GURU KASHI UNIVERSITY

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Masters of Science in Radiology and Imaging Technology

Session: 2024-25

Department of Paramedical Sciences

Graduate Attributes:

Graduates of M.Sc. RIT will be efficient to analyze complex problems, evaluate evidence, and develop innovative solutions. Graduates will be able to work independently on X-ray machines, CT Scans (computed tomography) MRI (Magnetic resonance imaging, and interventional Radiology take initiative in defining research questions and designing research projects.

Programme Learning Outcomes: After completion of this course graduates will be able to:

- Undertake further advanced research of the highest quality that contributes to knowledge and exhibits authoritative international standing in their own specialization.
- Make potentially innovative, and important contributions to society, culture, and the global community.
- Conduct original and rigorous research, contributing new knowledge and insights to their field of study.
- Formulate effective planning and time management to meet research deadlines and balance academic commitments.
- Explore new ideas and remain updated with the latest developments in their field.
- Think critically and creatively, exploring novel approaches to problem-solving and research questions.

Course Structure of M.Sc. RIT Programme

Semester –I							
Sr. No	**Course Code**	**Course Title**	**Type of course**	**L**	**T**	**P**	**Credits**
1	MRI101	Fundamentals of Research	Research Skills	2	0	0	2
2	MRI102	Radiological & Imaging Procedures	Core course	4	0	0	4
3	MRI103	Radiation Safety & Protection	Core course	4	0	0	4
4	MRI104	Radiological & Imaging Procedures (Practical)	Skill Based	0	0	4	2
5	MRI105	Radiation Safety & Protection (Practical)	Skill Based	0	0	4	2
6	MRI106	Human Rights and Duties	Multidisciplinary	3	0	0	3
7	MRI107	Communication & Soft Skills	Compulsory Foundation	**2**	**0**	**0**	**2**
Discipline Elective (Any one of the following)							
8	MRI108	Mammography & USG	Disciplinary Elective	3	0	0	3
9	MRI109	Pediatric Radiology					
Discipline Elective (Any one of the following)							
10	MRI110	Care & maintenance of diagnostic equipment/ instruments	Disciplinary Elective	3	0	0	3
11	MRI111	General patient care in hospital					
			Total	**21**	**0**	**8**	**25**

Semester -II							
Sr. No.	**Course Code**	**Course Title**	**Type of course**	**L**	**T**	**P**	**Credits**
1	MRI201	Advanced Technique & Instrumentation of MRI23	Core Course	4	0	0	4
2	MRI202	Recent Advancement in Modern Imaging Technology	Core Course	4	0	0	4
3	MRI203	Nuclear Medicine	Core Course	4	0	0	4
4	MRI204	Advanced Technique & Instrumentation of MRI23(Practical)	Skill Based	0	0	4	2
5	MRI205	Recent Advancement in Modern Imaging Technology (Practical)	Skill Based	0	0	4	2
6	MML299	XXXX	MOOC	**0**	**0**	**0**	**2**
Value Added Course (For other disciplines also)							
7	MRI206	First Aid	VAC	2	0	0	2
Disciplinary Elective (Any one of the following)							
8	MRI207	Fitness and Health Management	Disciplinary Elective	3	0	0	3
9	MRI208	General Pathology & Terminology					
Disciplinary Elective (Any one of the following)							
10	MRI209	Neuroradiology	Disciplinary Elective	3	0	0	3
11	MRI210	Biomedical Waste Management					
			Total	**22**	**0**	**8**	**26**

Semester -III							
Sr. No.	**Course Code**	**Course Title**	**Type of course**	**L**	**T**	**P**	**Credits**
1	MRI301	Research Methodology	Compulsory foundation	4	0	0	4
2	MRI398	Research Proposal	Research Skill	0	0	8	4
3	MRI303	Management & Planning of Radiology Dept.	Core	4	0	0	4
4	MRI304	Innovation, creativity and Entrepreneurial mindset	Entrepreneurship Skills	2	0	0	2
5	MRI305	Drug Abuse	VAC	2	0	0	2
6	MRI306	Bioinformatics and Computational biology	Skill Based	0	0	2	1
7	MRI399	XXXX	MOOC	0	0	0	3
8	MRI307	Bioethics & Intellectual Property Right	Elective Foundation	2	0	0	2
9	XXXX	XXXX	IDC	2	0	0	2
			Total	**16**	**0**	**10**	**24**
Open Elective Courses (for other Department)							
10	OEC072	First Aid	Open Elective	2	0	0	2
11	OEC016	Health care and Nutrition					

Semester-IV							
S. No	**Course Code**	**Course Title**	**Type of course**	**L**	**T**	**P**	**Credits**
1	MRI401	Dissertation	Research Based	-	-	-	20
2	MRI402	Skills & Professional Development	AEC	0	0	2	1
			Total	**0**	**0**	**2**	**21**

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks]

CA1- Surprise Test (Two best out of three) (10 Marks)
CA2- Assignment(s) (10 Marks)
CA3- Term paper/ Quiz/Presentation (05 Marks)

B. Attendance (05 Marks)
C. Mid-Semester Test: (30 Marks)
D. End-Semester Exam: (40 Marks)

Semester-I

Course Title: Fundamentals of Research

Course Code: MRI101

Hours 30

L	T	P	Cr.
2	0	0	2

Total

Course Learning Outcomes: On successful completion of this course, the students will be able to:

1. Understand and can create effective research writing documents for end-users.
2. Follow writing process and strategies to produce clear, high-quality research papers in a multitude of technical writing genres.
3. Apply professional research writing conventions of clean and clear design, style, and layout of written materials.
4. Analyze research documents appropriately with citing resources.

Course Content

UNIT-I **5 Hours**

Introduction to research writing - Knowing the details of research writing - Planning the purpose and material - Practicing for the audience and content delivery
- Processing the steps, activities and outputs

UNIT-II **10 Hours**

Nature and meaning of research methods - Types of research - pure and applied research - Types of communication research – Quantitative, Qualitative and

Rhetorical - Questionnaire and observation methods - Data collection and data analysis - Thesis/Synopsis writing - Structure and importance

UNIT-III **15 Hours**

Research writing in broader spectrum - The tone -The language - Conventions of research – Evidence-based arguments - Thesis-driven analysis - Complexity

and higher- order thinking -

UNIT-IV **15 Hours**

Formatting a research paper – Title page – Abstract – Introduction – Methodology – Conclusion – Proof reading – Citing sources

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question:

Suggested Readings

1. Work book for Advanced Research and Writing by Dr. L. Kavitha Nair, EFL, SRMIST, KTR.

2. Introducing Research Methodology: A Beginner's Guide to Doing a Research Project - Uwe Flick

3. Research Design: Qualitative, Quantitative and Mixed Methods Approaches - J. David Creswell and John W. Creswell

4. The Craft of Research - Gregory G. Colomb, Joseph M. Williams, and Wayne C Booth

5. Foundations of Behavioral Research - Fred N. Kerlinge

6. Technical Writing Style by – Dan Jones, Sam Dragga

7. Handbook of Technical Writing by – Walter. E.ollu

8. Technical Writing Process by – Kieran Morgan and Sanja Spejic

9. https://www.freelancewriting.com/copywriting/what-is-technical-writing/

10. https://web.mit.edu/me-ugoffice/communication/technical-writing.pdf

10.https://www.nitorinfotech.com/blog/best-practices-for-technical-writing.

Course Title: Radiological & Imaging Procedures

Course Code: MRI102

L	T	P	Cr.
4	0	0	4

Total Hours 60

Course Learning Outcomes: On completion of this course, the successful students will be able to:

1. Understand the responsibility of radiographer during radiological procedures.
2. Learn the basic techniques and their correlation with other techniques of the subsequent special procedures.
3. Classify the various types of contrast media used in radiology.
4. Determine appropriate patient interaction and preparation for all Radiographic examinations and procedures maintaining the principle of sterile technique and execute the knowledge of c-arm and manipulation.

Course Contents

UNIT-I **15 Hours**

Special Radiographic/Radiological procedures: Selection of Fluoroscopy Equipment, general considerations, responsibility of radiographers. Patient Preparation, Indications Contraindications Technique Post Care and Preparation of Drug Trolley/Tray, Radiation Safety, Contrast Media - Positive and Negative, Ionic & Non – Ionic, Adverse Reactions To Contrast Media and Patient Management, Emergency Drugs in the Radiology Department ,Aseptic technique for the following procedures, Gastrointestinal Tract: Barium swallow, pharynx and esophagus. 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. Including water soluble contrast media - e.g. gastrograffin studies. Including CT, US and MRI23 Special Imaging Techniques, Salivary glands: Routine technique, procedure - Sialography.

