

MMRIT 2nd Semester

Course Title: Radiation Safety and Protection			
Semester: II	Course code: MRT -201	Credits:07	Core
No of sessions Lectures / Tutorial: 60		No of practical hours:60	
Course Pre-requisites:		Number of sessions: 90	

Course Objectives: The purpose of this course is to provide an understanding of physical concepts and underlying various technological applications. This course also provides fundamental idea about circuit analysis, working principles of machines. In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.

Course Learning Outcomes

CLO 1- Use X-ray equipment and maintenance of equipment.

Should know the Warm-up procedures of X-ray machine and cooling methods.

CLO 2- To be able to know how to use X-Ray exposure switches.

CLO 3- Demonstrate work flow Digital/IITV fluoroscopy equipment handling

Demonstrate Handling, care and maintenance of equipment & accessories

Course Pedagogy

The course will use the mixed technique of interactive lectures, regular assignments and practicing numerical. Teaching in this course is aimed to engage the students in strengthening their conceptual foundation and applying the knowledge gained to different day-to-day real-world applications. It will not only help students to understand the fundamentals of applied physics but also improve skills and techniques for tackling practical problems.

Course contents

Radiation safety in diagnostic Radiology 1. Introduction to Radiation Protection-Need for protection, Aim of radiation protection.

2. Limits for radiation exposure: Concept of ALARA, maximum permissible dose, exposure in pregnancy, children. Occupational Exposure Limits - Dose limits to public

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

4. Radiation measuring instruments: survey meters, area monitor, personnel dosimeters, film badge, thermo luminescent dosimeter, pocket dosimeter.
 5. 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
 6. 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.
 7. 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.
 8. 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.
 9. 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.
 10. 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, XRay/Fluoroscopy/Mammography/Intervention/DSA/CT room design, structural shielding, protective devices
 11. 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).
 12. NABH guidelines, AERB guidelines, PNDDT Act and guidelines.
 13. Procedural safety
 14. Achievable safety through compliance on the regulations in India and recommendations of ICRT, IAEA.
- 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.

Course Assessment Scheme

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

Text Books:

1. S.K Bhargawa text book of Radiological Physics
2. Joseph Selman Fundamental of X Rays and Radium
3. Text book for Radiotherapy ,Radiation Physics by Walter and Miller's

Course Title: Modern Radiological and Imaging Equipment			
Semester: II	Course code: MRT -202	Credits:07	Core
No of sessions Lectures / Tutorial: 60		No of practical hours: 60	
Course Pre-requisites:		Number of sessions: 90	

Course Objectives

The purpose of this course is to provide an understanding of physical concepts and underlying various technological applications of mammography and computed radiography and DSA. Should able to scanning also in mammography, computed radiography and DSA.

Course learning Outcomes

CLO 1-Perform the procedure of mammography scanning.

CLO 2-Enumerate and able to know the principle computed radiography.

CLO 3-Able to know and perform vascular imaging with PACS

Course Pedagogy

The course will use the mixed technique of interactive lectures, regular assignments and practicing numerical. Teaching in this course is aimed to engage the students in strengthening their conceptual foundation and applying the knowledge gained to different day-to-day real-world applications. It will not only help students to understand the fundamentals of physics of mammography and CT scan but also improve skills and techniques for tackling practical problems.

Course contents

1. High Frequency X-Ray Generators and their types and applications.
2. Modern x-ray tubes-their types and advancements.
3. 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.
4. Image Receptors: Flat Panel Detectors, Image Processing Workstation and Imaging Cameras.

5. Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of topographic movements,
6. Tomosynthesis, Stitch radiography
7. Dual energy x-ray absorptionometry (DEXA) scan.
8. Vascular Imaging Equipment: Introduction, historical developments DSA Equipment- Principle, applications and definition of terms, Single Plane, Biplane, Hybrid DSA Lab- digital subtraction techniques.
9. Scatter radiation its formation and control: beam centering devices, collimators, cone diaphragms and grids.
10. Fluoroscopy and IITV systems including cine radiography with various recording devices.
11. 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.
12. Ultrasonography: :Basic principle of U.S., various types of transducers, mechanism of image formation, various advancements including Doppler, Elastography, HIFU,ABVS and image artifacts.
13. 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.
14. Radionuclide scanning including rectilinear scanner, gamma camera, PET, SPECT, their principles, working, applications and advancements.
15. Care and maintenance of radiological equipment.

Course Assessment:

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

Text Books:

4. S.K Bhargawa text book of Radiological Physics
5. Joseph Selman Fundamental of X Rays and Radium
6. Text book for Radiotherapy ,Radiation Physics by Walter and Miller's

Course Title: Radiological and Imaging Procedures			
Semester: II	Course code: MRT 203	Credits:07	Core
No of sessions Lectures / Tutorial: 60		No of practical hours:60	
Course Pre-requisites:		Number of sessions: 90	

Course Objectives-

This course is designed to provide the students the basic knowledge in systematic investigations with using contrast media and image intensifier.

