CURRICULUM FOR BSRADIOLOGY

INSTITUTE OF PARAMEDICAL SCIENCES

KHYBER MEDICAL UNIVERSITY PESHAWAR

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MHPE, MSc Ultrasound, BS(MIT)

CURRICULUM FOR BS RADIOLOGY

MISSION STATEMENT

The mission of the 4 years degree program in Radiology technology 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.To recruit and provide quality individuals with an ambitious, extensive education that equips them with knowledge, skills, and abilities to provide high quality, compassionate medical imaging.

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 YEARS 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		1course		12courses		23 courses	
Subject	Cr. Hr	Subject	Cr. Hr	Subject	Cr. hr	Subject	Cr. Hr
1. English-I	2+0	1- Bioethics	2+0	1. Human Physio-I	3+1	1-Regional and Radiological Anatomy-I	2+1
2. English-II	2+0			2. Human Physio-II	3+1		
3. Pakistan Studies	2+0			3. Medical MEDICAL BIOCHEMISTRY-I	3+1	2-Radiation Sciences and Technology	2+1
4. Islamic Studies	2+0			4. Medical MEDICAL BIOCHEMISTRY-II			2+1
5. Computer skills	1+1			5. Human Anatomy-I	3+1	3-General Radiology	2+1
6. Communication Skills	1+1			6. Human Anatomy-II			
7. Research Methodology	2+1			7-General Pharmacology	3+1	4-Regional and Radiological Anatomy-II	2+1
8. Biostatistics	2+1			8-General Pathology	2+1		2+2
				9-Clinical Medicine-I		5-Conventional Radiological Procedures & Clinical Practice	
				10-Clinical Medicine-II	2+1		2+2
				11- General Surgery			1+1
				12-Patient care and management	1+1	6-Radiological Positioning & Clinical Practice	
					1+1		2+2
					2+0		2+1

						7-Radiobiology &Radiation Protection	2+2
						8-Computed Tomography	1+1
						9- Mammography & Special	2+1
						Radiological Techniques	2+1
						10-Magnetic Resonance Imaging	2+1
						11-Computed & Digital Radiography	2+1
						12-Radiological & Cross sectional Anatomy	2+2 2+1
						13-Computed Tomography Procedures & Clinical Practice	1+1 1+1
						14-Magnetic Resonance Imaging Procedures & Clinical	1+1 0+6

						Practice 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.ResearchProject	
	16		**02**		**38**		**74**

SCHEME OF STUDIES FOR BS RADIOLOGY

Semester/Year	Name of Subject	Course Code	
	Medical MEDIC	PMS-601	

	ALBIOCHEMISTRY-I		
	Human Physio	PMS-602	

	logy-I		
	Human Anatomy-I	PMS-603	
	English-	PMS-604	

	I		
	Pakistan studies	PMS-605	
	Computer ski	PMS-606	1+1

	lls		
	Medical MEDICAL BIOCHEMI	PMS-607	

	STRY-III		
	Human Physiology-III	PMS-608	
	Hum	PMS	

	an Anatomy-II	-609	
	English-III	PMS-610	
	Islami	PMS-611	

	c s t u d i e s	1	
	R e g i o n a l a n d R a d i o	R A D - 6 0 1	

	logical Anatomy-I		
	General Radi	RAD-602	

	ology		
	Radiation Sciences and	RAD-603	

	Technology		
	General Pathology-I	PMS-612	

	Pharmacology-I	PMS-614	
	Communications	PMS-615	

	kills		
Fourth	Clinical Medicine-I	RAD-604	
	Reg	RAD	

	ional and Radiological Anatom	-605	

	y - I I		
	Conventional Radiological	RAD-606	

Procedures & Clinical Practi

	ce		
	Radiological Positioning	RAD-607	

	& Clinical Practice		
	Computed	RAD-608	

&

Digital

Radiography

(CR

&

DR

	)		
	Radiobiology & Radiation Prot	RAD-609	

	ection		
	Computed Tomography (	RAD-610	

	CT)		
	Mammography & Special Rad	RAD-611	

	iological Techniques		
	Magnetic	RAD-612	

	Resonance Imaging (MRI)		
	Gener	SUR-6	

	al Surgery	08	
	Interventional Rad	RAD-613	

	iology		
	Clinical Medicine-II	RAD-614	
	R	R	

	adiological & Cross sectional	AD-615	

	Anatomy		
	Computed Tomography	RAD-616	

(CT) Procedures & Clinical Pr

	actice		
	Magnetic Resonance Ima	RAD-617	

	g i n g (M R I) P r o c e d u r e s & C l i n i c a		

	l Practice		
	Therapeutic Radiol	RAD-618	

	ogy		
	Research Methodology	PMS-621	
	Biost	PMS-6	

	atistics	22	
	Clinical Sonograph	RAD-619	

	y		
	Angiography and Cardiac Imag	RAD-620	

	ing		
	Nuclear Medicine	RAD-621	
	Echocard	RAD-622	

	iography		
	Electrocardiography(	RAD-623	

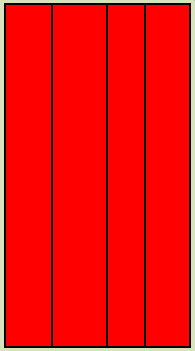
	ECG)		
	Clinical Pathology & Radi	RAD-624	

