

Faculty of Medicine

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

Semester – III

Human Anatomy and Physiology Including Pathology Part - II

Course Title	Human Anatomy and Physiology Including Pathology Part - II
Course Code	MRIT16
Course Credit	Lecture: 03
	Practical: 02
	Clinical Training: 00
	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.
- Introduction to system and cavities of the body.

#	Detailed Syllabus	Sessions
Section I		
1	Heart and blood vessels (Circulatory system): Diseases of blood vessels and heart and conditions of the system <ol style="list-style-type: none"> Blood vessels: arteries, veins, capillaries, sinusoids, structure and functions Heart: Position, structure and functions Circulation of blood: pulmonary, systemic, portal, main blood vessels, their origins and distribution. 	6
2	The Lymphatic system: Diseases and conditions of the system. <ol style="list-style-type: none"> The parts of the lymphatic system. Lymph channels: Capillaries, vessels, ducts structure and functions Lymph nodes: position, structure and functions Lymphatic tissues: tonsils, adenoids, intestinal nodules Spleen: position, structure and functions 	5
3	The digestive system: Diseases and conditions of the system <ol style="list-style-type: none"> Elementary tract structure: Mouth, pharynx, salivary glands, oesophagus, stomach, liver, gall bladder, small intestine, large intestine: Position, structure and functions of these organs. <ol style="list-style-type: none"> Digestion and absorption, Metabolism of carbohydrates. Proteins and fats.. 	6
4	The Urinary System: Diseases and conditions of the system <ol style="list-style-type: none"> Parts of urinary system Position, structure and functions Kidneys, ureters, urinary bladder and urethra Formation and composition of urine Water and electrolyte balance 	6

5	<p>The reproductive system: Diseases of female and male reproductive system.</p> <p>a. Female reproductive system:</p> <ul style="list-style-type: none"> • External genitalia: positions and structures and functions. • Perineum. • Internal organs: positions and structures. • Vagina, uterus, uterine tubes, ovaries. • Menstrual cycle" stages, hormone control, ovulation. • Breasts (Mammary glands) • Changes: puberty, in pregnancy, during lactation. <p>b. Male reproductive system:</p> <ul style="list-style-type: none"> • Scrotum, testis, epididymis: positions. • Spermatogenesis, • Spermatic Cords, seminal vesicles, • Ejaculatory ducts: position, structure & functions • Prostate gland: position • Functions of male reproductive system, puberty 	6
6	<p>The Endocrine system:</p> <ol style="list-style-type: none"> a. Endocrine glands: b. Pituitary and hypothalamus: Position & structure c. Thyroid gland, parathyroid glands d. Adrenal (supra renal) glands e. Pancreases: Position, types of cells f. Hormones: secretion, function and control, pineal gland g. Common terms and diseases related to the system 	6
7	<p>The organs of sense:</p> <ol style="list-style-type: none"> a. Hearing and the ear: b. External, middle and inner ear c. Physiology of hearing and diseases of ear. d. Sight and the eye: position, structure, sclera, cornea, choroid, ciliary body. e. Iris, lens, retina, optic nerves f. Physiology of sight and diseases of the eye. 	5
8	<p>Sense of smell:</p> <ol style="list-style-type: none"> a. Olfactory nerves, origins, distribution b. Physiology of smell c. Sense of taste : tongue 	4
9	<p>The nervous system: Common diseases of the system.</p> <ol style="list-style-type: none"> a. Neurons: Structure, types and properties b. Central nervous system: neurons, neuralgia meninges. c. Ventricles of brain, CSF d. Brain, spinal cord: structures, functions, peripheral nervous system. e. Spinal and cranial nerves: origin distribution and functions. f. Automatic nervous system 	6

	g. Sympathetic and para sympathetic: origin distribution and function.	
10	The Skin: a. Structure of skin b. Epidermis, dermis c. Functions of skin d. Hypothermia e. Wound healing: primary and secondary diseases of skin	4
11	Cross-sectional anatomy related to Ultrasound, CT and MRI techniques.	2
SECTION-II		
	Pathology	
1	General Pathology Adaptations, Cell Injury and Repair: Hyperplasia, atrophy, metaplasia, necrosis and apoptosis - Differences between apoptosis and necrosis.	3
2	Acute and Chronic inflammation: Five cardinal signs of inflammation- Outcomes of <ul style="list-style-type: none"> • acute inflammation • Chronic inflammation • Granulomatous inflammation • Acute phase proteins 	4
3	Tissue repair, regeneration and hemodynamic disorders: Cutaneous wound healing Pathologic aspects of repair-Hyperaemia and congestion-Thrombosis and Virchow triad Embolism-Infarction-Shock ; Bronchial asthma, COPD - Tumors	3
4	Diseases of immune system: Hypersensitivity reaction-Type I, II, III, and IV hypersensitivity reactions	2
5	Neoplasia: <ul style="list-style-type: none"> • Definition of neoplasia. • Differences between benign and malignant tumors • Metastasis • Carcinogenesis – Causes • Carcinoma of oral cavity – Causes • Etiology of Carcinoma cervix – type of virus implicated, high risk sero-types, Screening investigations • Breast carcinoma – Risk factors 	3
6	Systemic Pathology	1
7	RBC and Bleeding disorders: <ul style="list-style-type: none"> • Anaemia – Definition and classification, • Haemolytic anaemia, • Iron deficiency anemia, • Thrombocytopenia, 	3

