoom, The Video Invert, Transducer Selection, Calipers

Doppler and color flow Principle Doppler, The Doppler effect, Continuous Wave Doppler, Pulsed Doppler, Flow Direction, Flow Velocity, Low-Resistance versus High-Resistance, Flow Pattern within a vessel, Flow Distortion, Flow Volume, Aliasing, Color Flow Imaging, Color Flow Display and Direction within a vessel, Knobology of Doppler, Pitfalls

Basic Principles Terms relating to orientation, terms relating to Labeling, Scanning Techniques and choices, Patient Preparation, Patient-Sonographers Interaction, Sonographers-Sonologist Interaction

Practicals:

- Rule Out Pelvic Mass
- Pelvic Pain without Positive Pregnancy Test
- Intrauterine Contraceptive Devices
- Possible Fetal Anomalies
- Abnormal Fetal Heart
- Epigastric Pain
- Right upper Quadrant Mass/Pain
- Abnormal Liver Function
- Rule Out Abscesses

- Left Upper Quadrant Mass
- Possible Ascites
- Right Lower Quadrant Pain
- Renal Failure
- Possible Renal Mass
- Hematuria
- Benigin Prostatic Hypertrophy

Recommended Books:

- Clinical Sonography, A Practical Guide by Roger C.Sanders,3rd Edition
- Understanding Ultrasound Physics: Fundamentals and Exam Review by Sidney K. Edelman

PMS-412 **Angiography and Cardiac Imaging** **Credit Hours: 2+2**

Aims and Objectives

- To gain an understanding of coronary anatomy and hemodynamics and to acquire the technical skills required to gain venous and arterial access and to perform coronary angiography
- To review methodology of and indications for clinical applications of invasive cardiac and vascular imaging
- To become familiar with the current and potential future role of cardiac imaging for risk assessment, Scan protocol decision making and production of best image quality of imaging modalities used in cardiac imaging
- To refresh knowledge about clinical applications of CT and MR angiographic techniques for the pulmonary vasculature, the aorta and the peripheral arteries

Course Contents

Angiographic Equipment Angiographic Room, Generator, X-ray Tube, Cine Camera and Film, Filmless System
Intravascular Contrast High Osmolar Contrast Agents (HOCM), Low Osmolar Contrast Agents (LOCM)
Radiation in CATH. Lab Biological Effects of Radiation, Measuring Radiation Exposure, Reducing Radiation Exposure
Basic Techniques Percutaneous Needles & Guide wires, Catheter and their Selection, Patient Preparations, Local Anesthesia, Common Approaches for Catheter, Control of Puncture Site
Cardiac Catheterization General Description, Indications & Contraindications, Choice of Approach, Catheterization Protocol, Patient Preparation, Catheterization Facility
Hemodynamic Principles

A) **Pressure Measurements** Pressure Wave, Pressure Measuring Devices, Practical Pressure Transducer System, Physiologic Characteristics of Pressure Waveform, Zero Level, Balancing or Calibration, Micro manometers
B) **Blood Flow Measurement and Oximetry** Cardiac Output, Measurement of Vascular Resistance, Measurement of Qs and Qp, Valvular Resistance, Oximetry Run
C) **Electrocardiography** ECG Measuring Devices, ECG Leads, ECG Interpretation

Diagnostic Cardiac Catheterization in Infants and Children Catheterization Protocol, Sedation and Anesthesia, Equipment Used in Anesthesia, Catheterization Study and Vascular entry sites, Special Procedures
Complications of Cardiac Catheterization Special Complications, Cerebrovascular, Local Vascular, Cardiac perforations, Allergic and Anaphlactoid Reactions, Procedural Complications

Angiographic Techniques:
Coronary Angiography Coronary Anatomy, collaterals & Anatomic Variants, Indications, Catheter Selection, Needle and Wires, Femoral and Brachial Approach Injection Techniques, Angiographic Views, Side effects, Pitfalls Leading to Wrong Interpretation
Cardiac Ventriculography Choice of Catheter, Injection Site, Rate & Volume, Filming Projection and technique, Interventional Ventriculography, Complications and Hazards

Pulmonary Angiography Anatomy & Physiology, Indications & Contraindications, Technical Requirements, Catheter Selection, Contrast Media, Procedure, Filming, Angiographic Findings, Complications