	ological Presentation		
	Patie	RAD-6	

	nt care & Management	25	
	Bioethics	PMS-625	

	RESEARCH PROJECT	PMS-626	
			130

LIST OF GENERAL COURSES (9 Courses)



Total credit hours= 130

HEC recommendation=124-136

Discipline Specific Courses (23 Courses)

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

Regional and Radiological Anatomy
Radiation Sciences and Technology
General Radiology
Regional and Radiological Anatomy
Conventional Radiological Procedures & Clinical Practice
Radiological Positioning & Clinical Practice
Radiobiology & Radiation Protection
Computed Tomography (CT)
Mammography & Special Radiological Techniques
Magnetic Resonance Imaging (MRI)
Computed & Digital Radiography (CR & DR)
Radiological & Cross sectional Anatomy
Computed Tomography (CT) Procedures & Clinical Practice
Magnetic Resonance Imaging (MRI) Procedures & Clinical Practice
Therapeutic Radiology
Clinical Sonography
Angiography and Cardiac Imaging
Nuclear Medicine
Echocardiography
Electrocardiography (ECG)
Clinical Pathology & Radiological Presentation
Interventional Radiology
Research Project

1st SEMESTER COURSES

Course CodeSubject Name	Credit Hours		
PMS-601		Medical MEDICAL	BIOCHEMISTRY-I
3+1			
PMS-602	Human Physiology-I		3+1
PMS-603	Human Anatomy-I		3+1
PMS-604	English-I	2+0	
PMS-605	Pak Studies	2+0	
PMS-606	Computer Skills		1+1
Total	18		

PMS-601 MedicalBiochemistry-ICredit Hours: 3+1

Course objectives:

After successful completion of this course, students will be able to,

- Describe the chemical composition, biochemical role, digestion and absorption of macro and micro molecules of the cell.
- Discuss different biochemical reactions in cell.
- Explain 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 -602 Human Physiology-ICredit Hours: 3+1

Course Objectives:

After successful completion of this course, students will be able to,

- Describe the basic concepts of physiology beginning from the cell organization to organ system function.
- Discuss the organization of cell, tissue, organ and system with respect to their functions.
- Explain 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 Tissues, 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. Blood cells count (RBCs, WBCs ,Platelets, Reticulocytes)

Recommended Books:

- Essentials of Medical Physiology K Sembulingam, PremaSembulingam 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 -603 Human Anatomy-I Credit Hours: 3+1

Course Objectives:

After successful completion of this course, students will be able to,

- Identify the principle structuresof tissues, organs and systems
- Discuss the different concepts and terms of general anatomy including skeleton and Musculo skeletal system.
- Explain the anatomy of Thorax, Abdomen and pelvis.

Course contents:

General Anatomy; Descriptive Anatomic terms, Basic structures, Musculo skeletal system(Axial and Appendicular), Different bones of the human body and their surface markings, General concepts, parts , classifications of bones, Structural, Regional and functional classification of joints,Characteristics, Classifications, Movements of synovial joints. Muscular System (skeletal, Cardiac, smooth)**Thoracic wall**: Structure of the anterior thoracic wall, Muscles of thorax, Diaphragm **Thoracic cavity**: Mediastinum, Trachea, lungs, pleura , bronchi, blood supply and lymphatics, Heart and thoracic vessels**Abdominal wall**: Skin, nerve and blood supply, Muscles of anterior abdominal wall, Inguinal canal**Abdominal cavity**: General Arrangement of the Abdominal Visceras, Peritoneum, Omenta, mesenteries, GIT and its blood supply, Accessory Organs(Liver, Spleen, Gall bladder,Pancreas), Genitourinary System (Kidneys, Utreters)**The pelvic wall**: Anterior, posterior wall, diaphragm. **Pelvic cavity**: Uterus, Ovaries, Fallopian tubes, urinary bladder, Male genital organs, Female genital organs, Muscles of pelvic region, blood supply, nerve supply.

