RKUNIVERSITY

SYLLABUS

Faculty of Medicine

Bachelor of Science in Medical Radiology and Imaging Technology (B.Sc. MRIT)

Semester –II

HUMAN ANATOMY AND PHYSIOLOGY PART - I

Course Title	**HUMAN ANATOMY AND PHYSIOLOGY PART - I**
Course Code	MRIT11
Course Credit	Lecture: 03
	Practical + Clinical Training: 02
	Total: 05

Course Objectives

The course provide the students understanding of the structure and relationships of the systems and organs of the body which is essential in patient preparation and positioning. The radiographic anatomy component will enable MRITs to evaluate images prior to reporting by the radiologist...

#	**Detailed Syllabus**	
	Section I	**Sessions**
1	Introduction to the body as a whole	4
2	The cells, tissues of the body	5
3	The cell: Structure, multiplication. **Practical:** Microscopic slides examination of elementary human cells.	6
4	Tissue: Types, structure, characteristics, functions **Practical:** Microscopic slides examination of elementary human tissues.	6
5	Epithelium Simple : Squamous, Cuboidal, columnar, ciliated Compound: Stratified, transitional Connective: Areolar, adipose, fibrous, elastic, Cartilage, blood and bone	10
6	Muscle: Striated (Voluntary), Smooth (Involuntary, Cardiac)	5
7	Nervous tissue	5
8	Fibrous tissue	5
9	Cell regeneration	5
10	Membranes: Mucous, Serous, Synovial	5
	SECTION-2	
11	Osteology (including whole Skelton, bones and joints) **Practical** : Study of Human Skeleton parts with skeletal models	5
12	Development of bone (ostogenesis) : Cells involved	4
13	Types and functions of bone, Types of joints and various movements	5
14	AXIAL Skelton: Skull : Cranium, face, air sinuses, Vertebral column: regions, movements and characteristics, Sternum, Ribs	08

15	Appendicular Skelton: Bones involving -Shoulder girdle and Upper limb, Pelvic girdle and lower limb	09
16	Healing of bones: cellular activity, Factors that delay healing, Diseases of bones and joints.	09
17	The Respiratory System: Organs: Position and structure, Nose and nasal cavities, Functions: respiratory, Olfactory, Pharynx, and Larynx: Functions - respiratory, vocal, Trachea, Bronchi, lungs: lobes, lobules, pleura, and respiratory functions: External and internal respiration, common terms relating to disease and conditions of the system. **Practica**l: Study with charts and models of all organ systems mentioned above.	16

Instruction Method

1. Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students
2. Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.
3. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval
4. The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.

Reference Books

1. Anatomy and Physiology for Radiographers- C.A. Werrick
2. Imaging Atlas of Human Anatomy – JamieWeir et all (Mosby-Elsevier)
3. An Atlas of Normal Radiographic Anatomy – Richard and Alwin.
4. Surface and Radiological Anatomy – Hamilton et al (Heffer)
5. An Atlas of normal radiographic Anatomy – Ross and Wilson

BASIC PHYSICS INCLUDING RADIOLOGICAL PHYSICS

Course Title	**BASICS PHYSICS INCLUDING RADIOLOGICAL PHYSICS**
Course Code	MRIT12
Course Credit	Lecture: 02
	Practical + Clinical Training: 03
	Total: 05

Course Objectives

The students will be able to appreciate the role of basic physics related to radiological instruments. The course has focus on basic physics as well as radiological basic physics on instrument organization & operating system.

#	Detailed Syllabus	Sessions
	Section I	
1	**Basic concepts** • Units and Measurements-Force, work, power and Energy-Temperature and heat-SI units of above parameters • Atomic structure-atom model-Nucleus-electronic configuration-periodic table-Isotopes-Ionization-excitation-Binding energy-electron volt Electromagnetic radiation-Quantum nature of radiation-mass energy equivalent	08
2	**Electricity and magnetism** • Electric charges • Coulomb's Law-Unit of Charge-Electric potential • Unit of Potential-Electric induction • Capacitance and Capacitors, Series and parallel connection • Electric current, unit, resistance, ohm's law • Electric power • Joule's law • Varying Currents-Growth and decay of current in LR circuit time constant • Charge and discharge of a Capacitor through a resistance and inductance • Oscillations in an LC circuit • Alternating currents: Peak and RMS values and current and voltage, circuit containing LR, CR and LCR-Power factor, series and parallel LCR circuits • DC circuit • Ohm's law, resistivity, series and parallel combination • EMF - Kirchhoff's law • Heating effect of current	14

