Department of Paramedical Sciences

Faculty of Allied Health Sciences

SGT UNIVERSITY

Shree Guru Gobind Singh Tricentenary University

Gurgaon-122505

Syllabus

M.Sc. Radio-Imaging Technology (RIT)

Duration: 2 years (4th Semester)

W.e.f. Academic Session 2020-21

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M.Sc Radio-Imaging Techniology Scheme of Examination

1st Year

1st Semester			
S.No	**Subjects**	**Credits**	**Marks**
1	Human Anatomy & Physiology	4	100
2	General Microbiology & Pathology	4	100
3	Image production & Evaluation	4	100
	Practical	2	50
4	Radiation Physics	4	100
	Practical	2	50
5	Research Methodology &Biostatistics	4	100
6	Critical Research Appraisal, Presentation & Evaluation	2	50
7	Evaluation of Clinical Practice	4	100
Total		**30**	**750**
2nd Semester			
Subjects			
1	Radiation Hazards, prevention and safety	4	100
	Practical	2	50
2	Equipment Operation & Quality Control	4	100
	Practical	2	50
3	Radiation Protection & Advance Diagnostic	4	100
	Practical	2	50
4	Radio-Diagnosis/Radiographic Procedures & Positioning	4	100
	Practical	2	50
5	Nuclear Medicine & PET Training	4	100
	Practical	2	50
6	Project Development & Synopsis Submission	2	50
7	Evaluation of Clinical Practice	4	100
Total		**36**	**900**
2nd Year			
3rdSemester			
Subjects			
1	Mammography, Ultrasound (4D) & Echocardiography	4	100
	Practical	2	50
2	Special Investigation & Technology	4	100
	Practical	2	50
3	Hospital Management& Care of Patient	4	100
4	Magnetic Resonance Imaging (MRI) -Basic principle and techniques (Theory)	4	100

	Practical	2	50
5	Computerized Tomography (CT) -Basic principle and techniques (Theory)	4	100
	Practical	2	50
6	Technical Writing of Dissertation& Evaluation	4	100
7	Evaluation of Clinical Practice	4	100
Total		**36**	**900**
4th Semester			
Subjects			
1	MRI & CT Clinical Applications & Imaging Protocols (Theory)	4	100
	Practical	2	50
2	Interventional Diagnostic in Modern Imaging Technology	4	100
	Practical	2	50
3	Evaluation of Clinical Practice	4	100
4	Dissertation	12	300
Total		**28**	**700**
Gross Total		**130**	**3250**

MRIT 1st Semester

Human Anatomy & Physiology

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Introduction	Overview of the structure, Organization of the human body, Anatomical terminology.	2
2.Cell	Cell morphology and diversity, Introduction to the structure and function of cell organelles,Cell inclusions.	2
3.Tissues	Macroscopic & microscopic studies of epithelial tissue, Connective tissue, Bone, Cartilaginous tissue, Muscle tissue, Nervous tissue & The integument.	2
4.Skeletal Muscles	Major skeletal muscles of the Head, Neck, Thorax, Abdomen & upper and lower limbs.	1
5.General Osteology	General morphology of bones, Structural classification, Identification of individual bones of the skeleton, Development and growth of skeletal tissue and bones.	2
6.General Arthrology	Naming, Identification, classification and application of classifications to the major joints of the human body	2
7.Cardiovascular System	Anatomy of the adult & foetal heart &major arteries and veins; cellular components of blood.	3
8.Lymphatic System	Anatomy of the lymphatic vascular structures, Lymph nodes, their. Tonsils and other mucosa-associated lymphatic tissue, Spleen and thymus.	1
9.Nervous System-	The contents of the peripheral nervous system & autonomic nervous system.	1
10.Respiratory System-	Anatomy of the Respiratory System including the thoraco-abdominal diaphragm, epithelium of the respiratory tract and the lungs.	3

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11.Digestive System-	Anatomy of the Mouth, Salivary glands, Pharynx, esophagus, stomach, intestine, liver pancreas, biliary system & peritoneal cavity, esophagus, stomach, small intestine, pancreas & liver.	3
12.Urinary System	Anatomy of the kidneys, Ureters, Urinary bladder and the urethra.	2
13.Endocrine System	Anatomy of Thyroid, Parathyroid, Suprarenal glands, Pineal gland and organs with a minor endocrine function, Thyroid gland, Bulbourethral glands.	2
14.Male Reproductive System	Anatomy of the scrotum, Testes, Epididymis,Ductus deferens, Inguinal canal, Seminal vesicles, Prostate gland, Bulbourethral gland, penis &testis.	2
15.Female Reproductive System	Anatomy of the ovaries, Uterine tubes, Uterus, Vagina and external genitalia; ovary.Functions of Estrogen, Progesterone & Testosterone.	2
16.Special Senses	Anatomy of the contents of the Special Senses: Eye, Ear & skin.	2
17.Upper Limb	Detailed plain radiographic anatomy of skeletally mature and immature individuals Regional and surface anatomy of the shoulder, axilla, and upper limb	2
18.Lower Limb	Detailed plain radiographic anatomy, physiology of skeletally mature & immature individuals. Regional & surface anatomy of the hip, thigh, crus and pes	2
19.Head and Neck (EYE & ENT)	Surface anatomy, Major blood vessels & nerves of the head & neck. Regional anatomy of the brain: sectional anatomy of the head and neck	2
20.Cross sectional anatomy of body	Radiographic anatomy of different parts in various projections, Surface anatomy and applied anatomy pertaining to Radiology.	2

- **ADDITIONAL READINGS:**
- A. Anatomy for Radiographers-C.A. Warrick
- B. Gray's anatomy Descriptive and applied –T.B. Johnstor.
- C. Foundation of Anatomy -Ross and Wilson
- D. An Atlas of Normal Radiographic Anatomy-Richard & Alvin