Practicals:

1. Study Axial, Appendicular skeleton and musculoskeletal system on human skeletal models.
2. Study and identification of the anatomy of Thorax, Abdomen and Pelvis through:
3. Human Models 4. Video demonstrations

Recommended Books:

- Clinical Anatomy (By regions) 9th edition, Richard S. Snell
- Netter Atlas of human anatomy 5th Edition Saunders.
- Gray's Anatomy for students 2nd Edition Drake VogalMitcell.

PMS -604	English-I	Credit Hours: 2+0

Course Objective:

After successful completion of this course, students will be able to,

- Compose a well-constructed essay that develops a clearly defined claim of interpretation which is supported by close textual reading.
- Utilize literary terminology, critical methods, and various lenses of interpretation in their writing.
- Apply the rules of English grammar.
- Adhere to the formatting and documenting conventions of our discipline.

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 -605 Pakistan Studies Credit Hours: 2+0

Course Objectives:

After successful completion of this course, students will be able to,

- Develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.
- Inculcate patriotism in the hearts of students so that they may become a good citizen.

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

Recommended Books:

- Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
- Mehmood, Safdar. *Pakistan KayyunToota,* 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 -606	Computer Skills	Credit Course: 1+1

Course objectives:

After successful completion of this course, students will be able to,

- Use technology ethically, safely, securely, and legally.
- Identify and analyze computer hardware, software, and network components.
- Design basic business web pages using current HTML/CSS coding standards.
- Install, configure, and remove software and hardware.

Course Contents:

INTRODUCTION TO COMPUTER: I/O devices –memories, Networking – LAN,WAN,MAN (only basic ideas), TYPING TEXT IN MS WORD: Manipulating text, Formatting text - using different font sizes, bold, italics, Bullets and numbering, Pictures, file insertion, Aligning the text and justify, Choosing paper size - Adjusting margins, Header and footer, inserting page No s in a document, Printing a file with options, Using spell check and grammar, CREATING TABLE IN MS EXCEL: Cell editing-Using formulas and functions, Manipulating data with excel, PREPARING NEW SLIDES USING MS- POWER POINT: Inserting slides – Slide transition and animation, Using templates, Different text and font sizes –Slides with sounds – Inserting
clips arts, pictures, tables and graphs- Presenting using wizards, INTRODUCTION TO INTERNET Using search engine – Google search – Exploring the next using Internet Explorer and Navigator and Download of files and images – E-mail ID creation, Sending messages- Attaching files.

Practicals:

- Typing a text and aligning the text with different format using MS –Word
- Inserting a table with proper alignment and using MS-Word
- Create mail merge document using MS-Word to prepare greetings for 10 friends
- Preparing a Slide show with transition, animation and sound effect using MS-Power point
- Creating a worksheet using MS-Excel with data and use of functions
- Using MS-Excel prepare a worksheet with text, date time and data

- Preparing a chart and pie diagrams using MS-Excel
- Internet for searching, uploading files, downloading files and creating e-mail ID
- C language writing programs using functions

Recommended Books:

- CAMBRIDGE IGCSE® COMPUTER SCIENCE STUDY AND REVISION GUIDE (pb)2016
- Computer science by Muhammad Ashraf, edition 1st 2010

2nd SEMESTER COURSES

Course Code	Subject Name	Credit Hours
PMS-607	Medical Biochemistry-II	3+1
PMS-608	Human Physiology-II	3+1
PMS-609	Human Anatomy-II	3+1
PMS-610	English-II	2+0
PMS-611	Islamic Studies	2+0
Total	16	

PMS-607 MedicalBiochemistry-IICredit Hours: 3+1

Course Objectives:

After successful completion of this course, students will be able to,

- Describe the synthesis of proteins, lipids, nucleic acids, carbohydrates and their role in metabolic pathways along with their regulation
- Discuss the clinical role of enzymes in human being.
- Interpret and apply nutritional concepts to evaluate and improve the nutritional health of individuals with medical conditions.

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-608 Human Physiology-IICredit Hours: 3+1

Course Objectives:

After successful completion of this course, students will be able to,

- Demonstrate a systematic and coherent knowledge of the physiological functioning of the central nervous system, special senses (CNS & SS), cardiovascular system and respiratory system.
- Describe the formation of the formed element components of blood.
- Identify the components and function of the lymphatic system and discuss the role of the innate immune response against pathogens

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. Spirometry2. Electrocardiography
3. Blood Pressure Measurement4. Normal and abnormal ECG interpretation
5. Pulse rate measurement6. Heart sounds

Recommended Books

- Essentials of Medical Physiology K Sembulingam, PremaSembulingam Sixth Edition 2013
- Guyton And Hall Textbook Of Medical Physiology John E. Hall, Arthur C. Guyton Professor and Chair 2006

PMS-609 Human Anatomy-IICredit Hours: 3+1

Course Objectives:

After successful completion of this course, students will be able to,

- Identifybones of the upper limb and bony landmarks that articulate at each joint with all muscular compartments of the upper limb.
- Discuss bones of the lower limb and bony landmarks that articulate at each joint with all muscular compartments of the lower limb and identify these structures on radiographic images.
- Describe the topographical and functional anatomy of the head and neck, in particular the arrangement, relations and structure of the major skeletal, muscular and neurovascular components of the head and neck.