UNIT-II **15 Hours**

Biliary system: Plain film radiography. Intravenous cholangiography. Percutaneous cholangiography, Endoscopic retrograde cholangio- pancreatography (ERCP), Operative cholangiography, Post-Operative cholangiography (T-tube Cholangiography).Including CT, US and MRI23 Special Imaging Techniques, Urinary system: Intravenous urography, retrograde pyelography. Antegrade pyelography. Cystography and micturating cystouresthrography, Urethrography (ascending) renal puncture. Including CT, US and MRI23 Special Imaging Techniques, Reproductive system: All the Techniques relating to Male and Female reproductive system including Hysterosalpingography, Breast Imaging: Mammography: Basic views, special views, wire localization. Ductography, Tomosynthesis, ABVS, Various Biopsy Techniques including Prone Table Biopsy, CT, US and MRI23 Special Imaging Techniques

UNIT-III **15 Hours**

Respiratory system: - Bronchography: Including CT, US and MRI23 Special Imaging Techniques, Sinography: Routine technique and procedure, Central Nervous System: Myelography. Cerebral studies. Ventriculography etc .including CT, US and MRI23 Special Imaging Techniques, Arthrography: Shoulder, Hip, Knee, Elbow joints etc. including CT, US and MRI23 Special Imaging Techniques, Angiographic Studies: Carotid Angiography (4 Vessel angiography). Thoracic and Arch Aortography, Selective studies: Renal, SMA, Coeliac axis. Vertebral angiography femoral arteriography. Angiocardiography, Peripheral angiography

UNIT-IV **15 Hours**

Venography: Peripheral venography. Cerebral venography. Inferior and superior venocavography. Relevant visceral phlebography, Microbiology: Introduction and morphology - Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria. Growth and nutrition -nutrition, culture media, types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test Sterilization and disinfection - principles and use of equipment's of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants. Introduction to immunology, bacteriology, parasitology, mycology.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Berlin, L. (1994). A Guide to Radiological Procedures. Radiology, 191(2), 506-506.Chapman, S., & Nikielny, R. (1986). A guide to radiological procedures.*
- *Gupta, A. K., Garg, A., & Khandelwal, N. (2017).Diagnostic Radiology:*
- Gastrointestinal and Hepatobiliary Imaging. JP Medical Ltd.

Course Title: Radiation Safety & Protection

Course Code: MRI103

L	T	P	Cr.
4	0	0	4

Total Hours 60

Course Learning Outcomes: On successful completion of this course, the students will be able to

1. Perform the basic construction and handling of safety equipment's against radiation.
2. Acquire the basic knowledge of Radiation Protection, biological effects of Radiation.
3. Understand various biological effects of radiation.
4. Explain various dose fractionations.

Course Contents

UNIT-I **15 Hours**

Radiation safety in diagnostic Radiology
Introduction to Radiation protection-Need for protection, Aim of radiation protection
Limits for radiation exposure: Concept of ALARA, maximum permissible dose, exposure in pregnancy, children. Occupational Exposure Limits - Dose limits to public
Radiation Protection in: Radiography, Fluoroscopy, Mammography, Mobile Radiography, CT scan, DSA and Interventional Radiology.
Radiation measuring instruments: survey meters, area monitor, personnel dosimeters, film badge, thermo luminescent dosimeter, pocket dosimeter.
Radiation Quantities and Units: Radiation, Radioactivity, Sources of radiation -natural radioactive sources, cosmic rays, terrestrial radiation, manmade radiation sources. Kerma, Exposure, Absorbed dose, Equivalent Dose, Weighting Factors, Effective Dose

UNIT-II **15 Hours**

Biological Effects of radiation -Direct & Indirect actions of radiation ,concept of detriment, Deterministic & stochastic effect of radiation ,somatic and genetic effects, dose relationship , effects of antenatal exposure Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell-Chromosomal aberration and its application for the biological dosimetry- Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus -Somatic effects and hereditary effects- stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

UNIT-III **15 Hours**

Radiation detection and Measurements: Ionization of gases, Fluorescence and Phosphorescence, Effects on photographic emulsion. Ionization Chambers, proportional counters, G.M counters, scintillation detectors, liquid semiconductor detectors, Gamma ray spectrometer. Measuring systems: free air ionization chamber, thimble ion chamber, condenser chamber, Secondary standard dosimeters, film dosimeter, chemical dosimeter-thermo luminescent Dosimeter, Pocket dosimeter, Radiation survey meter- wide range survey meter, zone monitor, contamination monitor -their principle function and uses. Advantages & disadvantages of various detectors & appropriateness of different detectors for different type of radiation measurement

UNIT-III **15 Hours**

Dose and Dosimetry - CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization, Dose area product in fluoroscopy and angiography systems, AGD in mammography, Radiation protection, Hazard evaluation and control:: Philosophy of Radiation protection Radiation protection of self and patient and General Public, Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey, Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology, Planning consideration for radiology, including Use factor, occupancy factors, and different shielding materials Protection for primary radiation, work load, use factor, occupancy factor, protection from scatter radiation and leakage radiation. X-Ray /Fluoroscopy /Mammography/ Intervention /DSA/CT room design, structural shielding, and protective devices.

UNIT-IV **15 Hours**

Newer Radiation safety protocols and recent advances in radiation safety: Role of Radiographer in Planning & Radiation Protection: Role of technologist in radiology department - Personnel and area monitoring., Setting up of a new X-Ray unit, staff requirement, AERB specifications for site planning and mandatory guidelines –Planning of X-ray/CT rooms, Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification -Evaluation of workload versus radiation factors –Occupational exposure and protection Tools/devices, Regulatory Bodies & regulatory Requirements: International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) - Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of licenses, registrants & employers and Enforcement of Regulatory requirements. (ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection).

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Sherer, M. A. S., Visconti, P. J., Ritenour, E. R., & Kelli Haynes, M. S. R. S. (2013). Radiation protection in medical radiography. Elsevier Health Sciences*

- *Thayalan, K. (2014). The physics of radiology and imaging. JP Medical Ltd..*
- *Bushberg, J. T., & Boone, J. M. (2011). The essential physics of medical imaging. Lippincott Williams & Wilkins.*

Total Hours: 30

Course Name: Radiological & Imaging Procedures (Practical)	**L**	**T**	**P**	**Cr.**
Course Code: MRI104	**0**	**0**	**4**	**2**

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Grasp the responsibility of radiographer during radiological procedures.
2. Understand the basic techniques and their correlation with other techniques of the subsequent special procedures.
3. Classify various types of contrast media used in radiology.
4. Determine appropriate patient interaction and preparation for all Radiographic examinations and procedures maintaining the principle of sterile technique and executing the knowledge of c-arm and manipulation.

Course Contents

Radiography in various positions for all the special radiological procedures, using contrast media

Identification of various films for all the special radiological procedures, using contrast media and related pathologies.

Transactional modes

Video-based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Berlin, L. (1994). A Guide to Radiological Procedures. Radiology, 191(2), 506-506. – Chapman, S., & Nikielny, R. (1986). A guide to radiological procedures.*
- *Gupta, A. K., Garg, A., & Khandelwal, N. (2017).Diagnostic Radiology: Gastrointestinal and Hepatobiliary Imaging. JP Medical Ltd.*

Course Name: Radiation Safety & Protection (Practical

Course Code: MRI105

L	T	P	Cr.
0	0	4	2

Total Hours: 30

Course Learning Outcomes: On successful completion of this course, the students will be able to

1. Perform the basic construction and handling of safety equipment's against radiation.
2. Have the basic knowledge of Radiation Protection, biological effects of Radiation.
3. Understand various biological effects of radiation.
4. Explain various dose fractionations.

Course Contents **30 Hours**

Radiation Protection in: Radiography, Fluoroscopy, Mammography, Mobile Radiography, CT scan, DSA and Interventional Radiology

Radiation measuring instruments:

Survey meters

Area monitor

Personnel dosimeters

Film badge

Thermo luminescent dosimeter

Pocket dosimeter.