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MRIT 1st Semester

Human Anatomy & Physiology

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.General Physiology	Structure of cell membrane.	4
	Transport across cell membrane.	
	Blood Propagation of nerve impulse, Muscle- properties-classification –excitation /contraction coupling.	
2.C.N.S. & P.N.S. - Receptor Physiology	Classification & properties of CNS & PNS	2
	Reflexes-structure, properties& transmission.	
	Physiology of Touch, Pain, Temperature & Perception	
	Physiology of Muscle Tone, Stretch, Physiology of Voluntary movement.	
3.Excretory System	Kidneys: structure & function.	4
	Maturation - neural control- neurogenic bladder,	
	Temperature Regulation, Circulation of the skin- body fluid-electrolyte balance	
4.Respiratory System	General organization, Mechanics of respiration, Anatomical &Physiological Dead space- ventilation/perfusion ratio,	4
	Physiological changes with altitude & acclimatization	
5.Cardio-Vascular System	Structure & properties of cardiac muscle.	4
	Cardiac cycle, Heart rate regulation-factors affecting Heart Rate, BP: Definition, regulation, factors affecting BP, Cardiac output-Regulation & function affecting Cardiac output	
6.Lymphatic System	Physiology of the lymphatic vascular structures, Lymph nodes, their.	2
	Tonsils and other mucosa-associated lymphatic tissue, Spleen and thymus.	
7.Digestive System-	Physiology of the Mouth, Salivary glands, Pharynx, esophagus, stomach, intestine, liver pancreas, biliary system & peritoneal cavity, esophagus, stomach, small intestine, pancreas & liver.	4
8.Endocrine System	Physiology of Thyroid, Parathyroid, Suprarenal glands, Pineal gland and organs with a minor endocrine function, Thyroid gland,	4

	Bulbourethral glands.	
9.Male Reproductive System	Physiology of the scrotum, Testes, Epididymis,Ductus deferens, Inguinal canal, Seminal vesicles, Prostate gland, Bulbourethral gland, penis &testis.	**4**
10.Female Reproductive System	Physiology of the ovaries, Fallopian tubes, Uterus, Vagina and external genitalia; ovary.	**4**
	Functions of Estrogen, Progesterone & Testosterone.	
11.Special Senses	Physiology of the contents of the Special Senses: Eye, Ear & skin.	**2**
12.Head and Neck	Physiology nerves of the head & neck.	**2**

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- **ADDITIONAL READINGS:**
- A. Physiology for Radiographers-C.A. Warrick
- **B**. Foundation Physiology-Ross and Wilson
- A. Physiology for Radiographers-C.A. Warrick

MRIT 1st Semester

General Microbiology & Pathology

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Introductory Pathology	Cellular adaptation and cell death	18
	Inflammation and repair; infection; circulatory disorders; immune defense	
	Genetics of disease: Neoplasia	
	Cell injury and adaptation-Classification of tumors, Premalignant lesion	
	Types of inflammation &system, manifestations of inflammation	
	Disorders of vascular flow & shock (Brief introduction) Infarction shock, Ischemia,Over hydration, Dehydration, Response to infection, Categories of infectious agents	
	Host barriers to infection, How disease is caused, Inflammatory response to infectious agents,	
	Hematopoietic and Lymphoid System-Hemorrhage, Various types of Anemia, Leucopenia, Leukocytosis Bleeding disorders, coagulation mechanism.	
2.Fundamentals of Medical Terminology	Word Roots, Prefix, Suffix, Abbreviations & Symbols:	12
	Gastro intestinal	
	Respiratory	
	Circulatory	
	Renal	
	Nervous	
	Reproductive	
3.Fundamentals of Medical Terminology-II	Common Diseases & Procedures:	10
	Gastro intestinal	
	Respiratory	
	Circulatory	
	Nervous	

	Reproductive Oncology	
	MICROBIOLOGY **UNIT-I** Safety measures in laboratory Sterilization and Disinfection: Physical Methods of Sterilization, Chemical Methods of Sterilization, Methods of Disinfection Normal microbial flora of human body, role of normal flora **UNIT-II** Introduction and morphological features of Bacteria, Fungi, Viruses, Parasites, Microbial pathogenicity Brief Introduction of morphology and diseases associated with of, Streptococcus pneumoniae, Mycobacterium, Aspergillus, Tinea, Mycetoma, Cryptococcus.	

ADDITIONAL READINGS:

A. Robbins Basic Pathology

B. Robbins and Cotran Pathologic

C. Basis of Disease Medical Terminology for Health Professions

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MRIT 1st Semester

Image Production & Evaluation

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (50)
1.Photographic Process	Radiographic film- Image processing Manual as well as automatic – Content of Manual processing.	15
	Sensitometer, Intensifying screens, Film/screen combinations/analyzing the image	
	Establishing image standards- Professional imaging standards, The analytical process, Acceptance limits	
	Radiographic Quality- Density: contrast, Recorded detail, distortion	
	The art of films critique- Implementing imaging standers, Identifying an image problem.	
2.Exposure System	Comparing exposure systems	10
	Developing exposure charts	
	Fixed kilovoltage system, Variable kilovoltage system	
	Other exposure systems- Automatic exposure controls, Advantages and disadvantage associated with automatic exposure control	
3.Darkroom installation & Image processing:	Planning of a processing room as well as of a radiology department	7
	Day light processing system Image recording devices- Multi format camera, Laser camera, Dry camera etc.	
	Copying, radiography, Xero-radiography, Conventional Subtraction technique	
4.Factors affecting recorded detail:	Relationship among density, distortion, contrast, and recorded detail	7
	Factors that govern the selection of films, screens and grids.	
	Relationship between films and screens.	
	Effect of factors influencing exposure control, Exposure calculations for various radiographic procedures.	

5.Factor affecting the decision to use automatic exposure controls:	Simulated radiographic procedure, Use, Technique, Charts to select exposure factors, Film storage Considerations.	11
	Radiographic identification procedures. Periodic maintenance for automatic film processors	
	Procedures for loading and unloading of film in cassette.	