Course contents:

The upper limb Bones of shoulder girdle and Arm, Muscles, Axilla, Brachial plexus, Cubital fossa, the forearm, hand bones, Blood supply, Nerve supply, lymphatics**The lower limb** Fascia, Bones of the thigh, leg and foot, Muscles, Femoral triangle, Blood, Nerve, Lymphatic supply **Head and neck**Skull and facial bones, Cranial nerves, cranial cavity, Scalp, Meninges, Brain, Orbit, Muscles of the Neck, arterial and venous supply of the head and neck, The autonomic nervous system in the head and neck, Salivary Glands

Practicals:

Identification of the structures and the anatomy of Upper limb, Lower limb, Head and Neck through:

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

Recommended Books:

- Clinical Anatomy (By regions) 9th edition, Richard S. Snell
- Ross and Wilson Anatomy and Physiology in health and illness 11th Edition Waugh Grant.
- Netter Atlas of human anatomy 5th Edition Saunders.
- Gray's Anatomy for students 2nd Edition Drake VogalMitcell

PMS-610 English-IICredit Hours: 2+0

Course Objectives:

After successful completion of this course, students will be able to,

- Develop writing, reading and listening skills.
- Demonstrate integrative and independent thinking, originality, imagination, experimentation, problem solving, or risk taking in thought, expression, or intellectual engagement.
- Participate in discussions by listening to others' perspectives, asking productive questions, and articulating original ideas.

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 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 1986. ISBN 0 19 431350 6.

PMS-611 Islamic StudiesCredit Hours: 2+0

Course Objectives:

After successful completion of this course, students will be able to,

- Recognize basic concept of Islam (faith, pillars and systems etc.) and express their impact on society.
- Present Islam as complete code of life and demonstrate understanding of Islamic Ethics.
- Demonstrate the role of a medical professional in Islam.

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

Course Code	Subject Name	Credit Hours
RAD-601	Regional and Radiological Anatomy-I	2+1
RAD-602	General Radiology	2+1
RAD-603	Radiation Sciences and Technology	2+1
PMS-612	General Pathology-I	2+1
PMS-614	Pharmacology-I	2+1
PMS-615	Communication Skills	1+1
Total		18

RAD -601Regional and Radiological Anatomy-ICredit Hours: 2+1

Course Objectives:

After successful completion of this course, students will be able to,

- Apply the knowledge of Regional & Radiological sectional anatomy to relate clinical procedures
- 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.
- 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 ThoracicVein, Levatores Costarum, Serratus Posterior Superior Muscle, Serratus Posterior Inferior Muscle,DiaphragmRadiographic 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 of thorax

Abdominal Wall

Introduction to structure of the abdominal walls, Anterior and posterior abdominal wall muscles, Major arteries and veins, lymphatic supply, Inguinal Canal & its contents,, 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, Transversecolon, DescendingColon, Difference between the small & Large Intestine, Retroperitoneal Space, Ureter, Blood supply of abdominal organs, PortalVein,Lymphatics on

the posterior abdominal walls, LymphNodes, LymphVessels, Nerves on the posterior Abdominal Wall,LumbarPlexus, SympatheticTrunk (Abdominal Part), Aortic Plexus,Cross-Sectional Anatomy of the Abdomen, RadiographicAnatomy

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 ,Cross Sectional Anatomy of the Pelvis, Radiological Anatomy

Practicals:

- Identification of the Structures of different organs by skeleton and human models
- Radiological Presentation & Pathological Findings on Radiographs

Recommended Books:

- Clinical anatomy for medical student by Richard S Snell 9th 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

RAD -602General RadiologyCredit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able 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.
- Relate the knowledge of sectional anatomy to clinical procedures.
- Apply the principle of management, organization behavior, supervision, budgeting, human resourse management and labor relations in a medical imaging relation environment.

Course Contents

General Consideration of all imaging Modalities, Conventional and Digital Fluoroscopy Imaging SystemImage Capture, Image Display, Digital Subtraction Angiography (DSA)

Contrast Materials,Difference between Radiolucent & Radiopaque structures, Use of 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,

Radiographic Film

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

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

RAD -603Radiation Sciences & TechnologyCredit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Express a working knowledge of radiologic physics.
- Use X. Ray tube and equipments competently, through application of the principal and theories of its operation.
- Evaluate performance characteristics of equipments.
- Provide a base of knowledge from which practicing radiologic technologists can make informed decisions about technical factors, diagnostic image quality, and radiation management for both patients and personnel.