Occupational exposure and protection Tools/devices

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings-

- *Sherer, M. A. S., Visconti, P. J., Ritenour, E. R., & Kelli Haynes, M. S. R. S. (2013). Radiation protection in medical radiography. Elsevier Health Sciences.*
- *Thayalan, K. (2014). The physics of radiology and imaging. JP Medical Ltd.*
- *Bushberg, J. T., & Boone, J. M. (2011). The essential physics of medical imaging. Lippincott Williams & Wilkins.*

Course Title: Human Rights and Duties

Course Code: MRI106

L	T	P	Cr.
3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able:

1. To understand the concept of human rights and their historical development.
2. To examine the philosophical and ethical foundations of human rights and duties.
3. To analyze international legal frameworks and mechanisms for the protection of human rights.
4. To explore contemporary issues and challenges in the field of human rights.

Course Contents

UNIT-I **15 Hours**

Introduction to Human Rights, Definition and historical evolution of human rights, Universal Declaration of Human Rights (UDHR) and its significance, Cultural relativism vs. universalism in human rights discourse, Theories of natural law, social contract, and human dignity, Debates on the universality and cultural specificity of human rights, Relationship between rights and moral duties.

UNIT-II **10 Hours**

L	T	P	Cr
2	0	0	2

 International human rights law: treaties, conventions, and customary law, Regional human rights systems (e.g., European Convention on Human Rights, African Charter on Human and Peoples' Rights), National constitutions and domestic protection of human rights, Right to life, liberty, and security, Freedom of expression, assembly, and association, Right to a fair trial and due process.

UNIT-III **10 Hours**

Right to education, healthcare, and social security, Right to work, just and favorable conditions of work, and adequate standard of living, Challenges in realizing economic and social rights, Rights of indigenous peoples, Rights of minorities and marginalized groups, Intersectionality and multiple forms of discrimination.

UNIT-IV **10 Hours**

Human rights violations in armed conflicts and humanitarian crises, Gender equality and women's rights, Rights of refugees, migrants, and stateless persons, Strategies for promoting and defending human rights, Role of civil society organizations, NGOs, and grassroots movements, Ethical dilemmas and challenges in human rights advocacy

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested readings

- *"The Idea of Human Rights" by Charles R. Beitz*
- *"Just and Unjust Wars" by Michael Walzer*
- *"The Ethics of Authenticity" by Charles Taylor*
- *"Global Justice: A Cosmopolitan Account" by Gillian Brock*

Course Title- Communication and soft Skills

Course Code: MRI107

Total Hours 30

Course Learning Outcomes: On completion of this course, the successful students

will be able to:

1. Developing presentation skills involves organizing content, using visual aids effectively, maintaining audience engagement, and delivering information confidently and persuasively.
2. Critical thinking involves analyzing information, evaluating arguments, and presenting logical and well-supported ideas.
3. Speak fluently and clearly is crucial for effective communication. This includes
4. using appropriate vocabulary, grammar, pronunciation, and intonation to convey messages accurately.
5. Involve paying attention, asking clarifying questions, and demonstrating understanding through appropriate responses.

UNIT-I **10 Hours**

Basics of Grammar- Part I Vocabulary, Synonyms, Antonyms, Prefix and Suffix, Homonyms, Analogies and Portmanteau words. Basics of Grammar – Part II Active, Passive, Direct and Indirect speech, Prepositions, Conjunctions and Euphemisms.

UNIT-II **05 Hours**

Writing Skills, Letter writing, E mail, and Essay, Articles, and Memos, one word substitutes, note making and Comprehension.

UNIT-III **10 Hours**

Communication: Introduction: Communication process, Elements of communication, Barriers of communication and how to overcome them, Nuances for communicating with patients and their attenders in hospitals.

UNIT-IV **05 Hours**

Non Verbal Communication: Basics of non-verbal communication, Rapport building

skills using neuro- linguistic programming (NLP).

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings:

1. *The Elements of Style" by William Strunk Jr. and E.B. White*
2. *How to Win Friends and Influence People" by Dale Carnegie*
3. *Crucial Conversations: Tools for Talking When Stakes Are High" by Kerry*
4. *Patterson, Joseph Grenny, Ron McMillan, and Al Switzler*
5. *On Writing Well" by William Zinsser*

Course Name: Mammography & Ultrasonography

Course Code: MRI108

L	T	P	Cr.
3	0	0	3

Total Hours: 45

Course Learning Outcomes: On successful completion of this course, the students will be able to

1. Identify & label the anatomical structures of the breast.
2. Perform mammograms by positioning the patient & equipment according to department protocol or requisition.
3. Recognize clinical breast changes.
4. Assess and quantify pathologies.

Course Content

UNIT-I **10 Hours**

Instrumentation: Mammographic unit, X-ray tube design, Film screen mammography, Digital mammography, Digital breast Tomosynthesis, Laser mammography

UNIT-II **10 Hours**

ICRP guidelines- Indication & contra-indication, BIRADS, Scintimammography, Optical mammography, Positron emission mammography

UNIT-III **10 Hours**

USG-Tissue Harmonic Imaging**,** Contrast enhanced ultrasound**,** Transrectal ultrasound**,** Properties of USG**,** Interaction of Usg with matter**,** Physics of Transducer

UNIT-IV **15 Hours**

Doppler Imaging-Doppler principles and instrumentation, Types of Doppler Image Display-Display modes, Real time USG, Pulse echo USG, Ultrasound contrast agents

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Andolina, V., & Lillé, S. (2011). Mammographic imaging: a practical guide. Lippincott Williams & Wilkins.*
- *Hoda, M. N. (2016). INDIA Com-2016.*

Course Name Pediatric Radiology

Course Code: MRI109

L	T	P	Cr.
3	0	0	3

Total Hours: 45

Course Learning Outcomes: On successful completion of this course, the students will be able to

1.Have Knowledge of indications for the Paediatric Imaging examinations
2. Describe the positioning techniques & technical factors leading to optimum chest, abdomen, GI & GU radiographs of the infant.
3. Establish bone age on the basis of radiographic findings.
4. Perform fluoroscopic procedures with the assistance of the radiologist.
5. Explain films with the assistance of the radiologist.

Course Contents

UNIT I **10 Hours**

Introductory course-Pediatric chest Imaging**,** Pediatric Abdomen Imaging**,** Pediatric Fractures**,** Trauma in the pediatric patient

UNIT II **10 Hours**

Role of Radiographer in Neonatal/Pediatric Radiography, Systemic evaluation of newborn chest radiographs, Head trauma, cervical spine trauma, Chest trauma

UNIT III **10 Hours**

Cholelithiasis, Appendicitis, Renal calculi, Hydronephrosis , Vesicoureteric reflux, Nephritic Syndrome, Glomerular Nephritis, Pancreatitis, Appendicitis, Liver Cirrhosis.

UNIT IV **15 Hours**

Strategies for Radioprotection in children, Radiation management for fluoroscopy and angiography, Radiation protection in Radiography, Biological effects of radiation

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested readings

- *Amis Jr, E. S., Butler, P. F., Applegate, K. E., Birnbaum, S. B., Brateman, L. F., Hevezi, J. M., ... & Zeman, R. K. (2007). American College of Radiology white paper on radiation dose in medicine. Journal of the american college of radiology, 4(5), 272-284.*

- *Gennadios, A., Weller, C. L., & Gooding, C. H. (1994). Measurement errors in water vapor permeability of highly permeable, hydrophilic edible films. Journal of food engineering, 21(4), 395-409.*

Course Name: Care & maintenance of diagnostic equipments/ Instruments Course Code: MRI110	L	T	P	Cr.
	3	0	0	3

Total Hours: 45

Course Learning Outcomes: On successful completion of this course, the students will be able to

1. Have knowledge about Appropriate label, file and store film.
2. Demonstrate proper maintenance of radiographic equipment, including recognition of faulty equipment operation.
3. Implement radiographic quality control measures.
4. Develop an understanding of proper processing and handling methods for radiographic film.

Course Contents

UNIT I **10 Hours**

Methods used for the development of a radiographic technique chart
Importance of screen and film preparation in the production of diagnostic quality radiographs

UNIT II **10 Hours**

Explain different electrical & physical properties of a X ray machine affect the X ray beam before it enters the subject. Proper handling of x ray machine and its component parts

UNIT III **15 Hours**

Maintenance & care of all X Ray equipment's & accessories, Effect of KV and mAs.
Radiation protection devices, X Ray tubes and accessories. Portable X Ray equipment

UNIT IV **10 Hours**

Care of X ray cassettes, Intensifying screen, Image processing equipment's with demonstration. Handling of processing chemicals
Safe light test

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Reading

- *Curry, T. S., Dowdey, J. E., & Murry, R. C. (1990). Christensen's physics of diagnostic radiology. Lippincott Williams & Wilkins.*
- *CAS, M., & ICSSR, A. (1997). Evaluative Report of the Department. Science, 1, 1.*

Total Hours: 45

Course Learning Outcomes: On successful completion of this course, the students will be able to

1. Gain knowledge regarding maintenance of medical record and documents in radiology department

2. Understand about transferring the patients without causing any hurdle and can restrain the un co-operative patients throughout radiological examinations.