Course learning outcomes-

CLO 1- Explain indication, contraindication and reactions of contrast media Demonstrate how to take in minimum numbers of exposures in each special investigation.

CLO 2-Demonstrate the positioning and technique of the special studies.

CLO 3-Explain the technique of all GIT study according to investigation.

CLO 4- Demonstrate surface anatomy. To be able to know the technique behind the radiography.

Course Contents :

1. Special Radiographic/Radiological procedures
2. 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.
3. Gastrointestinal Tract: Barium swallow, pharynx and oesophagus. Barium meal and follow through. Hypotonic duodenography. Small bowel enema. Barium Enema routine projections for colon and rectum, colonic activators; double contrast studies; colostomy. Special techniques for specific disease to be examined. Including water soluble contrast media - eg. gastrograffin studies. Including CT, US and MRI Special Imaging Techniques.
4. Salivary glands: Routine technique, procedure - sialography.
5. 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 MRI Special Imaging Techniques.
6. Urinary system: Intravenous urography, retrograde pyelography. Antegrade pyelography. Cystography and micturating cystourethrography. Urethrography (ascending) renal puncture. Including CT, US and MRI Special Imaging Techniques.
 7. Reproductive system: All the Techniques relating to Male and Female reproductive system including Hysterosalpingography.
 8. Breast Imaging: Mammography: Basic views, special views, wire localization. Ductography, Tomosynthesis, ABVS, Various Biopsy Techniques including Prone Table Biopsy, CT, US and MRI Special Imaging Techniques
 9. Respiratory system: - Bronchography: Including CT, US and MRI Special Imaging Techniques.
 10. Sinography: Routine technique and procedure.
 11. Central Nervous System: Myelography. Cerebral studies. Ventriculography etc including CT, US and MRI Special Imaging Techniques.
 12. Arthrography: Shoulder, Hip, Knee, Elbow joints etc including CT, US and MRI Special Imaging Techniques.
 13. Angiographic Studies: Carotid Angiography (4 Vessel angiography). Thoracic and Arch Aortography. Selective studies: Renal, SMA, Coeliac axis. Vertebral angiography. Femoral arteriography. Angiocardiology, Peripheral angiography
 14. Venography: Peripheral venography. Cerebral venography. Inferior and superior venocavography. Relevant visceral phlebography.
 15. 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 equipments of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants. Introduction to immunology, bacteriology, parasitology, mycology

Course Assessment:

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

Course References:

Special Radiographic procedure Bhushan N. Lakhkar

Course Title: Research Methodology and Biostatistics -II			
Semester: I	Course code: MRT -204	Credits: 04	Core
No of sessions Lectures / Tutorial:40		No of practical hours: -	
Course Pre-requisites:		Number of sessions:40	

1. Course Objectives:

This is an extension of part one of RM course and focuses more on statistics .At the end of the semester the student is expected to do statistical analysis independently

2. Course contents

Module I: Introduction and revision

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

Module II

Measures of Central tendency, Measures of Dispersion, Skewness and kurtosis, Sampling, Sample size determination, Testing hypothesis- Chi - Square test, Student's t test, ANOVA

Module III

Concept of probability and Probability distributions – Binomial Probability distribution, Poisson Probability distribution and Normal Probability distribution

Module IV

Correlation-Karl Person, Spearman's Rank correlation methods, Regression Analysis

Module V

- Parametric tests–
 - a. Test for single proportion
 - b. Test for Equality of proportions
 - c. Test for single mean
 - d. Test for equality of means

- ANOVA:-
 - Oneway
 - Twoway
- Non parametric tests–
 - Chi-square tests
 - Fisher's exact test
 - McNemar test
 - Mann-whitney U-test
 - Median test
 - Sign test
 - Wilcoxon test

Course Assessment:

Students would be assessed continuously throughout the semester in the form of continuous evaluation. Periodic tests and surprise tests will be conducted. Students will have to submit written assignments, make charts and posters, make models, and conduct quiz for the topics. Practical will be conducted with viva. Midterm and end term evaluation will be done theoretically and practically. Students will also be assessed on the basis of presentations of various topics.

1. Text books:
 - B.K. Mahajan. Methods in Biostatistics, Jaypee Brothers
 - P.S.S. Sundar Rao. An Introduction to Biostatistics: A manual for students in Health Sciences, J.Richard Prentice Hall, 1996.
2. Reference Books :
 - Daniel, Wayne.W. Bio-Statistics: A foundation for Analysis in the Health Sciences, John Wiley and Sons Pub, 1991.
 - K. Vishwas Rao. Bio-Statistics: A Manual of statistical methods for use in the Health, Nutrition and Anthropology, Jaypee Brothers Medical Pub, 1996.
 - Verma B.L., Shukla G.D. Bio-Statistics perspective in Health care research and practice, C.B.S. Pub, 1993.
 - Krishnaiah, P.K. Rao, C.R. (ed), Handbook of Statistics, Elsevier Science Pub, 1988.