3	**Electromagnetic waves** • Introduction • Maxwell's equation • Electromagnetic waves, energy density and intensity • Momentum • Electromagnetic spectrum and radiation in Atmosphere	08
4	**Sound** • The nature and propagation of sound wave (the characteristics of sound, wave theory), speed of sound in a material medium, intensity of sound, the decibel, Interference of sound waves, beats, diffraction • Doppler's effect, Ultrasonic wave, production of ultrasonic waves (piezo-electric effect) in ultrasonography. • Use of principle of Doppler's effect in Diagnostic Radiology (e.g. Echo, blood flow measurement)	10
5	**Heat** • Definition of heat • Temperature • Heat capacity • Specific heat capacity • Heat transfer-conduction, convection, radiation, thermal conductivity • Equation for thermal conductivity (k) • The value of k of various material of interest in radiology • Thermal expansion • Newton's law of cooling • Heat radiation • perfect black body • Stefan law • Application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes)	14
6	**Electronics** • Semiconductors; Conduction in crystals, Energy bands. Intrinsic and Extrinsic semiconductors n-type and p-type semiconductors, majority and minority carriers • Semiconductor diodes: p-n junction-properties forward and reverse bias, characteristics of p-n junction Rectifiers-Half-wave and full wave, ripple factor, Efficiency of HW and FW rectifiers. Filter circuits; Zener diode, regulated power supply • Transistors-Symbols, Transistor connections and characteristics, Transistor as an amplifier, load line analysis, operating point, types of amplifiers-voltage and power amplifiers. Feedback-negative feedback in amplifiers	10

SECTION-2		
Basic Radiological Physics		
a	**X-rays** • Discovery of x-rays • X-ray production and properties • Bremsstrahlung Radiations-Characteristics X-Rays • Factors affecting X-ray emission spectra • X-ray quality and quantity • HVL measurements, heel effect • Soft and hard X-Rays • Added and inherent filtration • Reflection and transmission targets	08
b	• Interaction of ionizing radiation with Matter-Types of interactions of X- and gamma radiation • Photoelectric & Compton • Pair production, annihilation radiation.	04
c	I**nteraction of X and gamma rays** • Transmission through matter • law of exponential attenuation • Half value layer and linear attenuation coefficient-coherent Scattering-photonuclear Disintegration-Particle interactions • Interactions of X rays and Gamma rays in the body • Fat-soft tissue-bone-contrast media-total attenuation coefficient relative clinical importance.	04
d	Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.	02
e	• Radiation intensity and exposure • Photon flux and energy flux density	02
f	LET, range of energy relationship for alpha, beta particles with X-Rays	02

g	**X-ray tube** • Historical aspects • Construction of X-ray tubes • Requirements for X-ray production (Electron source, target and anode material) • Tube voltage, current, space charge • Early X-ray tubes (Coolidge tubes, tube envelop and housing) cathode assembly • X-ray production efficiency • Advances in X-ray tubes • Anode angulation and rotating tubes-line focus principle-space charge effect • Tube cooling • Modern X-Ray tubes • Stationary anode • Rotating anode • Grid controlled X-ray tubes • Heel effect • Off focus radiation • Tube insert and housing-Tube rating-Quality and intensity of x-rays-factors influencing them.	12
h	• Grid controlled and high speed tubes • Focal spot size • Speed of anode rotation • Target angle • Inherent filtration • Radiation leakage and scattered radiation) • Interlocking and X-ray tube overload protection	04
i	• Heat dissipation methods • Tube rating • Heat units • Operating conditions and maintenance and Q.A procedures	02
j	• Filament current and voltage • X-ray circuits (primary circuit, auto transformer) • Types of exposure switch and timers • Principle of automatic exposure control (AEC) and practical operation • Filament circuit • High voltage circuits • Half wave, full wave rectification • Three phase circuits	08

	• Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators • Capacitors discharge and grid control systems	
k	**X-ray generator circuits** • Vacuum tube diodes • Semi-conductor diodes • Transistor • Rectification • Half and full wave-self Rectification-X-ray generator • Filament circuit-kilo Voltage circuit • Single phase generator • Three phase generator • Constant potential Generator • Fuses - Switches and interlocks • Exposure switching and timers • HT cables • Earthing.	06
l	• Physical quantity, its unit and measurement • Fundamental and derived quantity • SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit (HZ)	02
m	**Radiation quantities and units** • Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose-electronic equilibrium-rad, gray, conversion factor for roentgen to rad-quality factor-dose equivalent-rem, Sievert • Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose	04
n	**Radiation detection and measurements:** • Principle of radiation Detection-Basic principles of ionization chambers • proportional counters • G.M counters and scintillation detectors • Measuring system: free ionization chamber-thimble ion chamber-condenser chamber-secondary standard dosimeter-film dosimeter-chemical dosimeter-Thermo Luminescent Dosimeter-Pocket dosimeter	04