3. Categorize the moral, clinical and ethical liability of radiographer.

4. Analyze sterilized techniques to reduce the chance of infection in work practices.

Course Name: General Patient Care in Hospital

Course Code: MRI111

L	T	P	Cr.
3	0	0	3

Course Contents

UNIT I **10 Hours**

Hospital Staffing and Administration, records, professional, ethics, cooperation with other staff and departments, Departmental organizations. Handling of the patients, seriously ill and traumatized patients, visually impaired, speech and hearing impaired, mentally impaired, drug addicts and non-English speaking patients. Understanding patient needs - patient dignity of inpatient and out patients. Interaction with the patient's relatives and visitors

UNIT II **10 Hours**

Methods of Effective Communication - Verbal skills, body language, professional appearance, visual contact etc., Elementary personal and departmental hygiene, dealing with receptacles, bedpans and urinals etc., General preliminaries to the exam

UNIT III **10 Hours**

Moving Chair and Stretcher Patient, Unconscious patient, general comfort and reassurance for the patient Vital signs and oxygen - patient's Homeostasis status, Body temp, respiratory rate, pulse, blood pressure, oxygen therapy, oxygen devices, Chest tubes and lines

UNIT IV **15 Hours**

First aid - Shock, electrical shock, hemorrhage, burns, Asphyxia, fractures, loss of consciousness, Emergency treatment to the collapsed patient, Artificial respiration and resuscitation, Preparation of patients for general and special radiological examinations, Supervision of patients undergoing special examination, Administration of drugs and contrast media. Aseptic and Sterile procedures, handling of infections patients in the department or in the ward, Regulation of dangerous drugs, Trolley set up for special x-ray examinations, Radiation hazardous and protective measures.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Ashalatha, P. R., &Deepa, G. (2012).Textbook of Anatomy & Physiology for Nurses. JP Medical Ltd.*
- *Pal, G. K. (2006).Textbook Of Practical Physiology-2Nd Edn. Orient Blackswan.*
- *Ehrlich, R. A., &Coakes, D. M. (2016).Patient care in radiography-ebook: with an introduction to medical imaging. Elsevier Health Sciences.*
- *Adler, A. M., & Carlton, R. R. (2015).Introduction to Radiologic and Imaging Sciences and Patient Care-EBook.Elsevier Health Sciences.*

Semester-II

Course Name **Advanced Technique & Instrumentation of MRI**

Course Code: **MRI201**

L	T	P	Cr.
4	0	0	4

Total Hours: 60

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Understand patient care/safety procedures.
2. Identify normal anatomical structures as seen in MRI23.
3. Explain the physical principles of magnetic resonance imaging.
4. Describe and justify the imaging protocols and alternative techniques used in MRI23.

Course Contents

UNIT I **15 Hours**

Basic principles, Spin precession Relaxation time pulse cycle, T1 weighted image T2 weighted image Proton density image, MR instrumentation, Types of magnets, RF transmitter & receiver coils, Gradient coils, shim coils, RF shielding

UNIT II **15 Hours**

Pulse sequences-Spin echo pulse sequence – turbo spin echo pulse sequence
Gradient echo sequence – Turbo gradient echo pulse sequence, Inversion recovery sequence – STIR sequence, SPIR sequence, FLAIR sequence, Echo planar imaging and fast imaging sequences, Advanced pulse sequences. Image formation, 2D Fourier transformation, K-space representation, 3D fourier imaging, MIP, Functional MRI23, Bold Imaging

UNIT III **15 Hours**

MR contrast media, MR angiography – TOF & PCA, MR spectroscopy, Protocols in MRI23 for whole body, MRI23 artifacts, safety aspects in MRI23, Cardiac MRI23, Musculoskeletal imaging protocols

UNIT IV **15 Hours**

Abdominal imaging protocols, Care, maintenance and tests, General care, Functional tests, Quality assurance program, acceptable limits of variation.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Horowitz, A. L., & Horowitz, A. L. (1992). MRI23 physics for radiologists. Springer.*
- *Bradley, R., Danielson, L., & Hallahan, D. P. (2002). Identification of learning disabilities: Research to practice. Routledge.*
- *Hassan, H. A. (2020). Study of MRI23 Image Artifacts.*
- *Bushberg, J. T., & Boone, J. M. (2011). The essential physics of medical imaging. Lippincott Williams & Wilkins.*

Course Name: Recent Advancement in Modern Imaging Technology **Course Code: MRI202**	**L**	**T**	**P**	**Cr.**
	4	**0**	**0**	**4**

Total Hours: 60

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Have the basic knowledge of systematic investigations using contrast media and image intensifier.
2. Know about Radiography in various positions for all the special Radiological procedures, using contrast media.
3. Identify various films for all the special radiological procedures, using contrast media and related pathologies.
4. Analyze various pathologies.

Course Contents

UNIT I **15 Hours**

High Frequency X-Ray Generators and their types and applications, Modern x-ray tubes-their types and advancements, Special radiological equipment: Computed radiography: its

principle, physics & equipment. Digital Radiography, Direct and indirect digital radiography Digital Fluoroscopy , Digital Mammography; including cones compression devices Stereotactic Biopsy system including Prone Table Biopsy system, Image Receptors: Flat Panel Detectors, Image Processing Workstation and Imaging Cameras.

UNIT II **15 Hours**

Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of topographic movements, Tomosynthesis, Stitch radiography, Dual energy x-ray absorptiometry (DEXA) scan, Vascular Imaging Equipment: Introduction, historical developments DSA Equipment- Principle, applications and definition of terms, Single Plane, Biplane, Hybrid DSA Lab- digital subtraction techniques.

UNIT III **15 Hours**

Scatter radiation its formation and control: beam centering devices, collimators, cone diaphragms and grids, Fluoroscopy and IITV systems including cine radiography with various recording devices, Computed Tomography -Principle, data acquisition concepts, image reconstruction, instrumentations, image manipulation Historical developments - Various generations, spiral/helical, single slice/multislice CT, Electron beam CT, mobile CT, Advances in volume scanning, continuous, sub-second scanning Real time CT fluoroscopy, interventional guidance tool, 3D CT, CT angiography. Virtual reality imaging, including image quality and quality control in CT Scanners.

UNIT IV **15 Hours**

Ultrasonography: :Basic principle of U.S., various types of transducers, mechanism of image formation, various advancements including Doppler, Elastography, HIFU,ABVS and image artifacts. MRI: Basic principle of MRI, complete imaging equipment and various requirements, T1 and T2 Relaxation behaviors of tissues, T1, T2 and proton density images, spatial localization of images. Types of imaging sequences (spin echo, fast spin echo, flash, inversion recovery, gradient echo etc. MR spectroscopy, principle and techniques, Contrast Agents in MRI, Image quality, Image artifacts and its compensators, NMR hazard and safety. Advances in MRI, Radionuclide scanning including rectilinear scanner, gamma camera, PET, SPECT, their principles, working, applications and advancements, Care and maintenance of radiological equipment's

Transactional modes

Video-based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Stanton, L. (1969). Basic Medical Radiation Physics.*

- *Seeram, E. (2019). "Digital Radiography: Physical Principles and Quality Control". Springer.*
- *Debnath, J. (2016). Textbook of radiology for residents and technicians. Astrocyte, 2(4), 221-221.*
- *Curry, T. S., Dowdey, J. E., & Murry, R. C. (1990). Christensen's physics of*
- *diagnostic radiology. Lippincott Williams & Wilkins.*
- *Allisy-Roberts, P. J., & Williams, J. (2007). Farr's physics for medical imaging. Elsevier Health Sciences.*

Course Name: Nuclear Medicine

Course Code: MRI203

L	T	P	Cr.
4	0	0	4

Total Hours: 60

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Understand the diagnostic neuroimaging and its role in radiologic diagnosis.
2. Accurately study all images.
3. Demonstrate knowledge of identifying indications for nuclear medicine diagnostic and therapeutic procedures.
4. Explain patient positioning as per protocols.