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, AtomicStructure, Atomic Nomenclature

Radioactivity Types of Ionizing Radiation, ElectromagneticRadiation, PhotonsEverywhere, Electromagnetic Spectrum,Radiologically Important Photons, Energy andMatter,Electromagnetism,Magnetism,Electricity and Magnetism, Energy Electrostatics,Electrodynamics,Electromagnetic Effects, ElectromagneticInduction, 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

Intensifying Screens Screen Construction, Luminescence, ScreenCharacteristics, 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, SubjectFactors, 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 -612General Pathology-ICredit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Specifythe abnormalities of cell growth and differentiation.
- Describe cellular responses to stress and noxious stimuli and inflammation.
- Discuss cell injury, cell death and mechanisms involved in wound healing.
- Explain the hemodynamic disorders and neoplasia.

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

- Blood culture
- Urine & stool examination
- Gram staining
- Neoplasia: Characteristics of malignancy
- Estimation of Bleeding, clotting, prothrombin time

Recommended Books

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

PMS -614Pharmacology-ICredit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Describe common terms related to pharmacology and drug therapy.
- Identify a range of drugs used in medicine and discuss their mechanisms of action.
- Report the clinical applications, side effects and toxicities of drugs used in medicine.

Course Contents:

Introduction to Pharmacology,Pharmacokinetics,Pharmacodynamics,Adverse effects of drugs, Classification of drugs, Drugs affecting the Autonomic Nervous System,NSAIDS, Opioids,Drugs Affecting Endocrine system (Corticosteroids, Thyroid and antiThyroid GastrointestinalDrugs (PPIs, Blockers and antacids) , Antihistamines, Anesthetics (General and Local Anesthetics)

Practicals:

- Routes of drug administration
- Introduction to drug dosage form
- Study of the action of drugs (Atropine) on the rabbit's eye

Recommended Books:

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

PMS-615Communication SkillsCredit hours: 1+1

Course Objectives

After successful completion of this 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 the interpersonal and organizational dynamics that affect effective communication in organizations.

Course Contents

Introduction to Communication, Meaning and definition of Communication,The process of communication,Models of communication

Effective Communications in Business, Importance and Benefits of effective communication, Components of Communication, Communication barriers, Non verbal communication

Principles of effective communication,Seven Cs.

Communication for academic purposes, Introduction to academic writing, Summarizing, paraphrasing and argumentation skills, Textual cohesion

Communication in Organizations, Formal communication networks in organizations, Informal communication networks, Computer-mediated communication (videoconferencing, internet, e-mail, Skype, groupware, etc)

Business Writing,Memos, Letters, Reports,Proposals, Circulars, etc

Public Speaking and Presentation skills, Effective public presentation skills, Audience analysis, Effective argumentation skills, Interview skills

Recommended books:

- Interpersonal CommunicationPaperback byKory 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

Course Code	Subject Name	Credit Hours
RAD-604	Clinical Medicine-I	1+1
RAD-605	Regional and Radiological Anatomy-II	2+1
RAD-606	Conventional Radiological Procedures & Clinical Practice	2+2
RAD-607	Radiological Positioning & Clinical Practice	2+2
RAD-608	Computed & Digital Radiography (CR & DR)	1+1
RAD-609	Radiobiology & Radiation Protection	1+1
Total		17

RAD -604Clinical Medicine-I Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Describe the general disorders and mechanisms of disease in different body systems.
- Discuss the common etiology, signs, symptoms and diagnostic tests to relate with radiological investigations.
- Explain indications of Imaging Procedures in selective Medical conditions.

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
- 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

RAD -605Regional and Radiological Anatomy-II Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Apply the knowledge of Regional & Radiological sectional anatomy to relate clinical procedures
- 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.

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 JointBones of the LegBones 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 joints,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 TheVertebral 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

RAD-606Conventional Radiological Procedures & Clinical Practice Credit Hours: 2+2

Course Objectives:

After successful completion of this course, students will be able to,

- Describe the fundamentals of different Radiological procedures and techniques.
- Recognize key concepts of density differences on radiographic images, radiographic Nomenclature for particular exams.
- Discuss the indications and complications of the examinations/procedures.

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, **RadiologicalPathology,** 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

RAD -607Radiological Positioning & Clinical PracticeCredit Hours: 2+2

Course Objectives

After successful completion of this course, students will be able to,

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

Course Contents:

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

RAD-608Computed & Digital Radiography (CR&DR) Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Describe several advantages of computed radiography over screen-film radiography.
- Discuss the operating characteristics of a computed radiography apparatus.
- Identify five digital radiographic modes in addition to computed Radiography.
- 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 FluoroscopyImaging 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

RAD -609Radiobiology and Radiation Protection Credit Hours: 1+1

CourseObjectives

After successful completion of this course, students will be able to,

- Describe the basics of ionizing radiation, biological effects and risks from cellular to human.
- Summarize acute and late effects from ionizing radiation.
- Explain the principles of radiation protection for both ionizing and non-ionizing radiation.
- Apply Radiation Protection Act and the relevant radiation protection regulations.