	<ul style="list-style-type: none"> Coagulation disorders – Terminology, Uses of Bleeding Time, PT and a PTT 	
8	WBC disorders: <ul style="list-style-type: none"> Leukocytosis, Leukemia – acute and chronic, Causes of splenomegaly 	3
9	Disease of the GIT: Causes of <ul style="list-style-type: none"> Peptic ulcer Carcinoma stomach Intestinal obstruction acute appendicitis Colonic carcinoma 	4
10	Diseases of Liver, Biliary tract and Pancreas: <ul style="list-style-type: none"> Jaundice – classification based on pathophysiology Cirrhosis – Definition and causes Hepatitis – Types of viral hepatitis and transmission Portal hypertension – Symptoms Hepatic failure 	3
11	Endocrine System: <ul style="list-style-type: none"> Diagnostic criteria of diabetes mellitus, Major subtypes of diabetes mellitus, Differences between type I and Type II diabetes mellitus, Complications of diabetes mellitus 	3
12	Systemic Path emphasis I	1
13	Blood vessels: <ul style="list-style-type: none"> Atherosclerosis Risk factors; American Heart association classification (1995) of Human atherosclerosis Hypertension – diagnostic criterion, types and causes Varicose veins Thrombophlebitis and Phlebothrombosis 	4
14	The Heart: <ul style="list-style-type: none"> Heart failure congenital heart diseases causing left to right shunt and vice versa Myocardial infarction – causes, laboratory changes and complications Cor-pulmonale Rheumatic fever 	4
15	Diseases of the Lung: <ul style="list-style-type: none"> Chronic obstructive pulmonary disease; Asthma – pathogenesis Pneumonia – lobar and bronchopneumonia Lung carcinoma – Incidence and Causes 	3
16	Systemic Path emphasis II	1

17	<p>The Kidney and Lower urinary tract:</p> <ul style="list-style-type: none"> • Acute Renal failure – definition and causes of Prerenal, renal and post-renal ARF • Chronic renal failure – definition and causes • Acute nephritic syndrome – definition and causes • Nephrotic syndrome – definition and causes; • Acute tubular necrosis – definition and causes • Urolithiasis – types of stones 	4
18	<p>Systemic Path emphasis III</p> <p>Female genital tract:</p> <ul style="list-style-type: none"> • Endometriosis – Definition • Adenomyosis – Definition • Leiomyoma <p>Male genital tract:</p> <ul style="list-style-type: none"> • Carcinoma penis – causes • Testicular tumors – Classification terminology • Prostatic Hyperplasia – Causes, symptoms and PSA screening 	3
19	<p>Systemic Path emphasis IV Nervous system:</p> <ul style="list-style-type: none"> • Intracerebral, Subarachnoid and Subdural haemorrhage, • Meningitis and Encephalitis – Bacterial and viral causes and CSF findings; • Epilepsy – Causes; • Acute brain failure – Coma; • Epilepsy – Classification terminology; • CNS tumors – Classification terminology 	4

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 – Jamie Weir et al (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
6. Eisenberg R.L. and Johnson N.M. (2012), *Comprehensive Radiographic Pathology* (5th edition), Mosby, ISBN 978-0-323-07847-4

7. Textbook of Pathology – Harsh Mohan

Clinical Radiography - Positioning Part - I

Course Title	Clinical Radiography - Positioning Part - I	
Course Code	MRIT17	
Course Credit	Lecture: 02	
	Practical: 02	
	Clinical Training: 01	
	Total: 05	
Course Objectives		
Describe the positioning factors and anatomical structures visualized as they relate to the performance		
#	Detailed Syllabus	Sessions
Section I		
1	Skeletal system:	
	a) Upper limb: <ul style="list-style-type: none"> • Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus. • Supplementary techniques for the above. E.g. Carpal tunnel view, ulnar groove, head of the radius, supracondylar projections. 	10
	b) Lower limb: <ul style="list-style-type: none"> • Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur. • Supplementary techniques: Stress view for torn ligaments, <ul style="list-style-type: none"> ✓ Subtalar joint and talocalcaneal joint. ✓ Inter condylar projection of the knee. ✓ Tibial tubercle. ✓ Length measurement technique. 	10
	c) Shoulder girdle and thorax: <ul style="list-style-type: none"> • Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint. • Supplementary projections and techniques <ul style="list-style-type: none"> ✓ Recurrent dislocation of shoulder. ✓ Traumatic dislocation of shoulder. ✓ Cervical ribs. 	8
	d) Vertebral column:	8