Course Contents

UNIT I **15 Hours**

History, isotopes and radionuclide, production of radionuclide, Radioactivity, Radioactive transformation, Specific activity, Radiopharmaceuticals and their preparations, precaution while handling radiopharmaceuticals, radioimmunoassay (RIA), documentation, safety consideration – Radiation dose and Quality Assurance, Disposal of Radio-active waste, safety considerations.

UNIT II **15 Hours**

Gamma Camera –Principles of tracer techniques, instrumentation – Parallel multi hole collimator, converging collimator, diverging collimator, pinhole collimator, crystal, photomultiplier, scanning techniques, resolution – Spatial, temporal and its importance.

UNIT III **15 Hours**

Nuclear Imaging – SPECT – Principle, patient preparation, Procedure, Applications,
PET – Principle, Patient preparation, Procedure, Applications.

UNIT IV **15 Hours**

Fusion – Imaging Technology, PET – CT – Principle, Patient preparation

Procedure, Applications, PET – MRI - Principle, Patient preparation, Procedure, Applications, DEXA.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Allisy-Roberts, P. J., & Williams, J. (2007). Farr's physics for medical imaging. Elsevier Health Sciences.*
- *Mettler Jr, F. A., & Guiberteau, M. J. (2012). Essentials of nuclear medicine imaging: expert consult-online and print. Elsevier Health Sciences..*
- *Mburu, L. G. (1997). The role of barium meal examination in diagnosis and evaluation of diseases of the upper gastrointestinal tract at Kenyatta National Hospital (Doctoral dissertation, University of Nairobi).*

Course Name: Advanced Technique & Instrumentation of MRI23 (Practical)
Course Code: MRI304

L	T	P	Cr.
0	0	4	2

Total Hours: 30

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Understand patient care/safety procedures.
2. Identify normal anatomical structures as seen in MRI.
3. Explain the physical principles of magnetic resonance imaging.
4. Describe and justify the imaging protocols and alternative techniques used in MRI.

Course Contents

30 Hours

Methods of MRI23 imaging – Head and Neck**,** Thorax**,** Abdomen**,** Musculoskeletal Imaging**,** Types of common sequences**,** Protocols for various studies, Paramagnetic agents and dose, Role of radiographer as MRI technician.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings –

- *Horowitz, A. L., & Horowitz, A. L. (1992). MRI physics for radiologists. Springer.*
- *Bradley, R., Danielson, L., & Hallahan, D. P. (2002). Identification of learning disabilities: Research to practice. Routledge.*
- *Hassan, H. A. (2020). Study of MRI23 Image Artifacts.*
- *Bushberg, J. T., & Boone, J. M. (2011). The essential physics of medical imaging. Lippincott Williams & Wilkins.*

Course Name: Recent Advancement in Modern Imaging Technology (Practical) **Course Code: MRI205**	**L**	**T**	**P**	**Cr.**
	0	**0**	**4**	**2**

Total Hours: 30

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Analyze the production of x-rays and various characteristics
2. Understand contrast image acquisition techniques.
3. Compare various digital radiography image receptor and detector systems.
4. Discuss beam restriction and its effect on patient dose and image quality

Course Contents

30 Hours

X-Ray tubes and accessories, general features.

Portable X-Ray Equipment

Image intensifier, its features, spot film.

Analyze the production of x-rays and various characteristics. Analyze the production of x-rays and various characteristics on protection devices

Effects of kV and mAS

Maintenance of X-ray equipment and accessories

Mammography X-Ray tube

Dental X-Ray unit

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Stanton, L. (1969). BASIC MEDICAL RADIATION PHYSICS*

- *Seeram, E. (2019). Digital Radiography: Physical Principles and Quality Control. Springer.*
- *Debnath, J. (2016). Textbook of radiology for residents and technicians. Astrocyte, 2(4), 221-221.*
- *Curry, T. S., Dowdey, J. E., & Murry, R. C. (1990). Christensen's physics of diagnostic radiology. Lippincott Williams & Wilkins.*
- *Allisy-Roberts, P. J., & Williams, J. (2007). Farr's physics for medical imaging. Elsevier Health Sciences.*

Course Name: First Aid

Course Code: MRI206

L	T	P	Cr.
2	0	0	2

Total Hours: 30

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Provide appropriate first Aid for minor injuries including small cuts, grazes, bruises etc.
2. Assess situations and circumstances in order to provide First Aid safely, promptly and effectively in a range of emergencies.
3. Manage organizations, records related to patients and departmental statistics.
4. Administer First Aid to an adult who is choking.

Course Contents

UNIT I **10 Hours**

First aid: Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus; drug reactions; prophylactic measures;

administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons

UNIT II **10 Hours**

Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; Asepsis and antisepsis. Universal precautions, hospital acquired infections-HIV, Hepatitis B, C, and MRSA etc.

UNIT III **05 Hours**

Principles of Asepsis: Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filament swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department (for study by radio imaging students only)

UNIT IV **05 Hours**

Departmental procedures: Department staffing and organizations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department;

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Curry, T. S., Dowdey, J. E., & Murray, R. C. (1990). Christensen's physics of diagnostic radiology. Lippincott Williams & Wilkins.*
- *Podgoršak, E. B. (2006). Radiation physics for medical physicists (Vol. 1). Berlin: Springer.*
- *Weishaupt, D., Köchli, V. D., & Marincek, B. (2008).How does MRI23 work?: an introduction to the physics and function of magnetic resonance imaging. Springer Science & Business Media*

Course Name: Fitness and Health Management

Course Code: MRI207

L	T	P	Cr.
3	0	0	3

Total Hours: 45

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Understand the modern concept of Fitness and Health management.
2. Develop competencies for profile development, exercise guidelines adherence.
3. Apply the fitness and wellness management techniques.
4. Analyze intermediate postures and will develop strength, endurance and increased flexibility.

Course Contents

UNIT I **10 Hours**

Introduction: Meaning and definition" of physical fitness, physical fitness concepts and techniques, Principles of physical fitness, physiological principles involved in human movement, Components of Physical Fitness, Leisure time physical activity and identify opportunities in the community to participate in this activity, Current trends in fitness and conditioning, components of total health fitness and the relationship between physical activity and lifelong wellness

UNIT II **10 Hours**

Nutrients: Nutrition labeling in formation, food choices, food guide pyramid, Influences on food choices social, economic, cultural, food sources, Comparison of food values. Weight management, proper practices to maintain, lose and gain, Eating disorders, proper hydration, and the effects of performance enhancement drugs

UNIT III **10 Hours**

Aerobic Exercise: Cardio respiratory endurance training: Proper movement forms, i.e., correct stride, arm movements, Body alignment: Proper warm-up, cool down and stretching, monitoring heart rates during activity, Assessment of cardio respiratory fitness and set goals to maintain or improve fitness levels, Cardio respiratory activities including i.e. power walking, pacer test, interval training, incline running, distance running, aerobics and circuits

UNIT IV **15 Hours**

Anaerobic exercise: Resistance training for muscular strength and endurance, principles of resistance training, Safety techniques (spotting, proper body alignment, lifting techniques, spatial, awareness, And proper breathing techniques), Weight training principles and concepts, basic resistance exercises (including freehand exercise, free weight exercise, weight machines, exercise bands and tubing. Medicine balls, fit balls) advanced techniques of weight training, Flexibility training, relaxation techniques and core training. Safety techniques (stretching protocol;

breathing and relaxation techniques) types of flexibility exercises (i.e. dynamic, static), Develop basic competency in relaxation and breathing techniques. Pilates, Yoga.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Miller, D. K., & Allen, T. E. (1990). Fitness: A lifetime commitment. Macmillan Publishing Company.*
- *Course, P. B. P. Part A: Theoretical Course. Education, 30(70), 100.*
- *Part, A. Course: Master of Physical Education (MP Ed) Semester–I. Education, 3, 3.*
- *Heindel, J. J., & Blumberg, B. (2019). Environmental obesogens: mechanisms and controversies. Annual review of pharmacology and toxicology, 59, 89-106.*
- *Education, P. SCHEME OF EXAMINATION MP ED. COURSE MP ED. SEMESTER–I. Education, 30(70), 100.*

Course Name: General Pathology & Terminology

Course Code: MRI208

L	T	P	Cr.
3	0	0	3

Total Hours: 45

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Classify diseases of various body systems and how they manifest clinically and histopathologically.
2. Apply knowledge of pathology's role in the diagnosis, staging and management of disease.
3. Explain the basic nature of disease processes from the standpoint of causation, epidemiology, and natural history, structural and functional abnormalities.
4. Utilize high quality reviewed literature to maintain currency in the management of pathologic conditions.