Instruction Method
1. Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students 2. Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc. 3. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval 4. The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.
Reference Books
1. Physics for Radiography - Hay and Hughs 2. Ball and mores essential physics radiographers, IV edition, Blackwell publishing. 3. Basic Medical Radiation physics – Stanton. 4. Christensen's Physics of Diagnostic Radiology – Christensen

CONVENTIONAL RADIOGRAPHY AND EQUIPMENT

Course Title	CONVENTIONAL RADIOGRAPHY AND EQUIPMENT
Course Code	MRIT13
Course Credit	Lecture: 02
	Practical + Clinical Training: 02
	Total: 04

Course Objectives

STUDENTS LEARN ABOUT BASIC RADIOGRAPHIC INSTRUMENTATION, PRODUCTION AND TECHNIQUES

#	Detailed Syllabus	Sessions
	SECTION I	
1	**PRODUCTION OF X-RAYS**: X-ray tube • Gas filled x-ray tube, construction working and limitations • Stationary anode, x - ray tube construction, working, methods of cooling the anode, rating chart and cooling chart • Rotating anode x - ray tube: construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect • Grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum	14
2	**HIGH TENSION CIRCUITS** • H.T. generator for x-ray machines • Three phase rectifier circuits • Three phase six rectifier circuit • Three phase 12 rectifier circuit, high and medium frequency circuits • Capacitance filter control and stabilizing equipment • Mains voltage compensator • Mains resistance compensator • Compensation for frequency variation • Control of tube voltage, kV compensator • High tension selector switch, filament circuit, control of tube current, space charge compensation	14
3	**METERS AND EXPOSURE TIMERS** • Moving coil galvanometer: construction and working/conversion to millimeter, ammeter and voltmeter, meters commonly used in diagnostic x-ray machines, pre reading kV meter and millimeter, digital panel meters • Clockwork timers, synchronous motor timer, electronic timers, photo	10

	metric timers (fluorescent and photoelectric effect as applied in timers), ion chamber based timers, integrated timer	
4	**INTERLOCKING CIRCUITS** • Relays: description and working, use of relays in diagnostic machines for over load protection, circuit diagram • Simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays	10
	SECTION II	
5	**CONTROL OF SCATTERED RADIATION** • Beam limiting devices: • Cones • Diaphragms • Light beam collimator • Beam centering device • Methods to verify beam centering and field alignment • Grids • Design and control of scattered radiation • Grid ratio • Grid cut-off, parallel grid • Focused grid • Crossed grid • Grided cassettes • Stationary and moving grid potter bucky diaphragms • Various types of grid movements • Single stroke movement • Oscillatory movement and reciprocatory movement	12
6	**Fluoroscopy:** • Fluorescence and phosphorescence – description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation • Image intensifier - construction and working, advantages over fluoroscopic device, principles and methods of visualizing intensified image, basic principles of closed circuit television camera and picture tube • Vidicon camera, ccd. Automatic brightness control, automatic exposure control, chamber selection during fluoroscopy. • Serial radiography: manual cassette changer, rapid automatic film changer, basic principles of cine fluoroscopy and angiography use of grid controlled x-ray tube	24

7	**Care and Maintenance of X-ray equipment**; • General care; functional tests • Testing the performance of exposure timers • Assessing the MA settings • Testing the available KV • Measurement of focal spot of an x-ray tube • Testing the light beam diaphragm, practical precautions pertaining to Brakes and locks • H.T. cables • Meters and controls • Tube stands and tracks as well as accessory equipment	12

Instruction Method

1. Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students
2. Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.
3. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval

Reference Books

1. X-Ray Equipment Maintenance and Repairs Workbook for Radiographers and Radiological Technologists Produced by the WHO Dept. of Essential Health Technology Series. Ian R. McClelland, Publisher- WHO, 2004.
2. Quality Assurance Workbook for Radiographers & Radiologic Technologists,Peter J. Lloyd Nons erial Publication WHO

RADIOGRAPHIC AND IMAGE PROCESSING TECHNIQUES

Course Title	RADIOGRAPHIC AND IMAGE PROCESSING TECHNIQUES
Course Code	MRIT14
Course Credit	Lecture: 02
	Practical + Clinical Training: 03
	Total: 05

Course Objectives

This course introduces Appreciation and application of all the factors will enable the student/technologist to produce X-ray films of good quality and diagnostic value. The lectures to be linked with practical demonstration to illustrate the importance of all that goes to make up correct exposure conditions.