Angiography of the Aorta & Peripheral Arteries Anatomy of Aorta & Peripheral Arteries, Peripheral Imaging Technique, Catheters & Guide wires, Contrast Agents, Vascular Access, Aortography, Subclavian & Vertebral Arteriography, Carotid Arteriography, Renal Arteriography, Pelvic & Lower Limb Arteriography

Interventional Techniques:

Coronary Angioplasty Basic Concept, Catheter & Guide wires, Indications, PTCA, Procedure and Complications

Coronary Atherectomy, Atheroablation & Thrombectomy Device Description, Procedures, Technique for Laser Angioplasty

Coronary Stenting Stent Design and Choice, Indications, Procedure, Complications

Balloon Valvuloplasty Indications and Contraindications, Technique, Complications, Percutaneous mitral Commissurotomy, Pulmonary Valvuloplasty, Aortic Valvuloplasty

Peripheral Intervention General Considerations, Indications, Equipment and Technique

Pediatric Intervention Balloon Dilatation Valvuloplasty, Percutaneous Balloon Angioplasty, Device Closure for ASD, VSD,VSD, PDA, Intravascular Stents, Coil embolization of Congenital and Acquired Thoracic Vessels

Practicals:

- Clinical Applications of Angiography
- Image Quality Control
- Clinical Management Practice
- Clinical Internship Angiography

Recommended Books:

- Grossman,s Cardiac Catheterization, Angiography, and Intervention by Donald S.Baim,7th Edition
- Abrams' Angiography: Interventional Radiology by Stanley Baum, M.D., Michael J. Pentecost

PMS-413 **Nuclear Medicine** **Credit Hours: 2+1**

Aims and Objectives

- To Value the comprehensive education and training in nuclear medicine, including the handling of radioactive materials and performance of diagnostic and therapeutic nuclear medicine procedures.
- To Understand the anatomy and the physiology necessary to perform and interpret gated studies, bone scans, hepatobiliary studies, ventilation and perfusion scans, and GI Bleeding studies
- To recognize the importance of obtaining all relevant information before interpretation or performance of exam, and be able to discuss the indications for the study.

Course Contents

Basic Review Atomic and Nuclear Structure, Binding energy, Ionization, Excitation, Artificial and Natural Radioactivity

Nuclides and Radioactive Process Nuclides and their classification, Radionuclide and stability, Alpha Decay, Beta Decay, Gamma Decay

Radioactivity Definition, Units, Dosage, **Law** of Decay, Half life, Exponential Decay

Production of Radionuclide Methods of Radionuclide Production (Reactor –Produced, Accelerator or Cyclotron Produced, Fission-Produced), Principles of a generator, Description Of a typical Generator

Radiation Detection and Instrumentation Basic Properties of radiation detectors and their common properties, Gas filled detectors and their applications, Scintillation detectors, Rectilinear Scanners, Non Imaging Probes, Scintillation Counters, Dose calibrator, Scintillation Camera,

Tomographic Imaging Techniques SPECT (Single Photon Emission Computed Tomography), PET (Positron Emission Tomography)

Quality Assurance Procedures Image Production & Display, Image Quality in nuclear Medicine, QA Procedures of instrumentation, Use of Computers in Nuclear Medicine-Principles & Applications to NM data acquisition, Processing & Display

Radiopharmaceuticals Technetium 99-m Labeled & other Radiopharmaceuticals, Therapeutic uses, QC & QA, Hot Laboratory and Dispensing Operations, Chemical Toxicity, Misadministration of Radiopharmaceuticals

Radiation Protection Radiation Quantities and Units, Radioactive Waste Disposal, Radiation Shielding & Transportation of Radioactive Materials, Health Physics instrumentation, Methods of safe handling of radionuclides and pertaining rules and regulations

Practicals:

- The Techniques and methods of major NM Diagnostic and Therapeutic applications
- Elution of Mo-Tc generator system
- Calculation of dose and Preparation of Radiopharmaceuticals
- Thyroid uptake Studies, Bone Scan, HIDA Scan, Renal Scan, Cardiac studies (Routine Operational Tests for SPECT)
- Quality Control tests for Gamma Camera, Quality Control of Radiopharmaceutical

Recommended Books:

- Nuclear Medicine Physics, The basics,by Ramesh Chandra, 6^{th} edition
- Nuclear Medicine Technology and Techniques by Donald R.Bernier,4^{th} Edition

PMS-414 **Echocardiography** **Credit Hours: 1+1**

Aims and Objectives

- To explain basic physical principles of ultrasound and instrumentation.
- To Correlate cardiac gross pathology with echocardiography images.
- To evaluate cardiac chamber size, left ventricular systolic and diastolic function and right ventricular systolic function.
- To Analyze and interpret echocardiographic derived hemodynamic data.
- To interpret transesophageal images and distinguish attributes and limitations versus transthoracic echocardiography

Course Contents

History of echocardiography, Development of various echocardiographic Technologies, Recording Echocardiograms, Cardiac Sonographers, Physics and Instrumentation, Physical Principles, Definition of Basic Terms**,** Principles of cardiac ultrasonography, Principles of ultrasound physics and instrumentation, The Doppler principles, The anatomical echocardiographic examinations (Basic Views), Examination and appearance of the normal heart, Quantification of the ventricular performance, Principles of the Doppler examination, Additional imaging formats and techniques, Contrast echocardiography, Artifacts

Practicals:

Clinical application of echocardiography in,

- Acquired valvular heart disease
- Evaluation of prosthetic heart valves
- Congenital heart disease Disease of the pericardium
- Cardiomyopathies
- Ischemic heart disease
- Diseases of the aorta
- Cardiac masses and tumors
- Pericarditis

Recommended Books:

- Feigunbaum's Echocardiography,6^{th} Edition
- Echo Made Easy, by Sam Kaddoura, 2^{nd} Edition

PMS-415 **Electrocardiography (ECG)** **Credit Hours: 1+1**

Aims and Objectives

- To Review of the heart anatomy and the cardiac cycle as they relate to the electrical conducting system
- To Prepare properly a subject for a 12-lead EKG
- To achieve technical competencies in recording and interpretation of Electrocardiogram and patient communication skills
- To understand a comprehensive analysis of the heart's propagation of an action potential, A comprehensive overview of EKG interpretation involving the recognition of the most common abnormalities

Course Contents:

Introduction to Electrocardiogram
Introduction to Heart Cardiac tissues and electricity Cardiac Action Potentials, 3-D Anatomy of the heart , Cardiac conduction system, Electrical events of the heart
ECG Recording Basics ECG recording systems, ECG electrode: correct placement, ECG electrodes, incorrect placement intrinsic problems with ECG systems,Artifacts
ECG Basic Leads The basics of ECG "leads", Frontal or Limb leads, Chest or Pericardial leads
Waves, VECTORS AND ECG AXIS, Normal and abnormal ECG interpretation

Practicals:

- Inspecting the ECG
- Identifying Waves and Intervals
- Effect of Lead Placement
- The Timing of the Heart Sounds
- Normal and abnormal ECG interpretation

Recommended Books:

- ECG Interpretation Cribsheets by G. Thomas Evans, Jr., M.D
- Marriott's Practical Electrocardiography by Galen Wagner 10th edition
- Malcolm S. Thaler's The Only EKG Book you'll ever need. (LWW, 4th Edition or 5th Edition)

PMS-416 **Clinical Pathology & Radiological Presentation** **Credit Hours: 1+1**

Aims and Objectives

- To become familiar with all of the imaging modalities used in Radiology, having knowledge of clinical Pathology with performing basic radiologic procedures
- To take increasing responsibility in designing patient examinations and in providing preliminary interpretations in consultation with the referring clinical staff
- To understand and take the responsibility for performing and interpreting procedures

Course Contents

(All the contents in this subject contains radiological presentation on X-rays, CT, MRI, and Ultrasound)

Introduction to Radiology, The Circulatory System (The Heart and Great Vessels), The Respiratory System, The Digestive System, The urinary Tract, The Acute Abdomen, The Reproductive System, The Musculoskeletal System, Neuroimaging, Pediatric Radiology

Practicals:

- Radiographs of Different systems of the body
- Audio/Video radiological presentation of pathology of different organs
- CT, MRI, Sonographic images interpretation

Recommended Books:

- Essential Radiology (Clinical Presentation. Pathophysiology. Imaging) Richard B. Gunderman 3rd Edition
- Radiology Secrets by E.Scott Pretorious,2nd Edition