Course Contents

UNIT I **15 Hours**

Cell injury, cellular adaptation and cell death, Causes of cell injury, Reversible and irreversible cell injury, Necrosis, Apoptosis, Calcification, Hyperplasia, Hypertrophy, Atrophy and Metaplasia

UNIT II **10 Hours**

Fluid and hemodynamic disturbances, Oedema, Shock, Thrombosis, Embolism and Infarction

UNIT III **10 Hours**

Neoplasia: Definition, types, Characteristics of Neoplasia, Routes of spread

UNIT IV **10 Hours**

Respiratory and Hematology, Pneumonia, COPD, Tuberculosis, Anemia and Leukemia

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings –

- *Goljan, E. F. (2013). Rapid review pathology: with student consult online access.*
- *Klatt, E. C., & Kumar, V. (2014). Robbins and Cotran review of pathology. Elsevier Health Sciences.*
- *Reid, R., Roberts, F., & MacDuff, E. (2011). Pathology illustrated E-book. Elsevier Health Sciences.*

Course Name: Neuroradiology

Course Code: MRI209

L	T	P	Cr.
3	0	0	3

Total Hours: 45

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Understand the diagnostic neuroimaging and its role in radiologic diagnosis.
2. Accurately study all images.
3. Impart adequate holistic knowledge – both basic and applied aspects of Neuroimaging.
4. Specify various advanced procedures.

Course Contents

UNIT I **15 Hours**

BRAIN – Normal anatomy and common variants**,** Congenital Malformations Inherited Metabolic Disorders, Acquired Metabolic, Systemic and Toxic Disorders Hemorrhage, Trauma, Herniation, Infarction, Dementia and Degenerative disease Vascular lesions

UNIT II **10 Hours**

HEAD & NECK – Skull base, Temporal bone, Orbit, Visual pathway, Paranasal sinuses, Nasal and Face, Mandible, Temporomandibular joint, Nasopharynx

UNIT III **10 Hours**

SPINE – Normal Anatomy, Imaging technique and common variants, Congenital Disease, Trauma, Degenerative disease, Arteriovascular disease & Ischemia, Infection and inflammation

UNIT IV **10 Hours**

Neoplasms - Soft tissues of the neck, vascular lesions, Cerebrospinal fluid disorders, Oral cavity, Oro-pharynx, Infection and Inflammation

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Waxman, S. G. (2016). Clinical neuroanatomy. McGraw-Hill Education.*
- *Osborn, A. G., & Digre, K. B. (2016). Imaging in Neurology E-Book. Elsevier Health Sciences.*

Course Name: Biomedical Waste Management

Course Code: MRI210

L	T	P	Cr.
3	0	0	3

- *Naidich, T. P., Castillo, M., Smirniotopoulos, J. G., Kollias, S., Cha, S., & Raybaud, C. (2010). Imaging of the Spine E-Book: Expert Radiology Series. Elsevier Health Sciences.*

Total Hours: 45

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Prepare infectious waste containers for proper disposal.
2. Identify appropriate personal protective equipment to handle regulated medical waste.
3. Segregate regulated medical waste into non-infectious and infectious categories.
4. Collect each category of wastes in the proper container.

Course Contents

UNIT I **10 Hours**

Sources, Composition and characteristic of hazardous waste, Hazardous Waste (Management and Handling) Rules, 1989 and amendments, Federal Hazardous Waste Regulations under RCRA, Superfund, CERCLA and SARA. Toxicology, public health impact, Protocols, issues and challenges in transportation of hazardous waste

UNIT II **10 Hours**

Characterization of medical waste- Bio-medical wastes (Management and Handling) Rules, 1998, Amendments and guidelines, segregation, packaging, storage, transport of infectious waste. Techniques of Biomedical waste management. Health and safety rules, Protocols, issues and challenges in transportation of Biomedical waste.

UNIT III **10 Hours**

Treatment method- Autoclave, Hydroclave, Microwave, Chemical Disinfection, Solidification and stabilization, Bioremediation, Thermal Conversion Technologies, accumulation and storage of hazardous waste, land disposal of hazardous waste, other treatment and disposal method. Common Hazardous Waste Treatment facilities (TSDF)

UNIT IV **15 Hours**

E-waste: Introduction, toxicity due to hazardous substances in e-waste and their impacts, domestic e-waste disposal, e-waste management, technologies for recovery of resource from electronic waste, guidelines for environmentally sound management of e-waste, occupational and environmental health perspectives of recycling e-waste in India.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Tchobanoglous, G. (1993). Integrated solid waste management engineering principles and management issues (No. 628 T3).*
- *Vijay, R., Gautam, A., Kalamdhad, A., Gupta, A., & Devotta, S. (2008). GIS-based locational analysis of collection bins in municipal solid waste management systems. Journal of Environmental Engineering and Science, 7(1), 39-43.*
- *Kiely, G. (2007). Environmental engineering. Tata McGraw-Hill Education.*
- *Manjare, S. D., & Karthick, S. (2008). Sustainability and Human Development. Environmental Science and Technology in India, 438..*
- *Johri, R. (Ed.). (2008). E-waste: implications, regulations, and management in India and current global best practices. The Energy and Resources Institute (TERI)..*

Semester III

Course Title: Research Methodology

Course Code: MRI301

L	T	P	Cr.
4	0	0	4

Total Hours: 60

Course Learning Outcomes: On successful completion of this course, the students will be able to:

1. Prioritize the needs of research in the clinical field of Radiology.
2. Choose the appropriate research design and develop appropriate research hypothesis for a research project.
3. Describe the appropriate statistical methods required for a particular research design
4. Develop the ability to apply the methods while working on a research project work

Course Contents

UNIT-I **15 Hours**

Research: its concept, nature, scope, need and Objectives of Research, Research types, Research methodology, Research process – Flow chart, description of various steps, Selection of research problem.

UNIT-II **15 Hours**

Research Design: Meaning, Objectives and Strategies of research, different research designs, important experimental designs, Methods of Data Collection and Presentation: Types of data collection and classification, Observation method, Interview Method, Collection of data through Questionnaires, Schedules, data analysis and interpretation, editing, coding, content analysis and tabulation.

UNIT-III **15 Hours**

Sampling Methods: Different methods of Sampling : Probability Sampling methods , Random Sampling,

Systematic Sampling, Stratified Sampling, Cluster Sampling and Multistage Sampling. Non probability Sampling methods, Sample size.

UNIT-IV **15 Hours**

Report writing and Presentation: Types of reports, Report Format – Cover page, Introductory page, Text, Bibliography, Appendices, Typing instructions, Oral Presentation

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question, pptx

Text Books:

Panneerselvam, R , 'Research Methodology', PHI, New Delhi.
Cooper, D.R.,Schindler,P.S., 'Business Research Methods,' Tata McGraw Hill Gupta S P,' Statistical Methods', Sultan Chand & Sons, Delhi Ronald E Walpole, 'Probability and Statistics for Engineers and Scientists'
(International Edition) , Pearson Education. Geode, Millian J. & Paul K. Hatl, "Methods in Research", McGraw Hills, New Delhi.

Reference Books:

- *Kothari C.R., "Research Methodology", New Age Publisher Nargundkar R, Marketing Research, Tata McGraw Hill, New Delhi, 2002. Sekran, Uma, "Business Research Method", Miley Education, Singapore.*

Website/Links/Online Portal/ICT

• https://www.academia.edu/
• https://www.studeersnel.nl
• https://www.scribd.com

Course Title: Research Proposal

Course Code: MRI398

L	T	P	Credits
0	0	8	4

Learning Outcomes

After completion of the course, the learner willbe able to

1. Get deep insights to collect, review and analyze the related literature.
2. To apply the knowledge to formulate hypothesis & design research process.
3. Find the research titles which are significant, applicable and researchable.
4. Interpret the findings to design statistical strategies & write references, bibliography and webliography.

Course Content

A research proposal contains all the key elements involved in the research process and proposes a detailed information to conduct the research.
The students are supposed to prepare the research proposal of any research area of their choice following these steps:

1. Selection of topic
2. Significance of the research area
3. Formulation of hypothesis/Research questions
4. Review of related literature
5. Method & Procedure (Includes sampling & design)
6. Data collection and proposed statistical analysis
7. Delimitations
8. Reference/Bibliography

Evaluation

The students will have to complete the writing process of each topic given above within one week, which will be evaluated at the end of every week. It will consist of 8 marks each. The final proposal shall be of 15 marks, Viva 16 marks and attendance 5 marks.