#	Detailed Syllabus	Sessions
	Section I	
1	**Radiographic Film** • Structure of film emulsion-film characteristics (speed, base + fog, gamma, latitude)-effect of grain size on film response to exposure, interpretation of characteristics curve-Grain technology-Gelatin-Basic film types-Film formats and packing-Direct exposure duplitised films-Single coated emulsions-Films for specialized use-manufacturing process. Structure, properties of different parts, handling, film wrappings. Handling of exposed and unexposed films. Types, applications, advantages/limitations of different types, safe light requirements	14
2	**Sensitometer** • Photographic density-characteristic curve-information from the characteristic curve-speed Vs definition • Storage of X-ray film	06
3	**Control of scattered radiation** • Methods of minimizing formation of scatter radiation, effectiveness of grids-grid ratio-preventing scattered radiation, use of cones, diaphragm light beam devices and effectiveness of collimation in reducing effects of scatter • Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure	12
4	**Intensifying screens** • Structure and functions, common phosphors used-types, screen mounting, care and maintenance of film screen contact • Intensifying factor-speed and detail- crossover effect-resolution-mottle-reciprocity-screen asymmetry-cleaning • New phosphor technology-influence of kilo voltage • Photo-stimulable phosphor Imaging	12

5	**Cassettes** • Structure and function-Types-single, gridded, film holder-Design features and consideration with loading/unloading-Care and maintenance (cleaning)	08
6	**Photochemistry** • Principles: Acidity, alkalinity, pH, the processing cycle, development, developer solution • Fixing, fixer solution, washing, drying replenishment, checking and adjusting-latent image formation--nature of development-constitution of developer-development time-factors in the use of developer • Fixers-constitution of fixing solution-factors affecting the fixer-replenishment of fixer-silver Conservation-Drying-developer and fixer for automatic film processor-rinsing-washing and drying • Replenishment rates in manual and automatic Processing-Silver Recovery-Auto and manual chemicals	12
	SECTION II	
7	**Processing** • manual processing-care of processing equipment-automatic processor-manual VS automatic processing-principles and typical equipment Microprocessor controlled-Cine processing-Daylight systems-Processing faults-maintenance.	12
8	**Automatic Film Processor**. a) Functions of various components. b) Film roller transport-transport time, film feed system. c) Importance and relation to temp, fixed and variable time cycles. d) Care and maintenance (cleaning routine and methods of cleaning).	12
9	Radiographic image-components of image quality-unsharpness in radiographic image-contrast of the radiographic image-distinctness of the radiographic image-size, shape and spatial relationships.	10
10	**Factors affecting Image Quality** • Meaning of radiographic image contrast, density, resolution, sharpness, magnification and distortion of image, noise and blur • Radiographic illuminators and viewing conditions, visual acuity and resolution	10
11	Presentation of radiographs-opaque letters and markers-Identification of dental films-preparation of stereo radiographs-viewing conditions	10

12	Monitor images-Characteristics of the video image-television camera-imaging camera. Laser-light and laser-laser imaging-laser imagers-imaging plates-Dry cameras.	10

Instruction Method

1. Teaching and training sessions will be carried out through active learning. Active participation and contribution in group discussion and seminars are mandatory for students
2. Lectures to be conducted with the help of black board and/or audio-visual aids that includes multi-media projector, OHP, etc.
3. Problem based and/or case based assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
4. The course includes a laboratory where the students have an opportunity to build and appreciation for the concepts being taught in lectures.
5. Instruction method will be integrated with clinical training, bedside / class room teaching and tutorials as necessary.

Reference Books

1) Radiographic latent image processing – W. E. J Mckinney
2) Diagnostic Radiography – Aoncise practical Manual – Glenda J. Bryan (4th edn),Churchill Livingstone.
3) Text book of radiology for residents & technicians – 4th edition, Satish K. Bhargave Radiological patient care – Jensen Chesney.
4) Atlas of dental and maxillofacial radiological imaging – Brownie

ENGLISH AND COMMUNICATION SKILLS

Course Title	**ENGLISH AND COMMUNICATION SKILLS**
Course Code	MRIT15
Course Credit	Lecture: 02
	Practical: 0
	Total: 02

Course Learning Outcomes.

to speak and write proper English ,
to read and understand English
to understand and practice medical terminology

Detailed Syllabus

	Section – I	Sessions
1	Letter writing	8
2	Note making	8
	Section II	
3	Essay writing	8
4	Report writing,	8

Instructional Method:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.