8Th Semester Courses

1. Research Project
2. Medical Sociology
3. Patient Care & Management

PMS-406 **Research Project** **Credit Hours: 0+6**

Aims and Objectives

- The student will learn some basic research methodology, gain knowledge of the specific area of radiology being researched and have the opportunity for more extensive one-on-one interaction with a member of the radiological staff. It will hopefully result in some form of presentation or publication for the student. This is most suitable for students planning to enter radiology as a career

Course Contents

- Preparation and evaluation of Technical Comparative statement of specifications of Imaging modalities
  Students will select a modality item among the Medical Imaging modalities and prepare a comparative
  Statement of same modality manufactured by various manufacturers

- Comparison of two different Modalities for any specific investigation
  Students will select a topic under the guidance of their teacher to compare the investigation of two different modalities for the same human body system

  Example:
  (i) Renal function test of Nuclear Medicine and IVP
  (ii) Renal function test versus Ultrasound
  (iii) Angiocardiography versus Nuclear medicine Cardiac Investigation

- Students will prepare a comprehensive report on Medical Imaging investigation of any human body system

PMS-409 **Medical Sociology** **Credit Hours: 2+0**

Aims and Objectives

- To introduce social factors into medical explanation that was most strongly evidenced in branches of medicine closely related to the community
- To explore phenomena at the intersection of the social and clinical sciences
- To play a role in the modernization of the medical industry
- To serves as a forum for communication between medical teachers and those involved in general education

Course Contents

Elementary Sociology, Scope of Sociology, the Scientific Method, Scientific Observation, Sociology for Professionals, Importance of Sociology in Radiology,
Social Processes Sociology as Science, Cooperation, Competition, Conflict,
Human Society & Group, Definition of Group, Types of Groups, Importance of Group, Definition of Culture, Types of Culture
Human Behavior in Groups (Values & Norms), Definition of Social Norms, Types, Definition of Social Sanctions, Types, Importance of Social Norms & Sanctions
Social Institutions, Definition, General Functions, Family, Education & Health, Religion, Economics, Justice & Politics
Social Change (Modernization)Definition, Theories of social Change, Agents of Social Change, Factors of Social Change, Resistance to Social Change, Social Planning & Change
Social Mobility & Adaptation, Definition, Factors causing Social Mobility, Types of Social Mobility, Social Mobility & Society,
Medical Sociology, Defining Health, Social Ideas about Health & Social Behavior, Development of Medical Sociology, Health Care,
Epidemiology, Definition, Development of Epidemiology, Disease & Modernization,
Social Demography, Age, Gender & Race, Socio economic Status,
Stress & Social Behavior, Sociologist's Contribution, Stress, Social factors & Stress,
Health Behavior, Life Style & Health, Preventive Care Illness Behavior,
The Sick Role, Illness & Deviance, The functionalist approach to Deviance, The Sick Role, Criticism of Sick Role, Being Sick & Disable,
Hospital As Institution of Health, Development of Hospitals as Social Institutions, Hospitals in Pakistan, The Organization of General Hospitals, The Hospital- Patient Role, The Rising Cost of Hospitalization,

Recommended books

- The Medicalization of Society: On the Transformation of Human Conditions into Treatable Disorders by Peter Conrad
- Medical Sociology by William C. Cockerham

PMS-417 **Patient Care and Management** **Credit Hours: 2+0**

Aims and Objectives

- To establish and maintain effective communication and relationships with patients
- To perform a history and physical examination appropriate for age, gender, and clinical setting
- To demonstrate effective medical problem solving skills
- To demonstrate ongoing responsibility for the health care of patients

Course Contents

Patient communication, Medical Record, Safety, Transfer and Positioning, Management of patient with specific care problems, Evaluation and meeting needs of patients, Physical signs, Vital signs, Dealing with acute situations, Emergency Carts, Victim Assessment, Basic Life Support(BLS),First Aid, Sudden Illness, Special Situations, Bedside Radiography, Medications and their administration, Intravenous therapy, Contrast Media and their administration, handling the adverse situation of contrast media

Recommended Books:

- Critical Care Patient Transport, Principles & Practice, by Richard A.Paterson 5th Edition
- The Patient Safety Handbook by Barbara J. Youngberg (Author), Martin J. Hatlie