	<ul style="list-style-type: none"> • Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco- lumbar spine, lumbo sacral spine, sacrum and coccyx. • Supplementary techniques to demonstrate: <ul style="list-style-type: none"> • Scoliosis • Kyphosis • Spondylolisthesis • disc lesion • Union of spinal graft. 	
	<p>e) Pelvic girdle and hip region:</p> <ul style="list-style-type: none"> • Technique for whole pelvis. Ilium, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter. • Supplementary techniques- <ul style="list-style-type: none"> ✓ Congenital dislocation of hips ✓ Epiphysis of femur ✓ Lateral projections for hip joints to show femoral head and neck relationship. 	8
	<p>f) Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.</p>	4
	<p>g) Skull:</p> <ul style="list-style-type: none"> • Basic projections for cranium, facial bones, nasal bones and mandible. • Technique for Petrous temporal for mastoids. Internal auditory canal. - Accessory nasal sinuses. • Temporo - mandibular joint. - Orbits and optic foramen. - Zygotic arches. • Styloid process. - Pituitary fossa. - Jugular foramen. 	8
	Practicals - Radiographic positioning of all parts of the body.	8
SECTION-II		
1	<p>Dental Radiography:</p> <ul style="list-style-type: none"> • Technique for intra oral full mouth. • Occlusal projections. • Extra oral projections including orthopantomography. • Supplementary techniques. 	12
2	<p>Upper respiratory system: Technique for post nasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre. - Phonation.</p>	12
3	<p>Lungs and Mediastinum:</p> <ul style="list-style-type: none"> • Technique for routine projections- • Supplementary projections: Antero-posterior, oblique, lordotic, 	12

	<ul style="list-style-type: none"> • apical projection, • Use of penetrated postero-anterior projection. • Expiration technique -Technique for pleural fluid levels and adhesions. 	
4	<p>Abdominal viscera:</p> <ul style="list-style-type: none"> • Technique for plain film examination. • Projection for acute abdomen patients. – • Technique to demonstrate: Foreign bodies, Imperforate anus. 	10
5	<p>Radiography using mobile X-ray equipment:</p> <ul style="list-style-type: none"> • Radiography in the ward: Radiography in the specialized unit such as: <ul style="list-style-type: none"> ✓ Intensive care unit, ✓ Coronary care, ✓ Neonatal unit. • Radiography in the operating theatre. 	10
	<p>Practicals Radiographic positioning of all parts of the body.</p>	08

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. Imaging Atlas of Human Anatomy – Jamie Weir et al (Mosby-Elsevier)
2. An Atlas of Normal Radiographic Anatomy – Richard and Alwin.
3. Surface and Radiological Anatomy – Hamilton et al (Heffer)
4. An Atlas of normal radiographic Anatomy – Ross and Wilson

Modern Radiological and Imaging Equipment Including Physics

Course Title	Modern Radiological and Imaging Equipment Including Physics	
Course Code	MRIT18	
Course Credit	Lecture: 02	
	Practical: 02	
	Clinical Training: 01	
	Total: 05	
Course Objectives		
Students learn about advance radiographic instrumentation, production and techniques		
#	Detailed Syllabus	Sessions
SECTION I		
1	Special radiological equipment:	8
	• Portable and mobile x-ray units, dental x-ray machine,	
	• skull table Mammographic device – Technical aspects of Mammography;	4
	• High Tension Generators, x-ray tubes-their types and advancements; Accessories; Resolution; Quality control; Application and role in medicine.	8
	• Digital radiography equipment, digital subtraction techniques.	8
	• Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of tomographic movements, Tomosynthesis,	8
	• Stich radiography,	4
• Dual energy x-ray absorptionometry (DEXA) scan.	8	
2	Picture archiving and communication system (PACS)	8
	Practicals - Demonstration of basic procedures in all modern modalities	8
SECTION II		
3	Computed radiography:	10
	• Principle, physics & equipment.	
	• Digital Radiography.	12
	• Flat panel digital fluoroscopy and radiography system,	10
	• Direct and indirect digital radiography and fluoroscopy systems.	10
• Digital radiography and Computed radiography its advantages, disadvantages and applications.	12	