ADDITIONAL READINGS:

A. Mosby's Comprehensive Review of Radiography

Image Production & Evaluation

M. Sc. Semester I (MRIT)

L	T	P	Credits		Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks		
					Total:	50 Marks

Topic
○ Loading and unloading of X-ray Films, Technique, Safety concern, Handling in loading and unloading films
○ Dark Room Procedures
○ Developer, fixer content, Developing technique, Fixing technique
○ Safe light test
○ Safe light principal, benefits and its location
○ Cleaning & maintenance of Cassette, Safe and hygienic handling of cassettes and maintenance
○ Light leakage test in Cassettes, Cassettes safety and image quality features
○ Handling and storage of X-ray Film & Film Boxes, Handling of X-ray films, easy to achieve locations, safe places of storage.
○ Using techniques of films by size of open boxes
○ Editing images in CR & Taking prints
○ Application of CR, its instrumentations, DRY and Laser printer, CR Printer's application.
○ DICOM, Application, Functions, Features and its advantages.
○ Automatic processor, Application, principal. Working technique, work load handling in automatic processor

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MRIT 1st Semester

Radiation Physics

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.General Physics	Electrical charges, potential difference, current and resistance.	4
	Ohms Law for electrical circuit, direct current, alternating current, conductors, semiconductors, insulators, power, ammeter and voltmeter.	
	Electromagnetism, Electromagnetic Induction: Self and Mutual, Capacitor, capacitance.	
2.X-rays and its Properties, Electric system, Components and Control in X-Ray Circuit	X-ray interaction with matter, Ionizing Radiation and its quantities and units. Thermionic emission and properties of X-Rays. Coherent scattering- Thomson scattering, Rayleigh Scattering, Photoelectric absorption, Characteristic radiation, Bremsstrahlung Radiation.	10
	Electric supply & Distribution; diagnostic X-Ray circuits- X-Ray Tube, Transformers, types of transformers, losses.	
	The Tube Stand and Control panel, Rectification; diodes and rectifiers, semiconductors, Incoming light circuits (Phases – Single & Triple Phase modes, Three Phase 6-pulse mode, Three phase 12-pulse mode; Specialized X-Ray Generators & Transformers.	
3.High Tension generator	Basic X-Ray circuits transformers laws and types used in X-Ray machine. The rectification of high tension, control of kilovoltage, filament circuit and tube current	
4.Exposure switches and Timer / AEC	Exposure switches and relays timers and its radiographic application. Beam limiting devices, Absorption co-efficient, grids, cones and filter.	4
	Electronic Timers; Automatic Exposure Control Timers, Phototimer	
5.X-Ray	Fixed and rotating anode, faults in X-Ray tubes,	10

Tubes	Grid Controlled X-Ray Tube,	
	Mammography X-Ray Tube,	
	Heavy Duty X-Ray Tube,	
	Micro-Focus X-Ray Tube	
	Tube Rating and Tube Support- Tube heat Ratings,	
	Line Focus principle,	
	Anode Cooling chart,	
	Type of X-Ray Tube Stands.	
	Tube overload indication, X-Ray Tube over Load Protection Circuits	
6.Grid / Bucky/X-ray Table	Definition, its types and Grid Cut-off—Moving and Stationary Grid, Floating Table, Variable height table, vertical bucky, versatile bucky.	2
7.Image Intensifier	Fluoroscopic equipment,	8
	Digital Fluoroscopic,	
	Dental radiographic equipment,	
	Portable and Non- Portable equipments	
8.Care and maintenance	Maintenance and care of all X-Ray equipment and accessories.	2

Practical

1) X-Ray tubes and accessories, general features.
2) Portable X-Ray Equipment.
3) Image intensifier, its features, spot film.
4) Radiation protection devices
5) Effects of kV and mAs.
6) Maintenance of X-ray equipment and accessories.
7) Mammography X-Ray tube
8) Dental X-Ray unit.

Additional Reading

1. Christensen's Physics of Diagnostic Radiology
2. The Physics of Radiology and imaging by K. Thayalan

MRIT 1st Semester

Research Methodology & Biostatics

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hours (65)
1.Introduction research methodology	Introduction to research methods,	10
	Variable in research	
	Reliability and validity in research	
	Conducting a literature review	
	Formulation of research problems and writing research questions	
	Hypothesis, Null and research Hypothesis, Type I and type	
	II errors in Hypothesis testing	
2.Data collection	Experimental and non experimental research designs,	5
	Sampling methods, data collection, observation method,	
	Interview method, questionnaires and schedules construction	
3.Research Frame work	Ethical issues in research Principles and concepts in research ethics-confidentiality and privacy informed consent Writing research proposals Development of conceptual framework in research	5
4.Introduction to statistics	Introduction to statistics	5
	Classification of data, source of data,	
	Method of scaling- nominal, ordinal, ratio and interval scale	
	Measuring reliability and validity of scales	
5.Data sampling	Measures of central tendency,	10
	Measures of dispersion, skewness and kurtosis, sampling, sample size determination.	
	Concept of probability and probality distributions- binomial probability distribution, poison probability distribution and normal probability distribution	
6.Data correlation	Correlation-Karl person, spearman's rank correlation methodsregression analysis, testing hypothesis-chi square test, student's test, NOVA	5
7.Health care – an overview	Functions of Hospital administration	13
	Modern techniques in Hospital management	
	Challenges and strategies of Hospital management	

	Administrative Functions– Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership. Designing health care organization.	
8.Hospital Management	Medical record, House-keeping services	12
	Laboratory performance.	
	Management of biomedical waste.	
	Total patient care – indoor and outdoor.	
	Nursing and ambulance resources.	
	Evaluation of hospital services.	
	Quality assurance. Record reviews and medical audit.	

3. ADDITIONAL READINGS:Methods in Bio-Statistics for medical students, Mahajan, B.K., Jaypee Brothers MedicalPublishers, New Delhi.