Transaction Mode

Collaborative learning, Group Discussion, E team Teaching, Activities, Assessments, Collaborative teaching, Peer Teaching, Video Based Teaching, Quiz, Open talk, E team Teaching, Case analysis, Flipped Teaching

Course Title: Management & Planning of Radiology

Course Code: MRI303

Hours 60

L	T	P	Cr.
4	0	0	4

Total

Course Learning Outcomes: On successful completion of this course, the students will be able to:

5. Have Known the fundamental ideas about circuit analysis, working principles of machines. In addition, the course is expected to develop scientific temperament & analytical skill in students, to enable them logically tackle complex engineering problems in the chosen area of application.
6. Have the basic knowledge of Radiation Protection, Biological effects of radiation, planning of radiation installation-protection, primary & secondary radiation & Personnel monitoring systems.
7. Learn about the regulatory bodies & regulatory requirements.
8. Analyze the rule of technologist in radiology department.

Course Content

UNIT-I **15 Hours**

Planning consideration for radiology, including Use factor, occupancy factors, and different shielding materials Protection for primary radiation, work load, use factor, occupancy factor, protection from scatter radiation and leakage radiation Ray/Fluoroscopy/Mammography/Intervention/DSA/CT room design, structural shielding, and protective devices.

Regulatory Bodies & regulatory Requirements: International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) - Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of licenses, registrants & employers and Enforcement of Regulatory requirements. (ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection)

UNIT-II **15 Hours**

Surveys and regulations**:** Radiation protection survey: Need for survey, Performance standards for beam directing, beam defining and limiting devices in radiation protection equipment survey of the following: Radiographic equipment, Fluoroscopic equipment, CT and special equipment. Controlled and non-controlled areas and acceptable exposure levels, State and local regulations governing radiation protection practice. Personal monitoring and occupational exposures: Personal monitoring for Radiation workers. Monitoring devices, Body badges and ring badges. Thermo-luminescent dosimeters, Pocket ionization chambers, Applications, advantages and limitations of each device, Values for dose equivalent limits for occupational radiation exposures

UNIT-III **15 Hours**

NABH guidelines, AERB guidelines and code, Basic safety standard, PNDT Act and guidelines, Procedural safety Achievable safety through compliance on the regulations in India and recommendations of ICRT, IAEA, Role of Radiographer in Planning & Radiation Protection: Role of technologist in radiology department - Personnel and area monitoring., Setting up of a new X-Ray unit, staff requirement, AERB specifications for site planning and mandatory guidelines –Planning of X-ray/CT rooms, Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification -Evaluation of workload versus radiation factors –Occupational exposure and protection Tools/devices.

UNIT-IV **15 Hours**

Introduction to Management of a Radiology Department**,** Strategic Management, Decision Making, conflict and stress management, Managing Change and Innovation, Understanding Groups and Teams, Leadership, Time Management, Cost and efficiency

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question:

Suggested Readings

- *Waugh, A., & Grant, A. (2014). Ross & Wilson Anatomy and physiology in health and illness E-book.Elsevier Health Sciences.*
- *Sembulingam, K., &Sembulingam, P. (2012). Essentials of medical physiology. JP Medical Ltd*
- *Chaurasia, B. D. (2004). Human anatomy (p. 53).CBS Publisher.*
- *Marieb, E. N., &Nicpon-Marieb, E. (1992). Human anatomy and physiology Redwood City, CA: Benjamin/Cummings Publishing Company.*
- *Hall, J. E., & Hall, M. E. (2020). Guyton and Hall textbook of medical physiology e-Book.Elsevier Health Sciences.*

Course Name: Innovation, creativity and Entrepreneurial mind set
Course Code: MRI304

L	T	P	Cr
0	0	4	2

Total Hours: 30

Learning Outcomes: After successful completion of this course, the learner will be able to:

1. Prioritize the needs of research in the clinical field of Radiology.
2. Choose the appropriate research design and developappropriate research hypothesis for a research project.
3. Describe the appropriate statistical methods required for a particular research design
4. Develop an appropriate framework for research studies.
5. Develop the ability to apply the methods while working on a research project work

Course Contents

UNIT-I **10Hours**

Need For Research in the Field of Cardiology. Introduction to research methods, conducting a literature review, Research design, Sampling methods, Data collection and data collection tools, Data analysis: Quantitative and Qualitatively, Public health research, Issues in Research of research problems and writing research questions, Hypothesis, Null and Research Hypothesis, Type I and Type II errors in hypothesis testing

UNIT-II **10 Hours**

Introduction of Epidemiology:- Descriptive epidemiology, Experimental and non-experimental research designs, Screening, Sampling methods, Biological variability, normal distribution.

Bias and Confounding, Association and causation, Odds ratio and relative risk, sensitivity and specificity Data collection methods- Observation method, Interview method, Questionnaires and schedules Construction,

UNIT-III **05 Hours**

Introduction to Statistics, Classification of data, Source of data, Method of scaling - nominal, ordinal, ratio and interval scale, measuring reliability and validity of scales, Measures of Central tendency,

UNIT-IV **05 Hours**

Measures of Dispersion, Skewness and kurtosis, Sampling, Sample size determination, Introduction and method of collecting and presenting statistical data. Calculation and interpretation of various measures like mean, median, standard deviations, Skewness and Kurtosis, Probability distribution, Correlation and regression Significance tests and confidence intervals

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question,pptx

Suggested Readings

Spiegel, M. R., Schiller, J. J., & Srinivasan,
R. A. (2013). Schaum's outline of probability and statistics.
McGraw-Hill Education Kothari, Chakravanti Rajagopalachari. Research methodology: Methods and techniques. New Age International, 2004.
Mahajan, B. K., &Lal, S. (1999). Methods in biostatistics for medical students and research workers.Indian Journal of Community Medicine, 24(3),

Course Title: Drug abuse

Course Code: MRI305

L	T	P	Cr.
2	0	0	2

Total Hours 30

Course Learning Outcomes: On successful completion of this course, the students will be able to:

9. Have Known the fundamental ideas about circuit analysis, working principles of machines. In addition, the course is expected to develop scientific temperament & analytical skill in students, to enable them logically tackle complex engineering problems in the chosen area of application.
10. Have the basic knowledge of Radiation Protection, Biological effects of radiation, planning of radiation installation-protection, primary & secondary radiation & Personnel monitoring systems.
11. Learn about the regulatory bodies & regulatory requirements.
12. Analyze the rule of technologist in radiology department.

Course Content

UNIT-I **10**

Problem of Drug Abuse: Concept and Overview; Types of Drug Often Abused
(a) Concept and Overview
What are drugs and what constitutes Drug Abuse?
Prevalence of menace of Drug Abuse
How drug Abuse is different from Drug Dependence and Drug Addiction?
Physical and psychological dependence- concepts of drug tolerance
(b) Introduction to drugs of abuse: Short Term, Long term effects & withdrawal symptoms
Stimulants: Amphetamines, Cocaine, Nicotine
Depressants: Alcohol, Barbiturates- Nembutal, Seconal, Phenobarbital Benzodiazepines –Diazepam, Alprazolam, Flunitrazepam
Narcotics: Opium, morphine, heroin
Hallucinogens: Cannabis & derivatives (marijuana, hashish, hash oil)
Steroids
Inhalants

UNIT: II –Nature of the Problem **05**

Vulnerable Age Groups
Signs and symptoms of Drug Abuse
(a)- Physical indicators
(b)- Academic indicators
(c)- Behavioral and Psychological indicators

3

SECTION B

UNIT: III – Causes and Consequences of Drug Abuse 10

a) Causes
Physiological
Psychological
Sociological
b) Consequences of Drug Abuse
For individuals
For families

For society & Nation

Unit: IV- Management & Prevention of Drug Abuse **05**

Management of Drug Abuse
Prevention of Drug Abuse
Role of Family, School, Media, Legislation & Deaddiction Centers

Suggested readings

1. Kapoor.T. (1985) Drug Epidemic among Indian Youth, New Delhi: Mittal Pub
2. Modi, Ishwar andModi, Shalini (1997) Drugs: Addiction and Prevention,Jaipur: Rawat Publication.
3. Ahuja, Ram,(2003),Social Problems in India, Rawat Publications: Jaipur
4. 2003 National Household Survey of Alcohol and Drug Abuse. New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
5. World Drug Report 2011, United Nations Office of Drug and Crime.
6. World Drug Report 2010, United nations Office of Drug and Crime.
7. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
8. The Narcotic Drugs and Psychotropic Substances Act, 1985, (New Delhi: Universal, 2012

Course Title: Bioinformatics and Computational biology

Course Code: MRI306

L	T	P	Cr.
0	0	2	1

Total Hours: 30

Learning Outcomes: On successful completion of this course, the students

will be able to:

1. Understand the concepts of computer system, Windows operating system, Internet, various storage devices and computer Networks, e- waste
2. Analyze various components and Input output devices used in a computer system.
3. Utilize various applications and software's used
4. Creating and manipulating presentation, views, and formatting and enhancing text, and slide with graphs

Course Contents

UNIT-I **05 Hours**

Generating Charts/Graphs in Microsoft Excel, Power Point

Presentation, Creating a new document with templates & Wizard, Word basics, Thesis Writing Formats & scientific editing tools. Style Formats (MLA & APA)

UNIT-I **05 Hours**

Using Words Drawing Features, Inserting Tables – (Adding, deleting, modifying rows and columns - merging & splitting cells), Using formulas in tables, Converting text to table and vice-versa, Mail Merge tool. Managing Workbooks, Working with Worksheets.