4	<p>Vascular Imaging Equipment:</p> <ul style="list-style-type: none"> • Introduction, historical developments, Principle, scanned projection radiography, digital subtraction angiography, applications and definition of terms, 	10
Instruction Method		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 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 Non serial Publication WHO 		

Contrast and Special Radiography Procedures

Course Title	Contrast and Special Radiography Procedures	
Course Code	MRIT19	
Course Credit	Lecture: 03	
	Practical: 02	
	Clinical Training: 02	
	Total: 07	
Course Objectives		
Students learn about special radiography procedures for the various systems of the body.		
#	Detailed Syllabus	Sessions
Section I		
1	<p>For each of the examination the points listed below should be included:</p> <ol style="list-style-type: none"> 1. Review the anatomy of the area. 2. State the clinical indication for the examination. 3. State contra indication if any for the examination. 4. Describe the preparation of the patient including the premedication if appropriate. 5. Specify the type and quantity of contrast agent used. 6. Describe the method of introduction of the contrast agent. 7. Describe the series of projections taken during the examination. 8. Indicate the timings of the radiographs in relation to the administration of contrast agent. 9. Outline the practical problems and the way in which they may be overcome. 10. Explain the choice of exposure factor. 11. Detail the measures that should be taken for radiation protection. 12. Explain the after care of the patient. 	12
	<p>Special radiographic procedures</p> <ol style="list-style-type: none"> 1. Responsibility of Radiographer during Radiological Procedures. 2. Preparation of Patient for Different Procedures. 3. Contrast Media - Positive and Negative, Ionic & Non – Ionic 4. Adverse Reactions To Contrast Media and Patient Management 5. Emergency Drugs in the Radiology Department 	12

	6. Emergency Equipments In the Radiology Department 7. Aseptic technique 8. Indications, contraindications, basic techniques and relationship to other techniques of the following special procedures	
2	Gastrointestinal Tract: <ul style="list-style-type: none"> • Fluoroscopy, general considerations, responsibility of radiographers • Barium swallow, pharynx and oesophagus • Barium meal and follow through • Hypotonic duodenography • Small bowel enema • Barium Enema routine projections for colon and rectum, colonic activators; double contrast studies; colostomy. Special techniques for specific disease to be examined • Water soluble contrast media - eg. gastrograffin studies 	12
3	Salivary glands: Routine technique, procedure – sialography	10
4	Biliary system: <ul style="list-style-type: none"> • Plain film radiography • Intravenous cholangiography • Percutaneous cholangiography • Endoscopic retrograde cholangio-pancreatography (ERCP) • Operative cholangiography • Post-Operative cholangiography (T - tube Cholangiography) 	12
5	Urinary system: <ul style="list-style-type: none"> • Intravenous urography • Retrograde pyelography • Antegrade pyelography • Cystography and micturating cystourethrography • Urethrography (ascending) • Renal puncture 	12
6	Female reproductive system: Hysterosalpingography.	8
7	Mammography: <ul style="list-style-type: none"> • Mammography: Basic views, special views, wire localization. • Ductography. 	10
SECTION II		
8	Respiratory system: Bronchography: Awareness.	12
9	Sinusography: Routine technique and procedure.	12
10	Tomography: Application of tomography to specific regions. <ul style="list-style-type: none"> • General principles. • Estimation, selection of depth of layer. • Layer thickness required for different examination. 	14

	<ul style="list-style-type: none"> • Spacing of layers. • Types and advantages of various movements. • Choice of tomographic movement- exposure factor. • Sequential, horizontal and multi section tomography 	
11	Macroradiography: <ul style="list-style-type: none"> • General principles. • Requirement. • Equipment. • Technique. 	12
12	Soft Tissue Radiography: <ul style="list-style-type: none"> • High and low kilo voltage technique; differential filtration. Non - screen technique - simultaneous screen and non -screen technique. • Multiple radiography. • Uses of soft tissue radiography. 	14
13	High kV Radiography: <ul style="list-style-type: none"> • General principles • Relation to patient dose • Change in radiographic contrast. • Scatter elimination; beam collimation; grid ratio. • Speed and type of grid movement. • Radiographic factor; application and uses. 	12
14	Localization of foreign bodies: Techniques to locate non-opaque foreign body. <ul style="list-style-type: none"> • General location principles. • Ingested; inhaled; inserted; embedded foreign bodies. • Foreign bodies in eye. • Preparation of the area to be investigated. • Appropriate projection for all 	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. 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 – A concise practical Manual – Glenda J. Bryan (4th edn), Churchill Livingstone.
3. Text book of radiology for residents & technicians – 4th edition, Satish K. Bhargava
Radiological patient care – Jensen Chesney.
4. Atlas of dental and maxillofacial radiological imaging – Brownie