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MRIT 2nd Semester

Radiation Biology and its Hazards & protection

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (60)
1.Radiation Protection Principles	History & development-National & international agencies, AERB, BARC, ICRP, WHO,IAEA and their role	8
	Equivalent dose, effective dose, absorbed dose, attenuation	
	Sources of radiation-natural& man made	
2.Biological effects of Radiation	Interaction of radiation with tissue, Cellular radiobiology, acute radiation syndrome, Hereditary effect, radiation effect in utero, Single strand, double strand DNA break and cross linking effects, Effects on cell-stochastic & deterministic effects-radiation risk-tissues at risk-genetic, Somatic &fetus risk-risk	8
	Dose equivalent limits-Philosophy-ICRP (60) Concepts-AERB guidelines.	
3.Planning of Radiation Installation	Protection from primary, leakage/scattered radiation, Workload-Use factor, Occupancy factor & distance.	8
	Primary & secondary barrier design calculations, Design of doors, Control of radiation-Effects of time, Distance and shielding, Barrier design- Barrier materials	
4.Personnel Monitoring Systems	Principle and objective-film badge-guidelines for use-Thermo luminescent dosimeter, Badge-pocket dosimeter	10
	Area monitoring and radiation survey- Practical use of survey meter, Zone monitors and phantoms,	
	Radiation Survey in x-ray, fluoroscopy and CT scan units.	
5.AERB safety code and ethics	Built in safety specification for diagnostic x-ray, Fluoroscopy and CT units	10
	Specification for radiation protection devices-room layout Operational safety-Radiation protection programme-Personnel requirements and responsibilities-regulatory controls. Human Dose limits as per permissible guidelines.	

6.Patient Protection	Safe work practice in diagnostic radiology-Radiation absorbed dose from general dental fluoroscopy, X-ray and CT examinations, X-ray examinations during pregnancy, medico-legal or insurance purpose, Medical research Avoidance of unnecessary radiation dose	**10**
7.Radiation Emergencies	Situation preparedness, safety and prevention-legal requirements Recent developments in radiation safety related topics	**6**

ADDITIONAL READINGS:

A. Radiation Protection in Hospital. Richard F. Mould
B. Basic radiological physics, Jaypee bothers pvt. Ltd New Delhi
C. An Introduction to Radiation Protection Allen Martin "& Samuel
D. Radiation safety in Medical practice. M.M. Rechami

Radiation biology andits Hazards& Protection (Practical)

L T P Credits Examination: 30 Marks
- - 2 Int. Assessment: 20 Marks
Total: 50 Marks

1) Knowledge of all hazards, education of general Public by posters and seminars
2) Safety of women and children , pregnant women, safety of patient attendants, radiation workers and hospital staff, checking of lead aprons, leakage radiation from tube head, radiation survey in and around X – ray installation.
3) Use of TLD film badges, GM counters, Scintillation detectors, Liquid scintillator, Pocket dosimeters and use of protective devices etc. Keeping of dose records of radiation workers, steps after high exposure report and investigations.
4) Biological effects of radiation- The cell effect of ionizing radiation on cell. Somatic effects and hereditary effect. Stochastic and deterministic effect.

5) Use of TLD film badges, GM counters, Scintillation detectors, Liquid scintillator, Pocket dosimeters and use of protective devices etc. Keeping of dose records of radiation workers, steps after high exposure report and investigations.
6) Biological effects of radiation- The cell effect of ionizing radiation on cell. Somatic effects and hereditary effect. Stochastic and deterministic effect.

Quality Assurance & Quality Control

7) Quality control tests for X-ray unit, Quality control tests for radiation leakage, Quality control tests for cassettes, Quality control tests for radiation shielding devices.

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MRIT 2nd Semester

Equipment operation & quality control

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Various Radiographic equipment and accessories	Component parts labelling	8
	Equipments used for Sonography, Computed radiography, CT,MRI & digital radiography	
	Differences in various types and models of portable radiographic equipment	
2.X-Ray Tube:	Theory of operation of an X-ray tube, Construction and function of an X-ray tube	10
	Determine the maximum allowable exposure factor for various radiographic procedures using an X-ray tube rating chart	
	Determine the rate of anode and tube housing cooling X-ray tube warm-up procedures for radiographic equipment from various manufactures.	
3.Image quality	Image contrast, ABC (automatic brightness control), Noise, Sharpness, magnification, spatial and temporal resolution	2
4.Safety checks of radiographic equipment:	Safety checks of radiographic equipment and accessories such as lead aprons and gloves and collimator accuracy	20
	Identify symptoms of malfunctions in radiographic equipment	
5.Quality control and quality assurance	Quality assurance and quality control of X-Ray, CT, MRI, USG, DEXA, DR, CR, Fluoroscopy, Mammography, DSA, Portable equipment etc. Quality control of Darkroom, PC-PNDT act and its rules.	

ADDITIONAL READINGS:

A. Essentials of Radiologic Science Workbook Robert A. Fosbinder
B. Textbook of Radiographic Positioning and Related operation and quality control
C. The Essential Physics of Medical Imaging – JERROLD T. Bushberg

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MRIT 2nd Semester

Radiation Protection & Advanced Diagnostic Techniques

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Beam Restricting Devices	Describe the use and function of beam limiting devices	16
	Beam filtration and shielding devices	
	Relationship between exposure factors and patient dosage	
	Define Term ALARA, Nature and function of the ten-day rule	
	Screen and exposure setting combination that will minimize the radiation dosage that patients receive.	
2.Radiographic Procedures	Methods to avoid repeat radiographs	8
	Radio diagnosis & radiographic equipments and techniques used to reduce personnel exposure during radiographic	
3.Radiographic Devices	Types and purposes of personnel protective devices used during radiographic, fluoroscopic, mobile, and surgical procedures	12
	Types, uses, and purpose of patient restraint devices for reducing personnel radiation exposure	
	Personnel monitoring devices in terms of purposes, types, characteristics, advantages and disadvantage.	
	Evaluation of image,	
	Image quality, Artefacts & corrective measures Safety considerations	
4.Digital Radiographic Imaging	Radiation protection in Digital Radiography, Radiotherapy and Bracheotherapy	4

ADDITIONAL READINGS:

A. Fundamentals of Diagnostic Radiology William E. Brant, Clyde A. Helms
B. The Essential Physics of Medical Imaging – JERROLD T. Bushberg

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Radiation Protection & Advanced Diagnostic (Practical)

L	T	P	Credits		Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks		
				Total:		50 Marks

1. Beam restriction Devices
2. Methods to avoid repeat radiographs
3. Radio diagnosis & radiographic equipment's and techniques used to reduce personnel exposure during radiographic
4. Radiation protection in Digital Radiography, Radiotherapy and Brachytherapy.