Course Contents

Fundamental Principles of Radiobiology From Molecules to Humans, HumanBiology, 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, HematologicEffects, CytogeneticEffects, Late effects of Radiation, Local Tissue effects, Life Span Shortening, Riskestimates, Radiation Induced Malignancy, Total Risk Of Malignancy, Radiation and Pregnancy

HealthPhysics, Cardinal Principles of Radiation Protection, Maximum Permissible Dose-Rays and Pregnancy, Design of Radiologic Imaging Facilities, DesignTeam, DepartmentalActivity, Location Of X-Ray Department, PlanLayout, ConstructionConsideration, Designing for Radiation Protection, Design of X-ray Apparatus, Design of Protective Barriers, Radiation Detection and Measurement, Radiation Protection Procedures, OccupationalExposure, PatientDose, 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 equipmentSystem
- Aprons, gloves and other shields against penetrating radiations

Recommended books:

- Radiologic Science for Technologists(Physics,Biology,and Protection) by Stewart C.Bushong10th edition
- Farr's Physics for Medical Imaging, 2nd Edition
- Radiation Protection and Dosimetry - An Introduction to Health Physics by Michael Stabin

5th SEMESTER COURSES

RAD-610	Computed Tomography (CT) 2+2
RAD-611	Mammography & Special Radiological Techniques 2+1
RAD-612	Magnetic Resonance Imaging (MRI) 2+2
SUR-608	General Surgery 1+1
RAD-613	Interventional Radiology 1+1
RAD-614	Clinical Medicine-II 1+1
Total	17

RAD -610 Computed Tomography (CT) Credit Hours: 2+2

Course Objectives:

After successful completion of this course, students will be able to,

- Describe the principles and operational definitions of CT
- Relate the CT system components to their functions
- Discuss the technique selection in different CT examinations
- Explain 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

RAD -611Mammography & Special Radiological Techniques Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Recognize the difference between soft tissue radiography and conventional radiography
- Describe the unique features of a mammographic imaging system
- Explain the diagnostic and screening mammographyand otherspecial radiological techniques

Course Contents

Soft tissue radiography,Anatomy of the Breast,Basic Principles & Instruments of mammography,X-ray Apparatus,Image Receptors,Positioning & Techniques,Special X-ray Imaging,Select plane film procedures, Screening and Diagnostic Mammography, Quality Control, Tomography,Steroradiography,Magnification radiography,Trauma Radiography, foreign bodies, Macroradiography, Skeletal Survey, Soft tissue, Forensic Radiography

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

RAD -612Magnetic Resonance Imaging (MRI) Credit Hours: 2+2

Course Objectives

After successful completion of this course, students will be able to,

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

Course Contents

FundamentalsOverview, Electricity&magnetism, Nuclear MagnetismEquilibrium, Radio frequency ,pulse sequence,MRI parameters, How to measure Relaxation time,T1 and T2 Weighted images, FourierTransformation, Imaging System,MRI Hard ware, Primary& Secondary MRI Magnets, ImageFormation, DigitalImaging, Walk through Spatial Frequency Domain,MRI images, Spin Echo Imaging, Chemical Shift & Magnetization Transfer, Gradient Echo Imaging, Faster Imaging TechniquesApplications, 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)

SUR-608General Surgery Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Recognizethe differential diagnosis with radiological investigations.
- Develop the clinical skills, professional attitudes, and knowledge base for the General Surgery through exposure to adult general surgical disorders.
- Appraise the medical management and basic foundations underlying the care of surgical patients.

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 Osteomyelitis,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:

- 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

RAD -613Interventional Radiology Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Identify the signs and symptoms of disorders amenable to diagnosis and/or treatment by percutaneous methods guided by radiologic imaging.
- Discussindications and contraindications for vascular and interventional radiologic procedures with the medical and surgical therapeutic alternatives for disorders.
- Explain pre-procedural clinical evaluation of patients and providing post procedural follow-up care.
- Interpret 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.

RAD -614Clinical Medicine-II **Credit Hours: 1+1**

Course Objectives

After successful completion of this course, students will be able to,

- Describe the general disorders and mechanisms of disease in different body systems.
- Discuss the common etiology, signs, symptoms and diagnostic tests to relate with radiological investigations.
- Explain Indications of Imaging Procedures in selective Medical conditions.