UNIT-III **10 Hours**

Introduction of Windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resize minimizing and maximizing, etc.). Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.

UNIT-IV **10 Hours**

Introduction to Excel: introduction, about worksheet, entering information, saving. Introduction of Operating System: introduction, operating system concepts, types of operating system. Computer Networks: introduction, types of network (LAN, MAN, WAN, Internet,
Intranet), network topologies (star, ring, bus, mesh, tree,
hybrid), components of network.

Transaction Mode-

Video based teaching, collaborative teaching, case based teaching, question

Text Books:

- *Leon & Leon, "Introduction to Computers", Vikas Publishing House, New Delhi Saxena S., "*
- *MS Office Xp for Everyone", Vikas Publishing House, New*

Delhi, 2007 June Jamrich Parsons, "Computer Concepts", Thomson Learning, 7th Edition, Bombay

Reference Books:

- *White, "Data Communications & Computer Network", Thomson Learning, Bombay Comer, "Computer networks and Internet", Pearson Education, 4eRajaraman, V., &Radhakrishnan, T. (2006).*
- *Digital Logic and Computer Organization. PHI Learning Pvt. Ltd..Mehdi,*
  M. M. (2015). Information Technology for Management by. FIIBBusiness Review, 4(1), 46-47.Ram, B. (2000).
- *Computer fundamentals: architecture and organization. New Age International.Basandara, S. K. (2017).*
- *Computers Today ,Galgotia publication PvtLtd. Daryaganj, New Delhi. MSadagopan, S. (1998).*
- *Internet for everyone by Alexis Leon and Matthews Leon, Vikas Publishing House, 1997, Rs. 128.00.Saxena, S. (2009).*
- *A first course in computers: Based on Windows Xp& Office. Vikas Publishing House Pvt Ltd. Sinha P.K. and Sinha, P. (2007)*
- *Computer Fundamentals,BPB Publications. Bangia, R. (2008). Computer Fundamentals and Information Technology. Firewall Media.*

Course Title: Bioethics and intellectual property right

Course Code: MRI307

L	T	P	Cr.
2	0	0	2

Total Hours: 30

Course Learning Outcomes: On successful completion of this course, the students will be able to:

1. Explain different kind of ethics and values.
2. Apply professional ethics in business.
3. Explain the role of IPRs in professional life.
4. Elucidate the importance of patents and copyrights

Course Contents

UNIT-I **07 Hours**

Ethics: definition, moral philosophy, nature of moral judgments and reactions, scope, Ethics with respect to science and research, Intellectual honesty and research integrity scientific misconducts:

UNIT-II **08 Hours**

Falsification, Fabrication, and Plagiarism (FFP) Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and Misrepresentation of data, Publication ethics: definition, introduction and importance.

UNIT-III **08 Hours**

Introduction to Intellectual Property rights: Concept & theories, Kinds of intellectual Property Rights, Advantages & Disadvantages of IPR, Development of IPR in India, Role & Liabilities of IPRs in India.

UNIT-IV **07 Hours**

Rights of trademark-kind of signs used as trademark-types, purpose & Functions of a trademark, trademark protection, trademark registration, selecting and evaluating trade mark, trade mark registration process.

Course Title: First aid

Course Code: MRI308

L	T	P	Cr.
2	0	0	2

Total Hours: 30

Course Learning Outcomes: On completion of this course, the successful students will be able to

1. Provide appropriate first Aid for minor injuries including small cuts, grazes, bruises etc.
2. Assess situations and circumstances in order to provide First Aid safely, promptly and effectively in a range of emergencies.
3. Manage organizations, records related to patients and departmental statistics.
4. Administer First Aid to an adult who is choking.

Course Contents

UNIT I **10 Hours**

First aid: Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus; drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons

UNIT II **10 Hours**

Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; Asepsis and antisepsis. Universal precautions, hospital acquired infections-HIV, Hepatitis B, C, and MRSA etc.

UNIT III **05 Hours**

Principles of Asepsis: Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filament swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department (for study by radio imaging students only)

UNIT IV **05 Hours**

Departmental procedures: Department staffing and organizations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department;

Transactional modes
Video based teaching, Collaborative teaching, Case based teaching, Question

Suggested Readings

- *Curry, T. S., Dowdey, J. E., & Murray, R. C. (1990). Christensen's physics of diagnostic radiology. Lippincott Williams & Wilkins.*
- *Podgoršak, E. B. (2006). Radiation physics for medical physicists (Vol. 1). Berlin: Springer.*
- *Weishaupt, D., Köchli, V. D., & Marincek, B. (2008).How does MRI23 work?: an introduction to the physics and function of magnetic resonance imaging. Springer Science & Business Media*

Course Title: Health care and Nutrition
Course Code: MRI309

L	T	P	Cr.
2	0	0	2

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Achieve a basic understanding of the major components of the current & potential health care delivery systems.
2. Anticipate the interaction of health care providers and diverse patients/families with the various components of the health care systems.
3. Describe the theories/models of leadership & management most effective in the current & potential health care systems.
4. Describe the communication styles of the primary health care providers, e.g., administrators, financial officers, managers, doctors, nurses, patients from low, moderate & high socioeconomic status.

Course Contents

UNIT: I **05 Hours**

Introduction to healthcare delivery system - Healthcare delivery system in India at primary, secondary and tertiary car; Community participation in healthcare delivery system; Health system in developed countries; Private / Govt Sector; National Health Mission; National Health Policy; Issues in Health Care Delivery System in India

UNIT: II **10 Hours**

National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme. Introduction to AYUSH system of medicine - Introduction to Ayurveda; Yoga and Naturopathy; Unani; Siddha; Homeopathy; Need for integration of various system of medicine

UNIT: III **05 Hours**

Health Scenario of India- past, present and future , Demography & Vital Statistics- Demography – its concept, Census & its impact on health policy

UNIT-IV **10 Hours**

Epidemiology - Principles of Epidemiology; Natural History of disease; Methods of Epidemiological studies; Epidemiology of communicable & non- communicable diseases, disease, transmission, host defence immunizing agents, cold chain, immunization, disease, monitoring and surveillance.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question Answer

Suggested Readings

- *Buchbinder, S. B., & Thompson, J. M. (2010). Career opportunities in health care management: Perspectives from the field. Jones & Bartlett Publishers.*
- *Franco, O. H., Peeters, A., Bonneux, L., & De Laet, C. (2005). Blood pressure in adulthood and life expectancy with cardiovascular disease in men and women: life course analysis. Hypertension, 46(2), 280-286.*

Semester 4th

Course Title: Training/Internship report

Course Code: MRI401

L	T	P	Cr.
-	-	-	20

Total hours 300

Course Learning Outcomes: On successful completion of this course, the students will be able to

1. Prepare and maintain Operation Theatre as well as patients before surgery.
2. Maintain a sterile field and theatre equipment and follow infection control policies.
3. Manage hazardous waste and follow biomedical waste disposal protocols.
4. Demonstrate skills and knowledge to assist anesthetist in handling emergencies.

Course Contents

Students have to carry out a research project (on any topic related to operation theatre technology) under the supervision of a faculty. The project report has to be prepared on the basis of the research work carried out. The assessment is done on the basis of the work done and the presentation and viva.

Course Title: Skills & Professional Development

Course Code: MRI402

L	T	P	Cr.
0	0	2	1

Total Hours: 30

Course Learning Outcomes: On successful completion of this course, the learner will be able to

Through seminars and workshops