MRIT 2nd Semester

Radio-Diagnosis/Radiographic procedure &Positioning technique

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (55)
1.Positioning Terminology	Types and functions of immobilization and positioning devices,	4
	Radiographic procedure, Appropriate breathing instruction for patient	
	Positioning and technique variations for various radiographic procedures	
	Procedures for patient preparation	
2.Routine Radiography Procedure Skeletal system:	Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbowjoint, radio ulnar joints and humerussupplementary techniques for the above. eg. carpal tunnel view, ulnar groove, head of the radius, supracondylar projections. Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg,knee, patella & femur. Supplementary techniques: Stress view for torn ligaments,Subtalarjointandtalo calcaneal joint. .Inter condylar projection of the knee.ibial tubercle, Lengthmeasurement technique.	8
3.Thorax	Shoulder girdle and thorax: Technique for shoulder joint, scapular, clavicle, acromioclavicularjoints, sternum, ribs, sterno-clavicular joint. Supplementary projections and techniques forrecurrent dislocation of shoulder. Traumatic dislocation of shoulder. Cervical ribs. Vertebral column: Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine,thoracic spine, thoraco- lumber spine, lumbo sacral spine, sacrum and coccyx.	8
4.Pelvis	Pelvic girdle and hip region: Technique for whole pelvis. Ilium, ischium, pubic bones, sacroiliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter. Supplementary techniques to demonstrate Congenital dislocation of hip joints, Epiphysis of femur, Lateral projections for hip joints to show femoral head and neck relationship.	8

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	Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.	
	Skull: Basic projections for cranium, facial bones, nasal bones and mandible. Technique for Petrous temporals for mastoids, Internal auditory canal, Accessory nasal sinuses,Tempero - mandibular joint, Orbits and optic foramen, Zygomatic arches,Styloid process, Pituitary fossa, Jugular foramen.	14
	Dental Radiography: Technique for intra oral full mouth, Occlusal projections, Extra oral projections including orthopantomography, Supplementary techniques. Upper respiratory tract: Technique for post nasal airways, larynx, trachea, thoracicinlet, Valsalva manoeuvre, Phonation. Lungs and Mediastinum:Technique for routine projections,Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection, Expiration technique, Technique for pleural fluid levels and adhesions. Abdominal viscera:Technique for plain film examination.- Projection for acute abdomen patients.- Technique to demonstrate: Foreign bodies, Imperforate anus. Radiography using mobile Xray equipment: Radiography in the ward: Radiography in the specialised unit, such as: Intensive care unit, Coronary care, Neonatal unit,Radiography in the operating theatre.	
	Macroradiography: Principle, advantage, technique and applications. Stereography: Procedure, presentation, for viewing, stereoscopes. High KV techniques & Low kVp Technique : Principle and its applications	2
	Localization of foreign bodies: Various techniques Operation theatre techniques: General precautions, Aspesis in techniques, Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.	8
	Trauma radiography/Emergency radiography, Neonatal and Paediatric Radiography, Tomography and Tomosynthesis, Dual energy X-ray absorptiometry, Forensic Radiography, Community Radiography	3

Radio-Diagnosis/Radiographic procedure & positioning technique (Practical)

L	T	P	Credits		Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks		
				Total:		50 Marks

Practical-

Radiographic positioning of various parts
Immobilization technique in pediatrics radiography
Selection of contrast media & its application
Its indication and contraindication, management of reaction/ side effects
Application of conventional radiography , USG, CT & MRI techniques
Systematised use of CR ,DR,DSA etc.

ADDITIONAL READINGS:

A. Textbook of Radiographic Positioning and related Anatomy by Kenneth L. Bontrager& John P. Lampignano.
B. Clark's Positioning in Radiography
C. A Guide to Radiological Procedures by Stephen Chapman

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MRIT 2nd Semester

Nuclear Medicine & PET Training

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Nuclear Physics &Nuclear Medicine	Electromagnetic spectrum. Radioactivity & Interaction of Radiation, Applications and Apparatus for nuclear medicine	**8**
2.Gamma Camera	Camera head construction and principle of operation Collimators – parallel multi hole, high resolution, high sensitivity pin hole, diverging hole, slant hole. Collimators Scintillation crystal, size Light guide – Photo multipliers per amplifiers,Applications, Function	8
3.SPECT	Definition, Applications, Clinical uses, advantages & disadvantages	**6**
4.PET CT & PET MRI	Benefits vs risk or PET-CT and PET-MRI Recent advances in SPECT, PET including hybrid system.	**6**
5.Radionuclides & radioactivity	Characteristics and half-life of Radionuclides. Commonly used Radionuclides, Radioactivity-Discovery-Natural & Artificial RadioactivityIsotopes and nuclides-binding forces between nuclear particles-alpha & beta particles, gamma radiation-mechanisms of radioactive decay-half life –Interaction of electrons, X-ray & x-rays with matter, Scattering and its types.	6
6.Others	**Protocols-** Routine protocols **Indication, contraindications of PET Scans-** Indication and contraindications of PET Patient care relevent to nuclear medicine	6

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Additional Reading

1. Physics and Radiobiology of Nuclear Medicine by Gopal. B Saha
2. Physics in Nuclear Medicine by James A. Sorenson
3. Nuclear Physics by Shatendra Sharma

NUCLEAR MEDICINE & PET SCAN (Practical)

L	T	P	Credits		Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks		
				Total:		50 Marks

1. Nuclear Medicine Protocol & application
2. Physics & construction of Gamma Camera
3. PET CT & PET MRI application
4. Radionuclides & their uses