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:

- Checkinguppatients
- SystematicExamination
- RadiologicalandPhysicalInvestigations
- FirstAid 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

RAD-615	Radiological & Cross sectional Anatomy 2+1
RAD-616	Computed Tomography (CT) Procedures & Clinical Practice 2+1
RAD-617	Magnetic Resonance Imaging (MRI)Procedures & Clinical Practice 2+1
RAD-618	Therapeutic Radiology 2+1
PMS-621	Research Methodology2+1
PMS-622	Biostatistics2+1
Total	18

RAD-615Radiological & Cross sectional Anatomy Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Recall gross anatomy in order to enhance understanding of radiologic imaging particularly radiographs and cross sectional imaging.
- Explain the normal and abnormal findings on Computed Tomographic (CT) and M.R images while doing a scan and film processing.
- Relate anatomical structures with their radiographic appearance.

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 Axial

MRI of the Abdomen Sagittal, Coronal

MR Angiography Renal Artery, PortalVein, 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), CervicalSpine (Axial, Sagittal, Coronal), ThoracicSpine (Axial, Sagittal), LumbarSpine (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

RAD-616Computed Tomography (CT) Procedures & Clinical Practice Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Apply knowledge and understanding of modified CT techniques, anatomy and image interpretation.
- Demonstrate the principles of exposure selection, image processing, and use of contrast media (oral and intravenous).
- Examine the range of procedures undertaken in CT.

Course Contents

All the Procedures consist of the following CT scanProtocol (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

RAD-617 Magnetic Resonance Imaging (MRI) Procedures & Clinical PracticeCredit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Exercise all aspects of MRI, including brain, neck, spine, cardiovascular, musculoskeletal and breast imaging.
- Develop independent skills in the performance and interpretation of magnetic resonance imaging studies.
- Use of contrast media and range of procedures undertaken in MRI

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)

RAD-618Therapeutic Radiology Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Identify radiological anatomy and discuss optimal imaging for radiotherapy, from diagnosis to on-treatment verification.
- Discuss the principles of contouring and become proficient in contouring for radiotherapy.
- Illustrate the manifestation of treatment-related side effects and their management.
- Summarize the types of radiation therapy, 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 radiologyBy Carl M. Mansfield Medical Examination Pub. Co., 1983

PMS-621Research Methodology Credit hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Recognize the basic concepts of research and the research process.
- Develop understanding on various kinds of research, objectives of doing research, research designs and sampling.
- Conduct research work and formulating research synopsis and report.

Course contents

Introduction to research (in simple term and a scientific term), concept of research, why do need research, advantage and scope of research, identification of research needs and its qualities, Types of research; Qualitative, Quantitative and their sub types, Research process Introduction (Deciding, formulating research questions, planning, conduct of study, data collection, processing and analysis, Research writing and reporting), Literature review (What, why, where from, how and qualities of good literature and its use), Writing a research problem/question and selection of the title of study, Identification of various research variables, Hypothesis its types, formulation and testing of hypothesis, Research study designs used in qualitative and quantitative studies, Designing of data collection tools/questionnaires, Selection of appropriate sampling technique in various study designs, Concept of validity and reliability, Research proposal writing, Ethical principles of Research and their examples to apply those principles, Data collection and processing/displaying techniques, Writing of research report (Chapters in research report/thesis, Outline/Abstract of research, Referencing and Bibliography

Practicals

- Literature Search
- Survey conduct
- Citation and Referencing
- Proposal writing
- Data collection and displaying

Recommended Books

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

PMS-622Biostatistics Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- State the principal concepts about biostatistics; collect data relating to variable/variables.
- Examine and calculate descriptive statistics from collected data.
- Interpret data via binomial distribution and the concept of sampling.
- Apply hypothesis testing via some of the statistical distributions.

Course Contents

Introduction to Biostatistics and its types; Descriptive and inferential statistics, Measure of central tendency, Measure of dispersion, Statistical data, Presentation of Data by Graphs, Data and its types, Data collection tools, Data analysis tools Health Related Data, Presentation of quantitative data, The concept of sampling, types and methods of sample, sample distribution, error of sampling, Variable and its types, Tests used in biostatistics their use and interpretation(t-tests, Chi-square ANOVA, Regression and correlation) Hypothesis formulation and testing on the basis of statistics and statistical tests, Sample and population, Basic considerations in sampling, random sampling, stratified random sampling, cluster sampling, systematic sampling, determination of sample size, elimination of sampling bias, 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, Preparing data analysis by various software, Use of SPSS

Practicals

- Manual calculation related to measure of central tendency and measure of Dispersion
- Defining variables in SPSS
- Entry of data in SPSS
- Analysis of data in SPSS