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MRIT 3rd Semester

Mammography, Ultrasound (4d)&Echocardiography

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Mammography	Dedicated mammographic unit and its special features, X-ray tube design, compression, scattered radiation, magnification.	10
	Mammographic Positioning and technical considerations,	
	Film screen mammography, digital mammography and BIRADS	
2.Ultrasound	Principle & history of Ultrasound, advantages and disadvantages of ultrasound, Types of Ultrasound, Equipment description,	12
	Indication and Clinical Application, Physics of transducers,	
	Physics of ultrasound imaging, Physics of Doppler	
	Ultrasound tissue characterization, Potential for three dimensional ultrasound, and 4D.	
	PC-PNDT act and its rules. Artifacts in ultrasound,	
	Comparison of ultrasound equipment Computerization of data, Image recording, Ultrasound jelly & Safety of ultrasound.	
3.Positioning and scanning technique	Abdomen and pelvis ultrasound, Neck, Orbit, Submandibular gland, Thorax, Breast, Scrotum- Pathologies and indications, patient preparation,	4
4.Color Doppler imaging.	Method of gynecologic ultrasound examination,Assessment of Normal fetal growth, fetalbehavior states, fetal breathing movements, fetal cardiac activity.	4
5.USG Contrast Media	Types of Ultrasound Contrast media and its advantages	4

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6.Echocardiography :	Introduction, indication and image formation. Uses of colorDopplerin echocardiography and equipment description with transducer.	6

Practical-

MRIT 3rd Semester

Special Investigation & Technology

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (50)
1.Contrast Media	History of contrast media, Definition, types of contrast media (Positive and negative). Adverse effect and contrast reactions.	6
2.Special Investigation	Soft tissue radiography, High KV techniques, Macro-Radiography, Micro-radiography, Foreign body localization. Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections, after care and pathology conditions.	6
3. Types of Fluoroscopy and non-fluoroscopy procedures	Special procedures: IVP/IVU, RGU, MCU, Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections, after care and pathology conditions.	4
4.Gastrointestinal Tract Imaging	Barium Study- Barium Swallow, Barium Meal, BMFT, Barium Enema, Double contrast, Hypotonic Dudenography, Defaecography and distal colography - Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections, after care and pathology conditions.	8
5.Biliary System	PTC, T-Tube cholangiography, ERCP, Pre-Operative cholangiography, Oral Cholecystography/Intravenous Cholangiography- Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections,	6

	after care and pathology conditions.	
6.Sialography &Sinography	Sialography, DCG- Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections, after care and pathology conditions.	8
7.Reproductive Glands	HSG- Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections, after care and pathology conditions.	6
8.Interventinal Procedure	Paediatric radiography, Discography, Myelography,Harniogram, Pouchogram, loopogram, invertogram, Scanogram, Fistulogram, sinogram, Arthrography, Pelvimetery- Anatomy, Clinical Indication and contraindication, Patient preparation, contrast media and does, injection procedure, techniques for radiographic projections, after care and pathology conditions.PTC, ERCP, PCN and FNAC: Fluoroscopy/ US/CT guided. DSA, Application, advantage, disadvantages, benefits etc Types of Catheter, stents, ballooning technique in Angiographic procedures. CT and MRI-Various imaging protocols and techniquesDigital imaging , applications and advancements	6

Special Investigations & technology (Practical)

L	T	P	Credits			
				Examination:		**30 Marks**
-	-	2	**Int. Assessment:**	**20 Marks**		
				Total:		**50 Marks**

Topic
1. Radiography in various positions for all the special radiological procedures, using contrast media
2. Identification of various films for all the special radiological procedures, using contrast media and related pathologies.
3. Various indication, technique of procedure used in diagnostic radiology.

ADDITIONAL READINGS:

A. Introduction to the Principles of Medical Imaging Chris Guy , Dominic Fitches

B. A Guide to Radiological Procedures by Stephen Chapman

C. Textbook of Radio-graphic Positioning and related Anatomy by Kenneth L. Bontrager& John P. Lampignano

MRIT 3rd Semester

Hospital Management & Care of Patient

L	T	P	Credits		
3	1	-	4	Examination:	60 Marks
				Int. Assessment:	40 Marks
				Total:	100 Marks

Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Patient Care	Principles of body mechanics applicable to patient care Procedures for patient transfer	10
	Procedures for turning patients who have severe trauma, Unconsciousness, Disorientation, or Amputated limbs Patient preparation stamps. Contrast reaction in radiology department, Emergency Drugs, ABCD principal.	
2.Infection Control	Disinfection and sterilization procedures	5
	Procedures for scrubbing, Donning gowns and gloves, Removing gowns and gloves, and handling sterile instruments	
	Procedures for handling and disposing of infectious wastes Isolation techniques	
3.Management of infectious patients	Psychological considerations for the management of infectious patients-Communicable disease, Patient Hygiene, Personal Hygiene and department Hygiene.	20
	Vital signs used to assess patient condition, measurements of Vital signs-Clinical measurement and recording of temperature, pulse, blood pressure and respiration.	
4.Emergency Patients Handling	Symptoms of cardiac arrest, anaphylactic shock, convulsion, seizure, hemorrhage, apnea, emesis, aspiration, fractures and diabetic coma/insulin reaction	
	Acute care procedures for cardiac arrest, Anaphylactic shock, Convulsion, Seizure	
	Hemorrhage, Apnea, Emesis, Aspiration, Fractures, diabetic coma/insulin reaction	
	Use of medical equipment and supplies in treating medical emergencies.	
5.Medico-Legal Considerations	Communication Skills of radiographer, Informed Consent form, Clinical/General and Ethical responsibilities, Misconduct and malpractice, handling female patients	5

ADDITIONAL READINGS:

A. Principles and Techniques of Patient Care

B. Pierson and Fairchild's Principles & Techniques of Patient Care

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MRIT 3rd Semester

Magnetic Resonance Imaging-principle and techniques (Theory)

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Chapter 1	Introduction of MRI Basic principle of MRI history of MRI	Must Know	10
	Introduction, atomic structure, motion within the atom, Hydrogen nucleus, alignment, precession, Larmour equation, resonance, MR signal, FID, law of electromagnetism	Must know	
	T1 relaxation time, T2 decay time, pulse timing parameter, Extrinsic parameter & Intrinsic parameter.	Must know	
Chapter 2	MRI Equipment description & Instrumentation- Introduction, magnetism, permanent magnet, resistive magnet, superconducting magnet, fringe field, shim coil, gradient coil, RF coil, the pulse control unit, patient transportation system, operator interface	Must know	5
Chapter 3	Image weighting & contrast Introduction, image contrast, contrast mechanism, T1 contrast, T2 contrast, proton density contrast, image weighting, T1 weighting, T2 weighting, proton density weighting	Must Know	5
	Encoding & Image Display Encoding- introduction, gradient, slice selection, frequency encoding, phase encoding gradients, K-space, K-space filling and its role	Must Know	5
Chapter 4	Factors that affect image quality & Trade off Introduction to SNR & CNR, factors effect on SNR & CNR, spatial resolution, scan time, Trade's off	Must know	5
	Artifacts: Introduction, phase mis-mapping, aliasing artifact, chemical shift artifacts, chemical misregistrationartifact, truncation artifact, magnetic susceptibility artifact, zipper artifact, shading artifact, motion related artifacts, cross excitation or cross talk artifacts	Desirable to know	5
Chapter 5	Pulse Sequences Introduction of spin Echo pulse sequence-	Must Know	5

	conventional, Fast spin echo, Inversion recovery, Gradient pulse sequence Conventional gradient echo, The steady state, Coherent residual transverse magnetization, incoherent gradient pulse sequence, SSFP, EPI, Balanced gradient		
Chapter 6	Flow phenomena- Mechanism of flow, time of flight phenomena, entry slice phenomena, intra voxel dephasing Flow phenomena compensation- Introduction, gradient moment rephrasing, pre saturation, even echo rephrasing.	Must Know	5
Chapter 7	Contrast media- Introduction, uses & methodology, mechanism of action, dipole-dipole interaction, magnetic susceptibility, relaxivity, gadolinium safety, feridex safety, application of contrast agent	Must Know	5

Magnetic Resonance Imaging- principle and techniques (Practical)

L	T	P	Credits		Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks		
				Total:		50 Marks

1) Physics, scanning principle and image formation in MRI
2) Equipment of MRI
3) Identification of different parts of MR scanner
4) Applications of various procedures in well-equipped Hospitals and Diagnostic Centers
5) MR artefact & its remedy.

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MRIT 3rd Semester

Computed Tomography- principle and techniques (Theory)

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Chapter 1-	C.T. Scan Basic principle of CT scan history of CT Scan	Must Know	6
	EMI- History, System design etc		
	CT Equipment description & Instrumentation CT gantry, patient table, CT computer & image processing system, image display, storage & recording, CT control console, other accessory		
Chapter 2-	Computed Tomography Scanning principle	Must Know	6
	Data acquisition, Data processing, Image display		
	Image reconstruction & its types		
	Image manipulation & Post processing Introduction, clinical use, advantages, disadvantages of MPR, MIP, SSD, CPR, VR		
	Scanning parameters		
Chapter 3	Generation of CT Scanner 1st generation, 2nd generation, 3rd generation, 4th generation, Slip ring technology, spiral/helical scanning, EBCT, Dual source scanning, flat panel detector Advantages and disadvantages	Must Know	6
Chapter 4	**Image Quality in CT** pixel, voxel, Image Brightness, spatial resolution, Contrast resolution, quantum mottle, Sharpness, Window width, Window level, Isotropic Imaging, CT Number, Pitch	Must Know	6
Chapter 5	**CT Scan Radiation Dose & Radiobiology** Attenuation of X-ray in tissue, Equivalent dose, effective dose, absorbed dose, tissue weighting factor, Organ dose from X-Ray procedure, CT dosimetry, CTDI, DLP, KERMA, occupany factor, CT phantom, Patient Dose	Must know	10

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	Radiation risk, Risk to generic Patient, Increasing radiation burden from Medical Imaging.		
Chapter 6	**QA & QC of CT scanner & artefacts** Purpose benefit, record maintaining of QA & QC. **Artefacts** Definition, manifestation & Remedy Motion artefact, metal artefact, out of field artefact, beam hardening artefact, partial volume averaging artefact, ring artefact, pitch artefact, stair step artefact,	Must Know	6

Computed Tomography -Principle and techniques (Practical)

L	T	P	Credits	Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks	
				Total:	50 Marks

1) Physics, scanning principle and image formation in CT

2) Identification of different parts of CT scanner

3) Applications of various procedures in well-equipped Hospitals and Diagnostic Centers

4) Quality control of CT

Subject: Neuro imaging Workup in Pre-surgical Evaluation

M Sc. Semester III (MRIT)

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Content	Hour
UNIT-1	Unit 1- Introduction to refractory epilepsy, pre-surgical evaluation, role of imaging modalities.	8
UNIT-2	Unit 2 :Introduction to neuro- imaging techniques, Principles, Advantages & Disadvantages, Recent advances. Introduction to Emission Computed Tomography (ECT) systems. Principles and applications of SPECT, Principles and applications of PET, Principles and applications of CT, System components of CT, Contrast Scale for different neuro- imaging techniques.	10
UNIT-3	Unit 3- Introduction to MRI system, Principles of MRI and fMRI, Basic MR components, Biological Effect on MR Imaging, Advantage of MR Imaging system.	12
UNIT-4	Unit 4- Introduction to BCI, Applications of BCI, Introduction to MEG, Applications of MEG, Advantage and disadvantage of MEG.	10