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

7th SEMESTER COURSES

Course Code	Subject Name	Credit Hours
RAD-619	Clinical Sonography	2+2
RAD-620	Angiography and Cardiac Imaging	2+2
RAD-621	Nuclear Medicine	2+1
RAD-622	Echocardiography	1+1
RAD-623	Electrocardiography (ECG)	1+1
RAD-624	Clinical Pathology & Radiological Presentation	1+1
Total		17

RAD-619Clinical Sonography Credit Hours: 2+2

Course Objectives

After successful completion of this course, students will be able to,

- Develop competent and professional ultrasonography skills, for the proficient entry in the field of diagnostic medical ultrasound.
- Acquire intensive training on the theoretical basis of medical ultrasound.
- Relate ultrasound physics and technology, with the rudiments of cross-sectional anatomy, in practical business of working on an ultrasound machine.
- Demonstrate clinical understanding and knowledge of disease required to use 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

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

KnobologyUse 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

RAD-620Angiography and Cardiac Imaging Credit Hours: 2+2

Course Objectives

After successful completion of this course, students will be able to,

- Identify coronary anatomy and hemodynamicto acquire the technical skills required for venous and arterial access to facilitate coronary angiography.
- Review methodology and indications for clinical applications of invasive cardiac and vascular imaging.
- Determine 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.
- Summarize 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

RAD-621Nuclear Medicine Credit Hours: 2+1

Course Objectives

After successful completion of this course, students will be able to,

- Relate the comprehensive education and training in nuclear medicine, including the handling of radioactive materials and performance of diagnostic and therapeutic nuclear medicine procedures.
- Recall the anatomy and the physiology necessary to perform and interpret gated studies, bone scans, Hepatobiliary studies, ventilation and perfusion scans, and GI Bleeding studies
- 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 TechniquesSPECT (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

RadiopharmaceuticalsTechnetium 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

RAD-622Echocardiography Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Explain basic physical principles of ultrasound and instrumentation.
- Relate cardiac gross pathology with echocardiography images.
- Evaluate cardiac chamber size, left ventricular systolic and diastolic function and right ventricular systolic function.
- Analyze and interpret echocardiographic derived hemodynamic data.
- Distinguish the Transesophageal images 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,Principlesof 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,6th Edition
- Echo Made Easy, by Sam Kaddoura, 2nd Edition

RAD-623Electrocardiography (ECG) Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Review the heart anatomy and the cardiac cycle as they relate to the electrical conducting system
- Prepare properly a subject for a 12-lead EKG
- Acquire technical competencies in recording and interpretation of Electrocardiogram and patient communication skills
- Analyzethe 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 electricityCardiac Action Potentials,3-D Anatomy of the heart, Cardiac conduction system, Electrical events of the heart

ECG Recording BasicsECG recording systems, ECG electrode: correct placement, ECG electrodes, incorrect placementintrinsic 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)

RAD-624Clinical Pathology & Radiological Presentation Credit Hours: 1+1

Course Objectives

After successful completion of this course, students will be able to,

- Recall all of the imaging modalities used in Radiology, having knowledge of clinical Pathology with performing basic radiologic procedures
- Acquire increasing responsibility in designing patient examinations and in providing preliminary interpretations in consultation with the referring clinical staff
- Summarize the responsibility for performing and interpreting radiological procedures in different diseased organs and systems.

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

Course Code	Subject Name	Credit Hours
RAD-625	Patient Care & Management	2+0
PMS-625	Bioethics	2+0
PMS-626	Research Project	0+6
Total		10

RAD-625Patient Care and Management Credit Hours: 2+0

Course Objectives

After successful completion of this course, students will be able to,

- Establish and maintain effective communication and relationships with patients.
- Perform a history and physical examination appropriate for age, gender, and clinical setting.
- Demonstrate effective medical problem solving skills.
- Apply 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

PMS-625	Bioethics	Credit Hours: 2+0

Course Objectives

After successful completion of this course, students will be able to,

- Identify ethical issues in medicine, health care and life sciences.
- Describe rational justification for ethical decisions.
- Practice the ethical principles of the Universal Declaration on Bioethics and Human Rights.
- Recognize and distinguish an ethical issue from other issues.

Course Contents:

Introduction to bioethics, ethical principles, autonomy , informed consent, intentional non-disclosure , patient self- determination act, the health insurance portability and accountability act of 1996 (HIPAA) privacy and security rules, non-maleficence, slippery slope arguments, beneficence, paternalism, justice, social justice, the patient protection and affordable care act, professional patient relationship, unavoidable trust, human dignity , patient advocacy, moral suffering, ethical dilemmas.

Recommended Books:

- Introduction to bioethics and ethical decision making by Karen L. Rich (chapter 2) 2015

PMS-626	Research Project	Credit Hours: 0+6

Course 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