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MRIT 4th Semester

MRI & CT Imaging Protocols & Clinical Application

Chapter 1	NCCT & CECT Brain, Face, Sinuses, Mastoid, TMJ, orbit, mandible, neck, chest, abdomen with pelvis, upper & lower extremities with image filters, 3D, VR, MPR, MIP & other reconstruction technique: : Indications. Contraindications, Patient preparation, Protocols and patient care	Must Know	8
Chapter 2	Angiography & its technique:- Cerebral angiography, carotid angiography, Pulmonary angiography, Abdominal angiography, Renal angiography, Peripheral angiography, Coronary angiography & its technique, Calcium scoring, Cardiac gating with image filters, 3D, VR, MPR, MIP & other reconstruction technique: : Indications. Contraindications, Patient preparation, Protocols and patient care	Must Know	10
Chapter 3	Special Procedure its technique & reconstruction method Virtual CT-bronchoscopy, colonoscopy, CT Enterography, CT guided Biopsy procedures, CT Urography, CT Fluoroscopy	Must Know	10
Chapter 4	Special MRI Protocol- MRCP, Urography, MR guided biopsy, Cardiac imaging, MRI Breast Imaging, MR angiography Cerebral Angiography, Carotid Angiography, Pulmomary Angiography, Peripheral Angiography, Abdominal Angiography, Cardiac Angiography-Chamber imaging Advancement in MRI- Functional imaging in MRI, Spectroscopy & its technique, DTI, Perfusion & its application	Must Know	10

L	T	P	Credits		
3	1	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**

Duration of Examination: 3 Hours

MRI & CT Imaging Protocols & Clinical Application

(Practical)

L	T	P	Credits		Examination:	30 Marks
-	-	2	Int. Assessment:	20 Marks		
				Total:		50 Marks

1. Principles of magnetic resonance imaging, Instrumentation, basis of magnetic relaxation of T1W & T2W, Image contrast and noise, Inversion recovery pulse sequence, Rapid scan techniques, Fast spin-echo and echo-planar imaging, Fast and water signal separation methods.

2. Spectroscopy, Artifacts, Flow phenomena, Contrast agents, Interventional magneticresonance imaging, Bioeffects and safety,

3. MRI Breasts, liver, Adrenal gland, kidney, Urinary bladder, Knee, Shoulder, Brain, Salivary gland, Spine, Neck, CE Angiography, perfusion, Dynamic MRI, Spectroscopy, MRCP, Function MRI etc.

4. All angiography procedure & its technique in CT scan.

5. Various NCCT & CECT procedure & their technique

MRIT 4th Semester

Interventional Diagnostic in modern imaging technology

L	T	P	Credits
3	1	-	4

Examination: 60 Marks
Int. Assessment: 40 Marks
Total: 100 Marks
Duration of Examination: 3 Hours

Unit	Teaching Guidelines	Hrs (40)
1.Interventional Radiology	History, Principal, patient preparation, High risks patients, advantages and disadvantages.	10
	Equipment application and details, Interventional procedure table specification.	
	Principal of interventional, Cine-fluorography camera.	
2.Basic Angiography and DSA.	History , technique, patient care, Percutaneous catherisation, catheterization sites, Asepsis, Guide wire, catheters, pressure injectors, accessories, Use of digital substraction- single plane and bi-plane.	18
	All forms of diagnostic procedures including angiography, angioplasty, renal evaluation and drainage procedure and aspiration cytology under flouoro,CT,US,MRI guidance Angiography: Carotid Angiography (4 Vessel angiography). Aortography, femoral arteriography. Selective studies: Renal, SMA, Coeliac axis. Angiocardiography.	
	Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography. Cardiac catheterization procedures: PTCA, BMV, CAG,Pacemaker, RFA, Nerve Block, etc	
	Real time CT Fluoroscopy Interventional guidance tool 3D	2
3.CR/DR and DEXA	Introduction, Types- Digital imaging, digital fluoroscopy, Scanned Projection Radiography.	5

4.PACS	History, Definition, Introduction, Display system, Computer Network, Storage System, Tele-radiology	5

Interventional Diagnostic in modern imaging technology

(Practical)

L	T	P	Credits		
-	-	2	Int. Assessment:	20 Marks	
			Examination:		30 Marks
			Total:		50 Marks

C.T. Guide procedures
Fine needle aspiration cytology
Fine needle aspiration Biopsy
Stereo tactic biopsy- Radio surgery
Ultrasound Guided Procedures-
Fine needle aspiration Cytology
Fine needle aspiration Biopsy
Fluoroscopy guided procedure
Endoscopic Retrograde CholedochoPancreatography
PercutaneousNephrolithotomy- PercutaneousNephrostomy, Percutaneous transhepatic biliary drainage, Angioplasty- Embolisation-Transjugular liver biopsy

ADDITIONAL READINGS:

A. Introduction to the Principles of Medical Imaging Chris Guy , Dominic Ffytche
B. The essential Physics for Medical Imaging by Jerrold T. Bushberg

Dissertation

L	T	P	Credits	Examination:	200 Marks
-	-	2	Int. Assessment:	100 Marks	
				Total:	50 Marks

The research project is to be carried out over a period of approximately 6 months and will be carried out in the hospitals, subject to approval by all concerned. Each student will select research project with their respective supervisors. The projects will be selected such that a student can reasonably be expected to make an original contribution to the chosen area of research within the time period allotted. The purpose of the project is to provide the student with training in academic research and acquisition of practical skills, including the design of a research project, planning of experiments, dealing with practical problems, recording of, presenting and analyzing data.

Unit I- Thesis Proposal Development is an independent tutorial conducted by the student's advisor, and involves a comprehensive literature survey of the chosen research area. Through regular meetings, the student and advisor discuss this literature in detail and the topic for research project will be finalized in the third semester.

Unit II- Thesis proposal Each student must submit to the university with the signed approval of the advisor, a thesis proposal defining the thesis project, the methods and design of the experiments needed for completion, the progress to date and plans for completion in the third semester.

Unit III – Thesis preparation: This is involving preparation of the thesis. The thesis must include a cover page, abstract, table of contents, introduction of the thesis topic with a comprehensive review of literature, appropriately organized methods, results and discussion section for the experiment performed and final conclusions section summarizing the outcome of the project. The student should submit a draft of the thesis to the advisor by the end of the fourth semester.